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Introduction

Risk management is about preparing for anything that might happen. People who try to predict the future are the enemies of risk management. They’re the ones who say, ‘Let’s build a wall on the north side of town because that’s where we predict the attack will come.’ Risk managers know that leaving any gap in the wall means the attackers will exploit the gap.

Preventing disaster is easy – you just don’t take any risk. Risk management is about surviving disaster, not preventing it. If there weren’t disasters, you wouldn’t call it risk. You need risk – and its attendant disasters – to learn, to grow, to excel.

If you want to be a risk manager, this book gives you a good start. You need practice at risk taking, plus some maths and financial theory, plus some practice at finance. If you already have all of those things, you should be writing this book, not reading it.

About This Book

People have been concerned about risk as long as there have been people. Financial Risk Management For Dummies explains the background and some theory about risk, quantitative analysis of risk and modern financial risk management and shows you how to apply them in practice, without jargon or mathematics. Okay, I throw in a few examples that require addition and multiplication, but they’re clearly labelled and can be skipped, and I also give you lots of simple, specific illustrations.

This book tells you what financial risk managers do and why they do it.

Foolish Assumptions

I make three different guesses about who you are and why you’re reading this book:

❖ You’re currently, or hope to be, a financial manager, and you want to delve into the risk management aspect of your job. By itself, this book
cannot teach you that, but if you already know the basic financial theory and mathematics or go elsewhere to discover them, this book can show you how to apply them properly to become a good financial risk manager.

✔ You work with financial risk managers and want to understand how they see things. This book can show you the world from their perspective, and help you form constructive partnerships.

✔ You have no professional connection to finance, but want to understand both the good risks in finance, the ones that help the economy grow and people realise their dreams, and the bad risks in finance, the ones that damage the economy and blight lives. This book can help you navigate the modern financial system to achieve financial security.

**Icons Used In This Book**

These little pieces of margin art bring your attention to exceptionally interesting or useful information. That is, except for text next to the Technical Stuff icon, which is information – usually maths – you may find helpful if you’re interested.

![Tip Icon](image)

Simple, standalone advice that you can take to improve your risk management.

![Remember Icon](image)

Standalone stuff it pays to keep in mind.

![Technical Stuff Icon](image)

Stuff I love and the *For Dummies* editors don’t has this icon. You can skip it if you want, I promise all the important ideas are explained clearly in non-technical language elsewhere. But come on, this stuff is really fun and a little maths won’t hurt you.

![Warning Icon](image)

This icon marks stuff not to do. In risk management, if you do something you’re not supposed to, it isn’t usually actually dangerous.
This icon marks situations that may seem attractive in the short run but that defeat the long-term goals of risk management.

Real-world scenarios, and sometimes real-life maths, get this icon.

**Beyond the Book**

Risk is a big topic, too big to fit entirely into the book or e-book you’re holding at the moment. I put some additional material on the web. I created cheat sheets ([www.dummies.com/cheatsheet/financialriskmanagement](http://www.dummies.com/cheatsheet/financialriskmanagement)) with the key ideas for managing seven specific kinds of risk:

- **Market risk**: Uncertainty due to changes in market prices.
- **Credit risk**: Uncertainty due to a failure of an external entity to keep a promise.
- **Operational risk**: Institutional uncertainties other than market or credit risk.
- **Liquidity risk**: Uncertainty about terms and the ability to make a transaction when necessary or desired.
- **Funding risk**: Uncertainty about whether investors will provide sufficient funds.
- **Reputational risk**: Uncertainty about how your entity will be perceived.
- **Political risk**: Uncertainty about government actions.

I also stick in some concentrated summaries of four sections of this book: Measuring Risk, Communicating Risk, Managing Risk and Working as a Risk Manager. You can also access bonus material at [www.dummies.com/extras/financialriskmanagement](http://www.dummies.com/extras/financialriskmanagement), including ten great links that illustrate ten financial risk management lessons is amusing and dramatic fashion, from killer molasses to an Olympic David versus Goliath tale.

**Where to Go From Here**
If you know nothing about finance or risk and want to be a financial risk manager, I recommend reading this book in order. But, you can jump around to whatever chapters and sections seem interesting. Switching back and forth between theory and practice, between high-level views of the forest and detailed descriptions of individual trees may be the best way to understand what modern financial risk management is all about.

If you know nothing about finance, risk or financial risk management and are walking into work for your first day as a financial risk manager of a major global bank, turn straight to Chapter 10 and follow the directions step-by-step through to the end of Chapter 13.

If you’re really in a hurry, turn right to Chapter 20 and get all the really important stuff in ten minutes. Not ten minutes to read, ten minutes to read and do!

Wherever you start, I trust you’ll find information you can put to use.
Part I
Getting Started with Risk Management

For Dummies can help you get started with lots of subjects. Visit www.dummies.com to discover more and do more with For Dummies.
In this part …

- Recognize risk and distinguish it from danger and opportunity.
- Choose the right framework to make risk decisions.
- Take charge of risk: identify the goal, consider the options, and make the decision.
- Manage risk in the front office of a financial institution: set limits, approve trades, approve portfolio strategies, and deal directly with risk takers.
- Manage risk in the middle office of a financial institution: determine risk appetite, set risk policy, deal with the board and senior management, and work with regulators.
- Manage risk in the back office of a financial institution: create control frameworks, compile reports, monitor constraints, and identify issues.
Chapter 1
Living with Risk

In This Chapter
- Exploring the idea of risk
- Managing financial risk
- Informing people about risk

Life is risk, and risk is life. Nobody knows what tomorrow may bring. As the poet Robert Burns famously put it, ‘The best-laid schemes o’ mice an’ men, gang aft agley, an’ lea’e us nought but grief an’ pain, for promis’d joy!’ (Roughly translated, Burns warns that careful plans can come to nothing.)

While most of us instinctively first think about bad risk, good surprises happen as well. ‘Fortune favours the bold,’ we are told, and, ‘Sometimes things just go your way.’ In fact, risk is more than just sometimes good, it is essential. As another saying goes, ‘The only place with people and no risk is a graveyard.’ Religions, philosophies and especially superstitions are deeply rooted in ideas about risk.

My topic is managing risk, not risk itself, which means that I don’t cover all the risks you can’t control – the sun going supernova tomorrow or being diagnosed with a genetic heart condition, for examples. Also, my topic is financial risk, so I don’t talk about risks that aren’t priced in the financial markets. That still leaves me with a large topic, but one I can cover in enough detail to be useful.

Understanding the Scope of Risk

Finance professor Elroy Dimson defined risk as meaning that more things can happen than will happen. Although stated in a folksy way, this idea is a deep one that comes from information theory and statistical thermodynamics. The tremendous range of future possibilities creates a kind of force – a tendency to disorder, a decay of information – called entropy. Entropy isn’t a physical
force like gravity or magnetism, yet in the long run it determines both the fate of the universe and whether the ‘best-laid schemes o’ mice an’ men’ bring grief and pain or promised joy.

Everything humans try to do can be thought of as attempts to influence what will happen, but even the most precise and complicated plans are vastly simpler than the range of things that might happen. This essential feature of risk is lost when risk is reduced to probability distributions. These distributions require that the range of future outcomes is known exactly. In most cases of practical interest, probabilities can be estimated reliably only for outcomes that have actually happened in the past, and they only have much use if decisions are repeated often enough that each potential outcome actually happens.

This doesn’t mean that conventional statistical analysis is useless – far from it. I’m a big fan of quantitative reasoning. But the risk in risk management is something distinct from the risk that can be modelled with probability distributions.

One popular approach is to model risk as a casino game. This frequentist approach can yield insights, but it is very limited. Casino games can be played over and over, and have a known range of outcomes with known probabilities. Real risks only happen once, and you can only guess at the range of outcomes and probabilities. Author Nassim Taleb has dubbed this approach the Ludic Fallacy. If all risks were playing roulette or drawing cards, we wouldn’t need risk managers.

Another popular approach, called Bayesian, treats all risk like bets on a sporting event. This is more accurate than the frequentist approach because it can handle events that only happen once, with some unknown potential outcomes and only guesses about probability. But it is still a limited model that does not capture all important aspects of risk. Risk managers draw on a broad spectrum of risk models, frequentist and Bayesian, plus models drawn from evolution, statistical thermodynamics, behavioural studies and game theory. And they know that even with all the different analytic approaches, important aspects of risk are missed.

Consider a teacup. You know that teacups can shatter into shards and dust, and also that shards and dust never spontaneously recombine into a teacup. Why? Because of all the possible arrangements of the atoms that make up a
teacup, only a negligible fraction actually are a teacup. That’s all you have to
know to predict that a teacup is fragile. It can shatter, but it can’t self-
construct. Any sufficiently large change in conditions – impact, temperature
or others – will destroy it. If I have a china shop, I know that it won’t last
forever; I don’t need a bull to destroy it. Risk and time are enough.

Some things in the universe do come into being spontaneously – stars, for
example, and people and crystals. In many cases these things gain from
disorder and change. They can be destroyed, but they can also recreate
without outside help.

The same thing is true of human plans and institutions. Some are fragile.
Disorder and change only hurt them. Such plans will fail, however solid they
seem. Perversely, people often respond to risk by building in more fragility,
making the teacup heavier and stronger but no less exposed to risk and time.
Risk managers don’t ask how strong your teacup is, they ask how it will
respond to the unexpected events that the future will bring. Will it gain or
lose? That’s what really matters, because although the events are individually
unexpected, you can be certain that unexpected events will occur.

Risk management isn’t about predicting or preventing disaster. Risk
management isn’t about estimating probabilities or outcomes. It is about
constructing plans or institutions that will thrive under disorder. It’s not
about guessing what will happen – in fact, people who guess are the
enemies of risk management. Risk management is preparing for
anything that might happen. Preparing not just in the sense of having
contingency plans to avoid problems, but also in the sense of being
ready to take maximum advantage of opportunities.

**Measuring risk**

I don’t talk much about measuring risk. For the most part, risk that can be
measured can be insured, avoided, hedged or diversified away. Generally I
insist that line risk takers do all the measurement and mitigation they can
before I take over the job of managing the residual risk.

Of course, there’s room for risk measurement in risk management but less
than outsiders tend to think. In addition, it’s definitely true that bad risk
measurements, as well as inappropriate attempts by inexperienced risk
managers to measure non-measurable risks, do a lot more harm in risk management than good risk measurements do good. (I talk about the various components of risk in Chapter 6.)

To see what I mean, consider the graph in Figure 1-1, which shows the distribution of daily returns for the S&P 500 index over the last 50 years.

You have various ways to measure the spread illustrated by this graph. You can compute a standard deviation, a mean absolute deviation, an interquartile range or something else. For that matter, you can just reproduce the graph. However, there’s something misleading about representing the data this way: You cannot see the essential risk on this graph, and the risk you think you see is largely irrelevant.
In round terms, the stock market has turned £1 into £100 over the last 50 years. On about 99 days out of 100, the market moved less than 3.5 per cent in either direction. But consider the 80 days on which the market went up more than 3.5 per cent. They’re barely visible on the chart, but collectively they caused about a 4,000 per cent increase in wealth. All other days were responsible for about a 150 per cent increase. If you consider the 60 days when the market went down more than 3.5 per cent, they collectively turned £1 into £0.03.

Now the 150 per cent increase from the 99 per cent of normal days isn’t insignificant. However, most of the action, especially to a risk manager, happens in the 1 per cent of extreme days, which are nearly invisible. This percentage isn’t true just of stock market returns, but also true of many important things in the world.

Consider the risk going forward, which of course is what matters. Suppose that you’re considering an investment in stocks with a 1,000-day horizon – about four years of trading days. You expect to get 990 normal days in which the market moves less than 3.5 per cent. You may get 996 or 987 or even 1,000 such days; but you won’t get much different from 990. Also, getting a few days more or less won’t matter much because the average return on these days is 0.04 per cent, and no day can make a difference of more than 3.5 per cent. With 990 or so events and limited range, you’re highly likely to get something quite close to the expected outcome. Moreover, you have lots and lots of historical data on what happens on normal days, so you’re reasonably confident you know what the expected outcome is. There just isn’t a lot of risk in 99 per cent of the days, and what risk does exist can be easily handled by front-line risk takers. After all, if they couldn’t handle the stuff that happens 99 days out of 100, you’d have noticed long ago.

You also expect to get about five days when the market loses more than 3.5 per cent, plus about five days when the market gains more than 3.5 per cent. However, there’s a lot of potential variability around those numbers. You might get 2 or 8 or even 0 or 10 or more of either one. Each one of these days is significant as they average about a 5 per cent move, and may be as large as -28 per cent or +18 per cent. With only a few events, you can get outcomes far away from the mean. Moreover, you have little historical data, you don’t
really know how big these days can get; and you can’t be confident that your front-line risk takers are prepared for them unless you check.

If you take a closer look, you have even more reason to be concerned about a small number of big days. Markets often don’t function properly. You may not be able to trade the way you usually do or at all. Financial intermediaries may fail. Trades may be reversed after the fact. Events may trigger investigations and fines. Financial instruments don’t move together as they usually do – correlations are different on big days.

Another problem is that the big days in the market can seldom be tied to observable economic events. On normal days, some fraction of stock price movements occurs in discrete jumps after clear news events such as central bank actions or corporate earnings announcements. A lot of unexplainable noise (price movements that cannot be easily explained) is evident too (which doesn’t stop commentators from jumping in with explanations after the fact), but it’s possible to imagine that prices are changing in response to economic news. On many of the biggest days, no news turns up at all, and on others, the extent and timing of the price move is inconsistent with the news the market is supposed to be reacting to.

If that weren’t enough, not all the days the stock market makes big moves are abnormal; some are just normal big moves. On the other hand, on some abnormal days, the market behaves strangely but prices don’t move a lot by the end of the day, such as the Flash Crash of May 2010 or the Quant Equity Crisis of August 2007. In addition, you need to consider days missing from the graph because the stock market was closed, such as the days after the 9/11 attacks.

The point is that almost everything a risk manager is concerned about is missing from the graph in Figure 1-1, or is nearly invisible on it. Therefore, any measurement of the graph is of only marginal use to a risk manager. Doing sophisticated analytics on the 99 per cent of normal days can be useful to line risk takers, but it’s false precision to a risk manager.

**Consider Nassim Taleb’s example of a casino that can measure the**
risks of the bets it makes with its customers at the roulette and craps tables. This risk averages out quickly, and a risk manager who focuses on it would be wasting his time. The three biggest losses of one particular casino in one year were:

- The star performer was mauled by a tiger.
- The owner’s daughter was kidnapped and held for ransom.
- It was discovered that a long-time, low-level employee, for unexplainable reasons, had been stuffing tax reporting forms in his drawer rather than sending them in to the IRS for years, which resulted in large penalties.

None of these things would have shown up in a graph of profit and loss from table games bets. None of these risks could have been reasonably measured before the fact.

Never confuse risk measurement with risk management. If you can measure it, you probably don’t have to manage it.

**Calculating risk**

People often like to segregate calculated risk from other types of risk. *Calculated risk* covers situations in which you know the possible outcomes and have good estimates of their probabilities. Examples are the risk of rolling a seven while trying to make your point in craps (one chance in six) or the chance of rain tomorrow. The more general *risk* covers situations where you can’t even specify all the possible outcomes, such as starting a war or embarking on a course of scientific research, and have no basis to estimate the probabilities of the outcomes you can foresee.

University of Chicago professor Frank Knight famously labelled the calculated risk as *risk* and the second, more general condition, as *uncertainty*. Risk management is about the uncertainty that remains after front-office risk takers – traders, portfolio managers, lending officers and others – make the calculations that are possible. If you can calculate a risk, you almost always want to minimise it, subject to constraints. For example, a portfolio manager may select a portfolio that minimises annual volatility subject to a constraint that the expected annual return be 8 per cent or better.
Minimising risk isn’t managing risk. This point is important because not many people know it beyond those with extensive day-to-day experience making significant financial decisions from a risk management – as opposed to a portfolio management – perspective.

Financial risk management is based on a different mathematical tradition than the one used in most economics and statistics. The conventional academic analysis of risk uses gambling games as models, and works only if the solution to the simplified game is a good approximation to the solution to the real-world decision. That works pretty well sometimes, and you don’t need a risk manager to help you with it. But in other cases it leads to disastrous decisions, even when done properly and carefully. Risk management doesn’t assume you know enough about possible outcomes and probabilities to treat decisions like actions in a casino game, and that you instead need to draw on concepts from information theory and other fields to improve your chances of long-term success.

Planning and plunging

The quotations here about planning and results emphasise a few of the ideas that a risk manager should absorb:

- ‘In preparing for battle I have always found that plans are useless, but planning is indispensable.’ General Dwight D. Eisenhower
- ‘Everybody’s got plans… until they get hit.’ Boxer Mike Tyson
- ‘If you wait until the right time to have a child you’ll die childless, and I think filmmaking is very much the same thing. You just have to take the plunge and just start shooting something even if it’s bad.’ Filmmaker James Cameron
- ‘Plunge, don’t plan.’ Instruction for commandos
- ‘Earlier theorists aimed to equip the conduct of war with principles, rules, or even systems, and thus considered only factors that could be mathematically calculated (e.g., numerical superiority; supply; the base; interior lines). All these attempts are objectionable, however, because they aim at fixed values. In war everything is uncertain and variable, intertwined with psychological forces and effects, and the product of a continuous interaction of opposites.’ General Carl von Clausewitz
- ‘Plunge boldly into the thick of life, and seize it where you will, it is always interesting.’ Philosopher Johann Wolfgang von Goethe

Careful planning is necessary, but don’t count on anything ever going to plan, and recognise
that success in anything requires risks.

I spare you most of the gory details of the calculations you use to manage risk – or at least segregate them in technical sections with clear warning signs posted. You don’t need to do the maths to understand the ideas. However, you do need to know that maths is an option. In other words, you need to understand that you can bring powerful mathematical tools to bear on incalculable uncertainty just as you can on calculated risk.

In my experience, people who are good at calculations tend to overanalyse the calculated risks and pretend that their models are an approximation to reality, which leads to disastrous risk management. People who aren’t good at calculations tend to emphasise the unknown unknowns (in Donald Rumsfeld’s famous phrase) – the deficiencies in the data, the un-modelled complexities of the situation and all kinds of other things that cause the calculated risks to be unreliable. This attitude is less problematic than the first, but is far from optimal. Risk managers provide a clear third voice, one that says, ‘We may not be able to calculate enough of the risks to be useful, but we can calculate our actions. We may not be able to measure the risk, but we can manage it.’

**Regenerating dinosaurs**

The movie *Jurassic Park* does a great job of illustrating how risk management differs from conventional approaches to uncertainty. In the book, the point is even clearer. (Author Michael Crichton should be an honorary risk manager for the many insights peppered through his fiction. I consider him the most intellectually stimulating popular fiction writer of the 20th century. He was also an outstandingly successful director and producer for movies and television.) When investors in a park that brings extinct dinosaur species back to life get concerned about the risks of the venture, they demand a report from three experts: a palaeontologist (Sam Neill), a palaeobiologist (Laura Dern) and a ‘mathematician with a deplorable excess of personality’ (Jeff Goldblum).

A number of movie reviewers remarked on the implausibility of sending a mathematician, especially one calling himself a *chaotician*. But the palaeo-people can only calculate and analyse factors about dinosaurs; they have no particular training in risk and are unlikely to have the kind of life experiences
that build risk wisdom. All they can do is double-check the calculations of the palaeo-experts who designed the park (which were probably double- and triple-checked already). Although some people tell you that an extra check is always prudent, I disagree. One person with clear responsibility for a decision is often more reliable than three people who all think someone else will catch any error.

The mathematician doesn’t do the careful observation of the other two experts – the palaeontologist who scrutinises the pack dynamics of running gallimimus or the palaeobiologist who sticks her arms into triceratops excrement. However, he correctly predicts disaster, without knowing anything about dinosaurs, genetics or park security. He understands that evolution is a powerful force powered by risk – far too powerful to be controlled by electric fences. (Evolution is also known as natural selection of random variation, and both random and variation are essential risk concepts.) He did not predict the specifics of disaster, only that the imperatives of life would easily win over the calculations of human experts.

Risk managers understand that risk is a powerful force that can be harnessed for great success or that can blast apart the best-laid schemes. Risk is not about laying better schemes; it’s about making sure that risk is the wind in your sails, not the approaching hurricane that will swamp your boat. And generally speaking (although certainly not always), experts in specialised fields are bad at recognising risk. Experts usually get paid to take the risk out of decisions – or at least to reduce the risk by making things more predictable. Doing so is certainly worthwhile, but it never works perfectly, so you need risk managers as well. More importantly, experts often get paid to reduce the appearance of risk, not risk itself. And most important of all, reflexively taking the risk out of decisions eliminates opportunities as well as dangers.

**Adding a little maths**

As I say, you need no maths to understand this book. However, if you’re willing to dip your toe into mathematical waters, you can get a deeper understanding of risk management more quickly. Feel free to skip this section if you’re not interested in the maths at all.
Suppose someone offers you a proposal that has a 50 per cent chance of a +20 per cent return and a 50 per cent chance of a –18 per cent return. A standard approach in economics for analysing this choice begins by asking how much happier a 20 per cent increase in wealth would make you and how much unhappier an 18 per cent decrease in wealth would make you. Because the probabilities are equal, you take this gamble if the happiness increase from 20 per cent is greater than the happiness decrease from –18 per cent. With certain qualifications, this approach can be reasonable for front-office risk takers, and it’s the usual approach in academic portfolio management (although economists prefer to speak about abstract utility rather than practical happiness). In this book, I refer to this approach as the portfolio management approach.

Most non-economists would find such a gamble too risky for 100 per cent of their wealth, but the risk gets more attractive if it can be repeated many times. With many repetitions, this gamble seems like being the casino – statistically certain to win in the long run due to a built-in edge.

The chart in Figure 1-2 shows a random simulation of 20 risk takers who repeat this bet 250 times, starting with initial wealth of 1. The solid black curve shows the growth of wealth at the expected rate of 1 per cent per bet (maths alert: 50 per cent probability times 20 per cent plus 50 per cent probability times –18 per cent equals 10 per cent – 9 per cent = 1 per cent expected growth of wealth) and the 20 other lines show individual paths.
Most paths go quickly to near zero. A few soar up far beyond the expected one per cent rate for a while, but all eventually crash. If you run the simulation longer, all paths would become indistinguishable from zero. To a risk manager, this bet is terrible – one that leads to certain disaster. The more times you repeat it, the worse it gets, not the better. Your psychology, your risk appetite, has nothing to do with it. This bet is worse than just losing all your money quickly because the paths that soar attract imitators and cause all kinds of foolish overreactions.

The problem is simple. If you win half your bets, you lose money. If you win 20 per cent, you turn £1.00 into £1.20. If you then lose 18 per cent, your £1.20 falls to £0.984. (The order doesn’t matter. If you first lose 18 per cent to turn £1.00 into £0.82, then a 20 per cent win turns £0.82 to the same £0.984.) Every pair of win and loss costs you 0.6 per cent of your wealth. In the long run, you’re virtually certain to have nearly 50 per cent wins and losses, so you’re virtually certain to wipe out your wealth.

How does the median 0.3 per cent loss per bet square with the expected 1 per

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**Figure 1-2:** Charting growth in wealth.
cent return? It’s absolutely true that your expected wealth increases 1 per cent each time you repeat this bet, but in the long run this fact results from a microscopic probability of winning an astronomical amount of money. You’re virtually certain to be broke, but theoretically have enough chance of winning far more money than exists in the universe that your expected value is positive.

This example is oversimplified, of course. With real risks, you never know the exact probabilities and outcomes. You don’t repeat them an infinite number of times, and the results are not independent of each other. You don’t bet constant fractions of your wealth each time. I use the example only to make the point that you can ask two different questions about any risk:

- The **line risk taker**, the person making risk decisions, asks some version of, ‘Will I be happier on average, or will the organisation be better off on average, if I take this specific bet once?’

- The risk manager asks, ‘Will a long-term strategy of taking this kind of bet lead with average luck to exponential growth or to disaster?’

The answers to these two questions are independent. Some risks increase average utility if taken once but can’t be accepted as part of a systematic strategy that leads to success, and some risks fit perfectly into systematic strategies but are unattractive as individual propositions. The only risks worth taking are the ones that make sense on their own and as steps in the long-term strategy. That’s why you need both line risk takers to ensure the first, and risk managers to ensure the second.

I emphasize that this is a practical result discovered by experience, not a theoretical one. The mathematical example was invested to illustrate the idea; it’s not the source of it. Quantitative risk managers learned that it was possible to analyse real risk-taking histories of real risk takers without assuming anything about probabilities or future possibilities or risk preferences and determine accurately whether they were on paths to riches or ruin. First they learned with their own risk taking, often from bitter experience, and then they learned it was possible to prove their contentions to risk takers, even when markets were in the peaks of success or the depths of slumps. This was the birth of the modern field of quantitative risk management.
Working with Financial Risk

The topic of this book is financial risk. Financial risk is created by people. It can represent natural risk: for example, an insurance company writing hurricane insurance or a venture capital investor taking on some of the economic risk of a start-up company. But most financial risk is entirely contained within the financial system, such as a futures trader making zero-sum bets with other futures traders or a government bond portfolio manager speculating on changes in interest rates.

Even when financial risk represents physical risk, it represents the virtual version, not the real thing. An insurance company writes checks after a hurricane; it isn’t pinned under a fallen tree without fresh water available. A venture capitalist writes off his investment if the company fails; he doesn’t fire people and auction off the office furniture.

The idea of converting physical and economic risk to virtual form and trading it is revolutionary. It allows people to shed their excess concentrated risk, such as that their company will fail or their house will burn down, and to take on opportunities in a diversified portfolio of other people’s risks. Done properly, the good risk – the innovation, the opportunity, the creation – is maximised for everyone’s benefit, and the bad risk – the ruin, the disaster, the catastrophe – is diversified into broadly shared affordable losses. This diversification is not always done properly, unfortunately, but it sometimes is. And whether the finance is done well or badly, it deals with risk, and risk must be managed.

Managing financial risk

In managing financial risk, you need to distinguish between the risk of the financial product – the stuff that’s bought, repackaged and sold – from the risk of running a financial business.

EXAMPLE

A printing company has a contract with the government to print money. On one day it prints a billion pounds worth of bills to send to the government, and earns £100,000 for the job. If you ask the CEO how much money the company made, the answer is £100,000, not one billion pounds. If the CEO forgets this distinction and starts spending the
money his company prints for the government, he goes to jail.

The distinction between types of risk is easiest to see with the manager of an S&P 500 index fund. The manager doesn’t make judgements about securities, he just promises to take investors’ money and use it to buy the 500 stocks that make up the index. (Investing in an index is slightly more complicated than this, but that doesn’t matter for this example.)

One risk, of course, is whether the S&P 500 basket of stocks goes up or down. However, this risk isn’t to the index fund manager. He sells this risk to his investors. His investors want it. This is like the billion pounds of bills the printing company printed for the government.

The index fund management company has a risk manager. The risk manager doesn’t spend time thinking about how risky the S&P 500 stocks are. That’s not his job. He is, however, concerned with the liquidity of the S&P 500 stocks because the index fund needs to trade in order to honour new subscriptions and redemptions. He worries a lot about valuation because errors may result in underpayments or overpayments. He pays attention to counterparty risks, such as what happens if a dealer fails to honour a trade, a custodian goes suddenly bankrupt or a stock-lending counterparty is unable to return borrowed shares. A host of other risks are present as well. The point is that the risk manager’s concern is that the management company does what it promises - deliver the risk of the S&P 500 to its investors – not whether the risk of the S&P 500 is a good or bad risk.

Investing with a mutual fund company that picks and chooses among stocks in an attempt to beat the S&P 500 is a bit more complicated. Now the company is selling a more complicated risk, a combination of S&P 500 risk plus the risk of the portfolio manager’s outperformance or underperformance. The company’s risk manager has all the concerns of the index company’s risk manager, plus the risk that the portfolio manager’s stock-picking skill isn’t properly represented in the portfolio. This scenario can happen, for example, if the manager makes unintentionally concentrated bets, changes strategy from what the prospectus promises, engages in chasing (doubling bets to offset past losses rather than allocating funds in sober calculation about the future) or window dressing (making trades just before reporting dates so the portfolio looks good in the report) or manages with an eye toward gaining more assets rather than delivering the best possible performance to existing
investors. But the risk manager’s job ends with making sure that the fund delivers the manager’s best efforts to beat the S&P 500 within the terms of regulation and the prospectus. Fund investors choose to be exposed to S&P 500 stocks and to the fund manager; the wisdom of this choice isn’t the risk manager’s concern.

With other financial businesses such as dealers, banks and insurance companies, the risk situation is even more complicated. Despite the complexity, you must keep separate the risk that is the company’s product from the risks that the company incurs in buying and selling its product.

Check out Chapter 15 for a discussion of the range of risk.

**Working in financial institutions**

The modern practice of financial risk management was developed in the late 1980s and early 1990s. It sprang up on *prop trading desks*, places where traders make financial bets for the benefit of the firm as opposed to executing trades on behalf of customers or for the convenience of customers. At that time, no one outside the prop trading desks knew or cared about these developments.

The 1990s saw the spread of modern financial risk management to all trading businesses of large financial institutions, creating what became known as a *middle office* between front-office risk takers and back-office support personnel.

The tumultuous financial events of the last 20 years (really no more tumultuous than any 20-year period but getting much wider attention) led to two strong ideas:

- Disasters occur when risk managers aren’t sufficiently independent of risk takers.

This idea led to walling off of the middle office so that these risk managers report only to other middle-office risk managers up to the level of the chief risk officer (CRO). The CRO reports directly to the CEO and board. No one in the firm can bypass the chain of command to direct the actions of any middle-office risk manager without going through the CRO.
Every stakeholder needs voluminous reports about every aspect of risk. This requirement has led to the creation of gigantic back-office risk management organisations that dwarfed the size of middle-office and front-office risk management.

Crunching data in the back office
Most of the available risk jobs are in back-office risk management, compiling reports, building IT (information technology) systems, scrubbing data, checking limits, auditing results and similar functions. Generally, back-office risk people learn their financial risk management on the job. They’re hired for programming or auditing or legal skills or for their general business information skills.

Although back-office jobs lack the pay and glamour of front-office positions, they tend to offer better quality of life, more stable careers and advancement based on doing the job well rather than politics or luck. Back-office risk reporting, for example, tends to be more interesting than other back-office jobs because it stitches together information from all parts of the organisation – everything affects risk. Moreover, risk is about reality rather than abstractions. In my experience, back-office risk offers more opportunity to move to middle- or front-office than other back-office jobs, but in most organisations that opportunity is limited even in the risk department.

Front-office risk management works directly with traders and portfolio managers. This is the best-developed part of risk management. The front office is the place with the highest pay and most day-to-day excitement. It used to be the place that all risk managers got their start – you moved from trader or portfolio manager to front-office risk manager to middle-office risk manager. That’s still the best career path, but is rare these days. Most front-office risk managers start in other front-office roles, and never leave the front office.

Making the most of the middle office
Middle-office risk management is where the overall risk policies and methodologies are set, where front-office risk decisions are aggregated and where back-office risk reports are analysed and interpreted for other departments. The middle office is smaller than either front-office or back-office risk groups. It is, however, my main focus in this book. The reason is
that all stakeholders, and in particular all risk managers, have to understand risk from the perspective of the middle office.

**Remember**

The middle office is where everything gets put together and communicated to the world. The back office does all the work, and the front office takes all the risks, but the middle office is where the risk is managed.

**Communicating Risk**

I’m often asked what the most important job of a risk manager is. The answer is simple but unexpected to most people: The risk manager’s most crucial task is to communicate a single vision of risk to all stakeholders: equity holders, creditors, customers, executives, regulators, employees, trading counterparties – everyone. It’s nice if that single vision happens to be accurate, but unfortunately you can only do your best in that respect. What you can promise is that the vision is the same for everyone.

**Remember**

Note that I don’t say that the risk manager convincies everyone of the same vision of risk. People will always disagree about what the risk is. What they should not disagree about is what vision of risk is driving firm decisions.

Suppose that an entrepreneur lays out a proposed project. A lot of people take a look, and most have no interest. But some people are optimistic enough to lend money for the venture. Others are even more optimistic and are willing to put money in for a share of any profits after the lenders are paid. Some people want to work in the project for salary, or for equity options. Some people want to sign up to be suppliers to the project, or customers of it. The government probably gets into the act with various regulatory and tax interests. These people disagree by necessity; otherwise they would all be vying for the same role.

How do you keep the process honest? That is, how do you prevent the entrepreneur from telling creditors that the project will be run for maximum safety of repayment, telling the equity buyers that the project will be run for
maximum upside, and the government that it will be run for social benefit? How do you prevent the owner from promising the same money to employees, suppliers and customers?

If you knew exactly how the project would turn out, an accountant could audit the projected books to make sure that each dollar went to exactly one place. However, given that many future scenarios are possible, that solution isn’t practical. Instead of an accountant, you need a risk manager to lay out the range of possible futures in a form that balances simplicity (so stakeholders can understand it) with detail (so it captures the important contingencies and decisions). Each stakeholder makes an informed decision to participate based on a consistent promise of how the project will be run.

Of course, the actual outcome of the project will differ from all the risk manager’s projections, perhaps in crucial ways. Some stakeholders may prosper while others suffer. After the fact, it’s impossible to say whether the outcomes were fair or not. However, as long as everyone had the same risk information going in and as long as the project was run consistent with the promises made, then the responsibility for any gain or loss rests with the stakeholders’ choices, and is fair in that sense. (I talk about communication in Chapter 18.)

This isn’t to say that communication is the only duty of a financial risk manager. You can do things to make risk taking more productive and successful. You can encourage good risk (innovation, opportunity, experimentation, creativity, attractive bets) and discourage bad risk (carelessness, recklessness, unnecessary danger, chasing unattractive bets). You can build a positive risk culture, and gain consensus behind a shrewd risk strategy. But consistent risk communication is job one.
Chapter 2
Understanding Risk Models

In This Chapter

- Flipping coins and betting on possibilities
- Spinning the wheel in predicting outcomes
- Exploring scientific risk theories

Risk management is a quantitative discipline, which means that it works with models of risk rather than risk directly. Choosing the right model is crucial. Most people make errors in risk management because they’ve no quantitative model of risk. Experts, by contrast, often make errors by being wedded to an inappropriate model of risk.

Risk managers must understand the common risk models, especially their flaws. This chapter explains many of the risk models you can use to support your risk management decisions, and how to spot errors in existing risk management frameworks.

Comparing Frequentism and Bayesianism

A famous scene in the film Zero Dark Thirty involves the director of the Central Intelligence Agency conferring with some subordinates about whether Osama bin Laden is in a house the agency has identified in Pakistan. “I’d say there’s a 60 per cent probability he’s there,” says the deputy director. What exactly does that mean?

The most common interpretation of probability statements among quantitative people is frequentism. In this view, the deputy means that given 100 potential missions with the same quality intelligence as is available for this one, he would guess about 60 of them would have the target’s location identified correctly.
The second favourite interpretation is that the deputy would bet $60 against $40 that Osama bin Laden is in the house. This goes by the name Bayesianism.

In neither interpretation are people talking about the actual risk of the mission. Frequentism talks about long-term average outcomes of long series of hypothetical future missions. Bayesianism talks about opinions of risk. That’s why we call them models. Models can be useful, but you have to be aware of the differences between model and reality.

Financial risk managers make use of both models, although Bayesianism is generally more useful than frequentism. But they use many other models as well. Most importantly, they pay careful attention to precisely which model is in use. Never make a probability statement without being sure about the model you’re using, and never fall in love with one particular model so that you ignore evidence from other approaches.

The next sections discuss these two risk models. Despite the deep philosophic gulf between the two camps, frequentist and Bayesian statisticians mostly use the same tools and mostly come to the same conclusions. When the data clearly indicate a conclusion, any reasonable method works. If a drug immediately cures 90 per cent of the people who take it, philosophic subtleties don’t matter. The drug works for frequentists and Bayesians and everyone else. On the other hand, if 51 out of 100 people survive after taking a drug, but 50 per cent survive untreated, and a few ambiguous cases come to light and some people experience serious side effects, statisticians cannot help. You need more data and doctors and other subject-matter experts to examine the details of the experiment – not a better analysis.

In cases where there’s moderate but not overwhelming evidence in favour of a proposition, statisticians have something to offer and may disagree. However, you don’t find that frequentists are more apt to agree with other frequentists, nor Bayesians more apt to agree with other Bayesians. Different conclusions depend on the models and forms of analysis and on adjustments to the data or assumptions, not on the fundamental approach to risk.

**Counting frequency**

Early risk theory was based on a limited idea of uncertainty. It models risk as
a casino game that can be played over and over, with the range of outcomes and their probabilities known to all. The early view didn’t allow for the possibility of someone being able to get superior information about outcomes or to influence those outcomes. This type of risk simply doesn’t exist except in casinos and other gambling places where extreme care is taken to create it (and as I show in “Analysing Roulette” later in the chapter, it really doesn’t even exist there). The dice games and lotteries used in the early study of risk are poor models for the uncertainty that people face in real life.

**Characterising risk**

Although risk is one of the most important facts of life, language about it is extremely limited. It’s hard to discuss risk without expressing an opinion. You say someone was reckless, foolish or careless if she takes a risk that turns out badly. If things go well, that same person is judged as bold, innovative or a creative thinker. Even before you find out the result, if you like a risk you say the risk taker is shrewd, daring or taking a calculated risk. If you don’t like a risk, the risk taker is rolling the dice or speculating.

The difficulty of making neutral statements about risk isn’t a linguistic anomaly of English. It exists in many languages – perhaps all – and it reflects a deep misunderstanding of risk, which in turn leads to mismanagement of risk.

The first step in understanding risk is to accept that a bet is a bet whether you like the bet or not and whether it wins or loses. The same mathematical principles apply to all bets. Risk managers struggle constantly against entrenched superstition that ascribes outcomes to luck, fate, righteousness or other immeasurable moral forces – even from rational people who would never blame demons for fairies for a physical event.

Life is a casino, and everyone bets. The people who deny this fact make the biggest and least attractive bets.

The early model of risk is known as frequentism, which defines the probability of an individual event only in terms of the long-run frequency of a series of independent events.

But how does a frequentist answer a practical question about risk, such as, ‘What is the probability that it will rain tomorrow?’ You can’t repeat tomorrow 1,000 times (or even twice) to define the probability.

A frequentist cannot answer the rain question directly. She may build a model that estimates the probability of rain. Her model may say that there’s a 60 per cent chance of rain tomorrow. Running the model in the past, she finds that it rained on 52 of the last 100 days when the model said there was a 60 per cent
chance of rain. The frequentist could construct a 99 per cent confidence interval for the probability of rain tomorrow that runs from 39 per cent to 65 per cent.

That sort of sounds like the frequentist is saying that the probability of rain is 99 per cent certain to be between 39 per cent and 65 per cent tomorrow. But she’s not saying even that. The frequentist can’t make any statement at all about tomorrow or about rain probability. The statement only concerns days in the past and refers to the probability of getting certain random samples in the past. Moreover, it’s not clear how you can put that prediction to use when deciding whether to carry an umbrella to work or to plan an outdoor wedding reception or to write a weather insurance policy.

To be fair to frequentists, they understand the problems and use techniques to give their statements practical meaning. For example, good frequentist statisticians insist on testing the weather model on the best available alternative models rather than arbitrary hypotheses, doing out-of-sample validation, and testing assumptions like constant rain probabilities. But most uses of frequentist statistics aren’t done with these safeguards, and that’s true of academic journals as well as popular media. And even with all the safeguards, the basic logical problems persist.

For most practical problems of risk management, frequentist statistical methods cause more misunderstanding and error than they provide solid guidance.

**Betting with Bayes**

An entirely different theoretical understanding of risk was developed in the 1930s by a brilliant Italian mathematician, Bruno de Finetti, and fully formalised in the 1950s by American Jimmie Savage. Like frequentist probabilities, Bayesian probabilities require events with a known range of outcomes that cannot be influenced by the individuals estimating the probabilities. However, Bayesians understand that different people can have different information and opinions about events, and that some events cannot
Bayesians define probability as subjective belief, measured by how much you would bet on various outcomes. For example, if you’re willing to bet $40 against $60 that it will rain tomorrow; and equally willing to bet $60 against $40 that it won’t rain tomorrow; your subjective probability that it will rain tomorrow is 40 per cent. Of course, other people can have their own views, which may differ considerably from yours.

Bayesians choose their ideology and are often passionate about it. For many thinkers, Bayesianism is a reaction to the perceived failures of frequentism.

The great virtue of Bayesian methods is that they can give direct answers to questions such as, ‘What’s the probability that it will rain tomorrow?’ According to strict Bayesian theory, different individuals can have different probabilities for the same event, but one individual never has conflicting beliefs. That is, the Bayesian who thinks the probability that it will rain tomorrow is 40 per cent cannot also believe that the probability that more than a centimetre of rain will fall tomorrow is 50 per cent. The second statement must have the same or lower probability than the first.

Like frequentists, Bayesians turn all risk questions into gambling games. But frequentists use games like dice and coin flips, in which everyone can agree on the probabilities, and the games are fair; not necessarily fair in the sense of having equal odds of winning, but in the sense that no one can influence or predict the outcome.

Bayesians, by contrast, use what a gambler calls proposition bets, bets about the truth of some proposition, such as ‘It will rain tomorrow’ or ‘Germany will win the World Cup’ rather than bets on a mechanical device like dice or cards. Wagers on sporting outcomes are often proposition bets. De Finetti’s famous example is a bet that pays £1 if there was life on Mars a billion years ago. Assume that an expedition will settle this question tomorrow, and consider the price at which you would buy or sell the £1 claim. If you price the claim at £0.05 and are willing to buy it for that price or sell it to someone else at that price, then di Finetti says that the probability of life existing on Mars a billion years ago is 5 per cent … to you.
Notice that this bet isn’t fair in the frequentist sense. Both sides are expected to do their own research and have their own opinions about the outcome. In many such bets, both sides are expected to attempt to influence the outcome – the simplest example is two competitors betting on the outcome of a match they’re about to play.

In place of fairness, Bayesians prize consistency. It’s entirely possible for two equally good frequentist models based on the same data to give different answers to the probability of rain tomorrow. But for a Bayesian, any individual at any given time can give only one answer to that question. Moreover, frequentist methods can give inconsistent results – for example, a probability of rain tomorrow greater than the sum of the probability of rain before noon tomorrow plus the probability of rain after noon tomorrow. That cannot happen for a Bayesian.

Playing Roulette

The mathematical study of risk began with casino gambling games. Later Bayesians did a reappraisal of that work using proposition bets in which you take one side or the other on a proposal (see the preceding section). Although you can get a great deal of insight from both approaches, they’re inadequate for risk management, even if you’re managing simple betting risk – the risk created for the purpose of making the bet.

Spinning the roulette wheel

You don't need to understand the details of roulette for this discussion but I offer them here just in case you're not familiar with the game. It may make some of the discussion clearer.

A roulette wheel consists of a wooden bowl with a spindle in the middle. The wheel head is a metal disk placed on the spindle, with the numbers 0 to 36 (plus 00 in American wheels) in slots around the outside. The slots are lined with a springy material – wood or plastic. The bowl has raised areas called deflectors that look like decorations but serve an important purpose.

The wheel head is spun in one direction, and a small, hard plastic ball is spun in the opposite direction against a lip at the outside of the bowl. As the ball slows, it drifts down from the lip, spiralling down toward the wheel head. Along the way, its direction gets changed when it hits deflectors. Eventually the ball touches the wheel head, which is still moving quickly enough to give the ball a hard bounce; also the springy wood or plastic in the number slots keeps the ball bouncing around for a while. But eventually the ball settles into a slot, and the wheel head slows to a stop.
Players make bets on the number the ball will land in, or its colour (18 of the numbers are red, 18 are black and the zeros are green) or other combinations. Most payouts are computed as the fair amount – the payout amount that would cause bettors to break even in the long run – ignoring the zeros. So if a player bets £1 on a single number, she wins £35 if she’s right and loses her £1 if she’s wrong. If you ignore the zeros, she wins one time for every 35 losses and breaks even. However, because she loses on zeros, she really has 36 (37 for an American wheel) £1 losses for each £35 gain.

Casinos allow bets for a brief period after the wheel is spun, which is what creates one of the main edges for advantage players (gamblers who play in way such that they, not the house, get the advantage). One reason is that a longer time for the bettors means more bets, which means more profit for the casino. But the other reason is that it makes the wheel seem more fair, because the croupier (the casino employee who spins the wheel) cannot try to bias the spin against your bet. Many players prefer to bet only on things that are in spin, meaning no human can influence the outcome any more.

Winners are paid, losing bets are collected and the next round begins.

**Analysing roulette**

Blaise Pascal, the 17th-century French mathematician who was one of the two founders of mathematical probability theory, actually invented the first roulette wheel in 1655 (about a decade before he got interested in probability) while trying to build a perpetual motion machine. But roulette didn’t get popular as a gambling game until nearly 150 years later. Almost immediately afterwards, however, gamblers got the idea that they could beat the game by exploiting biased wheels. That meant they observed results looking for numbers that came up more often than average, due to tilting or another defect in the wheel.

It took another 150 years for the next big insight by Ed Thorp, who realised that if the wheel was biased, of course you could beat it. But he appears to be the first person to also realise that if the wheel were not biased, it had to be machined so well that it would be predictable. This insight is a fundamental one about risk in general, not just roulette.

This point is obscured by the English language. When the average person says a roulette wheel is *random*, she means each number comes up with equal probability – there’s no advantage to betting one number over another. When a statistician says the roulette wheel is *random*, she means the numbers are unpredictable – not the same thing at all. If the roulette ball landed in the numbers 1, 2, 3 and so on in order up to 36 and then back to 0 (or 00 on American wheels), the outcome would be perfectly random in the first sense
in that each number would come up the same number of times. But the outcomes would be completely non-random in the second sense in that the outcome was highly predictable. If the roulette wheel always came up 1 or 2, but mixed the two numbers perfectly, the wheel would be non-random to the average person, but perfectly random to the statistician.

You can easily build a roulette wheel that’s unpredictable – any kind of sloppy engineering will do. But you’re likely to find that this wheel is also biased and that some numbers come up more than others. If you machine the wheel so perfectly that the numbers all come up with exactly the same frequency, it’s likely that someone observing the spin can predict where the ball ends up – not necessarily perfectly every time but with enough success to win money in the long run. You’ll find it hard to build a wheel that’s both completely uniform and completely unpredictable. In fact, no one has ever managed to do it, with roulette or anything else. If no one can build one under controlled conditions, there’s no reason to expect events that are both completely uniform and completely unpredictable to occur naturally.

**Beating roulette**

What Thorp (and many others who have attacked this problem) discovered is that the roulette spin has two phases:

- In the first phase, the ball spins around the outer lip of the bowl. This action is highly predictable, you can easily compute when the ball will start spiralling down from the lip and what number will be underneath it when it does.

- The second phase starts when the ball begins spiralling downward. The path of the ball becomes hard to predict, due to deflectors built into the wheel and the violent bounces possible when the ball first makes contact with the wheel. But that unpredictability isn’t uniform and you can determine the segment of the wheel where the ball is most likely to end up.

Thus you have a period of predictability in which the result can be calculated, followed by a period of chaos, in which statistical patterns can be found. As you get deeper into this problem, you find phases within phases, but at each level you can segregate the phases into predictable elements to be computed and chaotic elements for which you compile statistics.
Although some people are quick to call something random, those with a practical interest in risk instead drill in to tease out aspects of a situation that can be calculated and aspects that can be analysed by frequency. Successful practical risk takers in almost any field ignore the obvious high-level prediction modelling or statistical analysis that occurs to a novice or is simple enough for a textbook approach. Risk takers end up obsessively measuring things other people think are irrelevant and compiling statistics about seemingly unrelated or trivial things while showing no interest at all in the things other people think matter.

For almost any risk of practical importance, a line risk taker, such as a portfolio manager, actuary and credit officer hired to choose which risks to take, automatically handles all the obviously predictable aspects and is well aware of the statistics about the range of outcomes. In order to add value, risk managers have to drill down to a deeper level to find the randomness within the predictability and the predictability within the randomness. It’s always there; you can always find deeper levels than those line risk managers use. Going one level deeper in your analysis is the trademark of a good risk manager.

**Comparing to quantitative modellers**

Most quantitative modelers model situations, including predictable aspects and random ones. But unless they have long experience managing real risk, they never have the obsessive drive to go deep enough in their risk analysis. Moreover, they’re constrained by needing to produce results that are explainable and statistically significant, and that can be achieved at reasonable cost through accepted methods. These handicaps usually make the results worthless for risk management.

The goal of most quantitative research is to model things at a level higher than the front-line risk takers. Research shows that if you model what an expert does, the model usually performs better than the expert. In other words, experts discover how to do something, but usually insist on adding intuitive judgement that actually makes things worse. If you
just do what the expert says she does, you’re better off.

But risk management isn’t about making slightly better choices than the front-line risk taker. It’s about drilling down to a deeper level where the real uncertainty resides. The front-line risk taker already manages the risk at the level she understands, and all the preceding levels as well (or if she doesn’t, it’s easy to fix – you don’t need a risk manager to do it – fire her).

This is the big gulf between risk management and most conventional quantitative modelling. If you see people casually assuming something is random and compiling statistics or casually assuming something is predictable and making calculations, you’re not looking at risk managers. Risk managers are sure that they can exploit the wisps of pattern in other people’s randomness and the wisps of noise in other people’s signals. You see them obsessively cleaning data that everyone else thinks are both irrelevant and already clean enough for all practical purposes. At the same time, the risk managers are ignoring what everyone else thinks are the important data.

**Getting Scientific with Risk**

It’s a little embarrassing philosophically that neither of the two main concepts of randomness actually exists. Dice rolls are determined by physics, not chance. We just pretend they’re random. And, although experts know less about the human mind than about simple physics, you can be confident that people do not have a consistent set of subjective beliefs about any possible eventuality. So Bayesian probabilities don’t really exist either. (See “Betting with Bayes” earlier in this chapter for an explanation of Baynesianism.)

However, in the 350 years since mathematical investigation of probability began, science has uncovered some important kinds of randomness that actually exist in nature. These models have been much more important to the development of risk management than traditional probability and statistics.

**Evolving**

*Darwinian evolution* is defined as random variation and natural selection. It was the random part that was revolutionary when Darwin published *On the Origin of Species* in 1859. The idea of random selection is what distinguished Darwin’s ideas from earlier theories of evolution and is what upset many religious people at the time.
The main difference between the randomness exploited by evolution and the randomness manufactured in a casino or used to model the uncertainty of an individual is that the mechanism of randomness is created and regulated by evolution. I’m not going to go into the complex theoretical and mathematical meaning of that, but I can illustrate it with three examples.

**Stealing from a tiger**

Consider the question of what the stock market will do tomorrow. A frequentist pretends that the result will be the draw from some probability distribution, and tries to guess the characteristics of that distribution. She knows that the actual outcome will be the result of a complex interaction of economic news and traders’ reactions, but she considered that too complicated to model in detail. To a Bayesian, the question is, ‘What do I think are the possible moves the market might make and what probability do I assign them?’ The frequentist treats the market like a roulette wheel and tries to guess what numbers will come up with what frequency. The Bayesian treats it as something she’s uncertain about and tries to quantify that uncertainty.

Both attitudes are unwise for someone managing risk. They fail to give the market the respect it deserves. Suppose instead that you think about the stock market as a highly evolved entity. In order to survive, it evolves defences against people guessing what it would do. If people make accurate guesses they can extract money, which comes from other participants who eventually leave the market. The market’s defences don’t have to be perfect – they can allow some people to make some money – but the defences have to be extremely good given the number of smart people devoting great resources to beating the market.

But the market has to do more than just defend against smart traders. It has to

- Encourage people to bring information to it
- Attract both issuers of securities and investors in securities
- Direct economic activity in reasonable ways
If the market fails in any of these tasks, it won’t survive. Of course, many financial markets have failed over the years.

If you think of the market as a roulette wheel, you think that all you have to do is predict its next number with a bit better than random accuracy. If you think that the market is a highly evolved entity threatened by any profits you extract, you think you have to snatch a piece of meat from a tiger. One of the formative events in the career of a risk manager is getting mauled by the market. I don’t mean losing money because you’re wrong – that’s justice, not a mauling. I mean getting blown up despite being right because you didn’t see the market’s defences.

A Bayesian approach disrespects the market in another way: it treats the market as something that can be understood, albeit with some uncertainty. You won’t get the meat by understanding the tiger and negotiating. What you want is inconsistent with the tiger’s survival. That’s what you have to understand.

**Shorting the big one**

Michael Lewis’ book *The Big Short* (WW Norton and Company) is an entertaining account of traders who managed to get rich during the 2007–2008 financial crisis by betting against subprime mortgages. If you don’t work on Wall Street, you probably think the hard parts of that are figuring out the right bet to make, and getting the money to back your opinions. But as the book shows, those two things were minor hurdles compared to figuring out how to place the bets and then to collect the winnings. Lots of people got the bet right and lost all their money anyway. In addition, all the successful bettors in Lewis’ book had to survive multiple crises, none of which had anything to do with the economics of their bet and any one of which may have gone the other way.

You can look at each of problem one at a time and ascribe it to a tricky detail of the market or regulation, or some shady practice by dealers or an attack by people on the other side of the bet. Of course, if you want to be a successful trader, you have to discover all the tricks that can be used to extract your profits when you win, so this analysing each factor makes sense. However, in another sense it misses the point. These people were all trying to take money out of the market. The market has evolved ways to make that difficult. Not all these market defences can be traced to rational actions by individuals; many
of them are consequences of group behaviour.

On one extreme are certain academic thinkers who treat the market as if it doesn’t care what they own. At the other extreme are superstitious traders who believe that the market is always out to get them. For risk managers, the traders’ perspective is closer to right attitude. There’s an old military adage, ‘Prepare for your enemy’s capabilities, not his intentions.’ Sound financial risk management prepares for anything the market is capable of doing, not just what the market should do, or what you expect it to do, or what makes sense.

**Getting shipwrecked**

Most people are familiar with the stories of Robinson Crusoe and the Swiss Family Robinson about people who had to find a way to survive in a completely new environment. These stories offer an excellent contrast between treating risk as something that powers evolution versus risk as something manufactured in a casino or resulting from subjective uncertainty.

Daniel Defoe’s realistic Crusoe is thoroughly aware that he is thrusting himself into a foreign ecosystem that he must respect in order to survive. Mostly that means he must adapt himself, and while changing things on the island where he’s shipwrecked, he must make small changes and think the consequences through thoroughly before acting.

In contrast, Johann Wyss’s Robinson family sets energetically to the task of recreating the Swiss environment they came from on the tropical island they land on. In the novel, they’re completely successful. In real life, their strategy would have been a disaster.

The idea of being shipwrecked on a desert island has an enduring romantic appeal. However unpleasant the reality would be, in imagination the island provides a blank canvas without all the complexities and accumulated environmental damages of modern life. But that imagination is false, and Defoe knew it deeply and instinctively, while Wyss apparently did not.

The world is highly evolved, and no blank canvases remain. Whatever projects you undertake, you need to think through the consequences of everything you’re changing. Even if you cannot trace direct cause-and-effect relations, you have to respect the possibility that even markets fight to survive.
**Going thermodynamic**

A completely different understanding of randomness underlies the field of statistical thermodynamics.

One popular way to think about the stock market is as a random number generator. News comes out about each company every day, which pushes its stock price up or down. The movement of an index like the S&P 500 is just an aggregation of the moves of the 500 stocks that make it up. The day’s move is treated like a random variable. You try to guess its distribution by studying past moves and using other information. The risk to a stock investor is that she gets an extreme draw from the left tail of the distribution – that is, a big down move, as large or larger than the big down moves in history.

That’s a fine story and useful for answering some questions about stock market risk. But what if you invert the story and say that the way things work is that macro financial variables such as interest rates and gross domestic product growth and inflation, along with other large-scale financial forces like total investor risk appetite, tax policy and leverage rules, all combine to determine the appropriate move in the S&P 500. Instead of being a random variable, the S&P 500 move is determined by economic forces. Now no one understands all the forces and no one can measure them precisely, so no one knows what tomorrow’s S&P 500 move will be, but just because no one knows something doesn’t mean it’s random.

The macro-economic variables that affect the stock market as a whole don’t put much direct pressure on the prices of individual stocks, which are still driven mostly by company-specific news. But because the S&P 500 is just the sum of the 500 stocks that make it up, if it goes up 1 per cent, the average of the 500 stocks must also go up 1 per cent.

The randomness in the stock market is how the market-level move determined by macro-economic forces gets distributed down to move individual stocks. When I say the individual stock moves are random, I don’t mean that something like a lottery is in place to determine which stocks go up and how much. Individual stock prices are still determined mostly by company news and investor opinions. But suppose that on days when the S&P 500 goes up investors underreact to any bad news that comes out about companies and overreact to good news. If a big investor wants to sell a stock for some reason on a good market day, the sale has minimal price impact, but
if a big investor (or a lot of little investors) decides to buy on a good day, the price of the stock will jump up.

For what it’s worth (and it’s probably not worth much), this is how the market feels to many participants – that macro forces determine a market mood and the market mood affects how investors react to individual pieces of news or changes in supply and demand. In this view, the stock market isn’t a clearinghouse for evaluating news and balancing supply and demand, it’s a mechanism for translating macro-economic forces into specific individual transactions in specific stocks.

Now the risk to a stock investor is completely different. It’s not the risk that the stock market as a whole will get a draw from the left tail of some distribution because there is no distribution. The person who invests in the stock market over long periods of time will earn a return based not on randomness but on how good the economy is. However, people who hold concentrated portfolios of only a few stocks, and especially people who hold levered positions and derivatives, face the risk that their particular positions will be randomly selected to do worse than the market as a whole.

For risk managers, the big issue isn’t normal day-to-day randomness, but the possibility that the stock market mechanism may break down. A breakdown may cause a crash unrelated to macro-economic forces, or a flash crash, or a bubble, or a liquidity crisis. These risks are the major ones for professional investors, and they’re significant risks even for long-term, diversified buy-and-hold investors, because a single major event can wipe out many years of normal returns. But these risks cannot be studied in a bottom-up random walk model.

Atomic theory says that a jar full of air is really a jar full of molecules whizzing around and occasionally hitting and bouncing off the jar. You can measure properties of the air in the jar like temperature and pressure. But these properties do not apply to any individual particle; they can only be defined and measured on an aggregate level. An economic analogy is aggregate economic statistics, like the inflation rate or the unemployment rate. These rates are measured by compiling individual transactions. But in one sense, there is no inflation, there’s just a bunch of people buying and selling a bunch of different things –
some at higher prices than yesterday, some at lower prices. No individual experiences the inflation rate directly; it’s something that can only be defined and measured as an average over many transactions. Similarly, no individual experiences the unemployment rate. A lot of people are in the job market – some have jobs, some don’t, some want jobs, some don’t; and a lot of people are in intermediate job states – employed part time, employed but looking for a new job, self-employed by choice or not by choice, student, retired and so on.

Physicists and economists want to make statements about the aggregate values. Physicists want to say that increasing the pressure by shrinking the jar will increase the temperature. Economists want to say that increasing inflation by cutting interest rates will reduce unemployment. But how does an air molecule know what the aggregate pressure is, and how can it use that knowledge to increase temperature? Also, if air molecules aren’t the things that react to pressure to increase temperature, what is? For economists, how does the inflation rate that the Bureau of Labor Statistics is going to announce in six weeks affect whether or not an employer takes on an additional worker?

The answer that physicists worked out at the end of the 19th century, and that risk managers came to appreciate about 80 years later, is that the macrostates like temperature or inflation rate are actually statistical statements about the likelihood of individual microstates, which are the motions of individual particles or the decisions of individual economic actors.

Okay, that’s pretty technical. (I think it’s fascinating, but you’re free to disagree.) What’s important to understand in order to understand risk management is that this concept of likelihood and statistics is an entirely new way of thinking about risk. There’s nothing random about particle movements or the unemployment rate, yet to understand the properties of a jar of air or the properties of an economy, you have to treat the particle properties and unemployment rate as random variables.

There is a difference between physics and finance. In finance, you typically talk about millions, or at most billions, of transactions. In physics, statistical thermodynamics is applied to systems with billions upon billions of particles or more. In physics, it’s entirely possible that a benign macrostate will, purely by random chance, select a microstate that puts all the air molecules in the
same part of the jar, or at least enough of them to create a temperature and pressure that cracks the jar, thus changing the macrostate. However, so many particles exist that the chance of a measurable aberration from uniform temperature and pressure is negligible. In finance, you deal with systems small enough that these sorts of events are rare but do in fact occur from time to time.

A major risk in the financial markets is that the random distribution of macro forces to individual transactions will align by chance in a way that disrupts the markets, which in turn disrupts the economy, which in turn delivers additional shocks to the market. If that happens, it may be months or years before any kind of equilibrium is restored.

**Trading in uncertainty**

In the early 20th century, physicists discovered an entirely new kind of randomness, *quantum uncertainty*, that didn’t obey the rules of macroscopic probability. Subatomic particles behave randomly, but not like coin flips or dice throws, and not like Bayesian bets.

When you flip a coin, the result is either heads or tails, it makes no difference if anyone looks at it or not. But in the quantum world, the coin is both heads and tails until someone checks to see which it is.

An analogy putting you as the detective in a murder mystery may make this difference clearer: Before you know whodunit, you’re suspicious of everyone, and you’re uncertain about events because the testimony of the murderer is likely false. Given what you know so far, you think you have a 66 per cent chance the duke did it and a 34 per cent chance the butler did it. If you knew it was the duke, you would lock up the duke; if you knew it was the butler, you would lock up the butler; but given your uncertainty you lock up no one. You don’t lock the duke up 16 hours in the day and the butler 8 hours. The point is that the actions you take under uncertainty are not the weighted average of the actions you take under each of the possible resolutions. The state of uncertainty is fundamentally different from any of the possible resolved states.

Now consider an example in finance: You run a capital structure arbitrage portfolio. That means you buy and sell different securities from the same company in such a way that you make a profit regardless of what happens to
the company in the future – whether it goes bankrupt, or restructures, or is sold, or operates normally with good or bad results. If you think of risk as like a coin flip, the only risk is that you miscalculate and some possible outcome comes to pass in which you lose money.

In fact, the major risk in capital structure arbitrage, at least when done by competent professionals, is that some future state of uncertainty reduces the value of your positions so much that they’re taken away from you. You blow up (meaning that your prime broker and counterparties force you to exit your positions at a loss – often a loss of all your assets), even though the eventual outcome proves that your positions were profitable.

It’s not enough to consider every possible state of the world after uncertainty is resolved; risk managers must also consider states of uncertainty in which things happen that couldn’t happen in any consistent state.

All the financial markets operate in a constant state of uncertainty. This uncertainty leads to a set of prices that isn’t consistent with any future state, and that can exist only because people are uncertain about future states. Arbitragers set up complex portfolios to exploit this, and those portfolios are exactly the ones most exposed to increases in the level of uncertainty (in effect, the real bet that all arbitragers make, regardless of their specific positions, is that uncertainty will decline in their markets before it increases enough to blow them up). But every financial market participant is exposed to the sudden realignments that occur when uncertainty is resolved. Most conventional non-arbitrage portfolios amount to bets that the net level of uncertainty in the market is going to increase.

Extreme market events generally don’t result from big, surprising news. Think of murder mysteries: The big events – new people murdered, sudden revelations of buried secrets and so on – are typically not the things that allow the detective to solve the crime. The key is usually a tiny detail, unnoticed or unappreciated until the climax, or no event at all, just a reconsideration of an assumption.

It’s not enough to have a correct view on all the big stuff – whether a government will default on its debt, or what the central bank will do, or whether holiday retail sales will be high or low. Some minor piece of news in
an unexpected place may be what drives the market; or even no news at all, just investors reconsidering assumptions. This unpredictability is one of the things that makes predicting the market so difficult.

Conventional probability theory treats all this little stuff as random noise and tries to extract the signal, the fundamental economic information expected to persist after all the minor stuff diversifies away. But thinking in information terms, the signal is what is random; the noise is highly structured.

You can’t predict (or at least I can’t, and I have never met anyone who can) the little stuff, but you can predict how the market will react to increases or decreases in the level of uncertainty. Some positions are vulnerable to sudden extreme down moves, other positions are vulnerable to sudden extreme up moves, and you can’t identify either by observing their past price behaviour, only by trying to understand which market prices are supported by uncertainty and which market prices are being depressed by uncertainty.

**Playing with game theory**

Game theory is the most recent major alternative concept of uncertainty. Although there was some game theory-like thinking prior to 1944, it was Princeton University Press’s publication in that year of *Theory of Games and Economic Behavior* by mathematician John von Neumann and economist Oskar Morgenstern that put game theory on the intellectual map.

*Game theory* models uncertain future events not as the unpredictable outcomes of natural events, but as the choices of rational beings with at least partially understood motives.

Consider the oldest known written legal system, the Code of Hammurabi, which codified legal practices in the Near East about 4,000 years ago. The second law reads:

If anyone bring an accusation against a man, the accused must leap into the river. If he sinks in the river, his accuser shall take possession of his house. But if the river proves the accuser not guilty, and he escape unhurt, then the accuser shall be put to death, while he who leaped into the river shall take possession of the house that had belonged to his accuser.
If law seems like a relic of impossibly ancient times, recall that as late as 200 years ago the accused in England had the option of trial by combat. That’s the same basic system as Hammurabi’s: a contest between accused and accuser in which one of them dies, but less fair because it favours people skilled in fighting. Large disputes are still settled by wars and many small ones by personal confrontation. But, a tiny minority of disputes in between ends up in the formal justice system where people at least attempt to ascertain the facts of the case and the relevant law.

Hammurabi’s law obviously relies on people believing that guilty people would drown while innocent people would survive the river. (It’s not clear exactly how this test was conducted, but my guess is the accused had to jump from a high place or into a dangerous current so the probability of survival was roughly even.) So why not just do what many people have done through the ages and just say that people who violate the law will be punished by the gods in this life or the next?

The trouble with the simpler system is that it only works if everyone believes it. The clever game theory wrinkle of Hammurabi’s Code is that it works if anyone is superstitious. I may think that the river dive is a random proposition unrelated to my guilt, but I still won’t break the law because I’m afraid some superstitious person will accuse me in order to get my house. The superstitious person may think that making an accusation is risk-free way to acquire real estate. So superstitious people won’t break the law because they think that they’re certain to drown if accused, and non-superstitious people won’t break the law because they think that they’re likely to be accused.

Rather than treating guilt or innocence as an uncertain matter to be resolved by looking at the facts, Hammurabi designed a system that exploited the predictable actions of rational (rational given their beliefs, that is) beings. Note that the system falls apart if people act irrationally.

Now think of financial markets from the same perspective. Don’t think of the stock market as an institution for aggregating information, assessing uncertainty and setting economically meaningful prices; think of it as a game and ask yourself who’s playing and what strategies they use. Some people put their retirement savings in diversified portfolios and assume that the market will go up in the long run. Others try to guess what the market will do over the next few months – or few milliseconds. Some make bets on individual companies, some on industries, some on countries, and some make more
complex bets. But don’t forget the people who come to raise money for their business ventures or to play other games, like the stockbroker game (talking other people into buying or selling stocks for a commission), the financial advisor game, the hedge fund game, the stock buyback game and so on.

All the people in these groups affect stock prices by buying or selling, and in some cases by doing other things like issuing stock or making recommendations, and all of them have motivations that can be at least partially understood and predicted.

Game theory models are particularly useful for analysing risks from bubbles and crashes, for example. They’re also the only way I know to explain rationally why certain investment anomalies persist for many decades in many different markets – for example, the belief that value investments (securities that are cheap relative to their underlying economic worth) do better than growth investments (securities with large upsides if things go the right way) or that prices have momentum (securities whose prices have gone up recently tend to keep going up, and securities whose prices have gone down recently tend to keep going down).

The first two models of risk I discussed, frequentism and Bayesianism, are models that people tend to assume uncritically and narrowly, not seeing the alternatives. The next three, from evolution, thermodynamics and uncertainty, are models that people often overlook. Game theory explanations occur to many people and are often put forward as obvious truths. But without rigorous and consistent analysis, these explanations are worthless or even misleading. Most people, even people who have no concept of probability theory, accept the ideas of game theory, even if they’ve never heard of it. But many of those people apply it in superficial and inconsistent ways.
Chapter 3
Taking Charge of Risk

In This Chapter

- Differentiating risk from opportunity
- Understanding the four requirements of a goal
- Setting goals considering all the factors

Risk management isn’t risk measurement, nor risk analysis, nor risk navel gazing. Risk management is active. Risk managers don’t spend time worrying about risk; they make decisions and live with the consequences.

Of course, it’s one thing to say, ‘Be proactive’, it’s another thing to know what to do. Often the problem isn’t choosing the right option, it’s figuring out what the options are.

The average person is no concert pianist, but if you put him in that job he at least understands that the idea is to press the keys and pedals on the piano in order to make the audience applaud. The amateur would know what to do and what the goal was, but would probably be unable to accomplish it. The same person appointed risk manager of a global bank would likely not even know what kinds of things he was supposed to be doing, and what the goal was … unless he’d read this chapter, of course.

I don’t tell you how to be a risk manager in this chapter, but I do tell you just what it means to be a risk manager.

Distinguishing Risk

Everyone understands risk in sporting contests. The team that’s behind increases its risk, perhaps by playing faster and more aggressively. The team that’s ahead plays to reduce risk, maybe slowing down the game and playing defensively. The specific tactics vary from sport to sport, but the general concept applies to all sports.
This sense of risk is the one in the phrase *risk management*. You dial risk up or down in order to accomplish goals, which I talk about in ‘Choosing Your Goal’ a little later in the chapter.

Risk is neither good nor bad in itself. You don’t manage risk based on feelings or risk preferences or fixed notions of prudence; you select an optimal level of risk based on objective external circumstances. You don’t consult psychologists or lawyers to choose risks, you gather data and do the math.

**Taking risk**

My topic in this book is financial risk, but in this section I discuss other types of risk because the broader perspective makes it easier to understand the financial context. I mention sports because sports give a particularly clear view. The unambiguous outcomes in sporting contests make it easy to see when risk is desirable and when risk is undesirable.

Every decision you make involves risk, because no outcome can be predicted perfectly. You can stay at home and read a good book or head out on the town for a night of wild adventure. The first choice is lower risk – you can be reasonably confident of the outcome. The second has a wider range of possibilities. You can take a government job with low chances of being fired, steady pay raises and a good pension; or you can join a start-up company that pays mostly in stock options. You can collect stamps for a hobby, or you can climb mountains.

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**Distributing power**

You often hear people say, ‘That's the stupidest thing in the world.’ They can't all be right. Granted a lot of competition is out there, but my candidate for the stupidest thing in the world is to distribute power based on claimed ability to manage risk, by predicting outcomes or by reacting intelligently as events occur, and never testing to see whether those claims are correct. Candidates for office make all kinds of confident predictions and get elected even though their records of accuracy are well below that of monkeys throwing darts. In a crisis, people tend to listen to the loudest and most confident voices, which tend to be the least thoughtful people, not the wisest ones.

Risk management is a disruptive field precisely because it insists on rigorously measuring prediction accuracy and effectiveness. That changes the entire power structure of an institution, shifting the balance away from the loudly overconfident toward the quiet and humble but accurate. Rewards shift from the people who get lucky with big risks to the people with demonstrable, consistent, positive risk-adjusted performance. Continuously monitoring
what actual works usually leads to more change, more diverse empowerment, more experimentation and more fun than fits within many people's comfort zones.

Of course, disruption induces a reaction. Powerful people may seek to eliminate or co-opt risk or neuter it by putting people in charge who won't disrupt anything. Natural institutional forces may also retard change – traditional rules and divisions, entrenched groups, laws and regulations. So risk managers must be prepared for conflict – if you want to get along with everyone, don't be a risk manager.

Another important point is that risk managers should not fight power with power. Risk managers like institutions where lots of people have influence, and have little need for power. If the risk manager accumulates power to accomplish his goals or because he likes it, it corrupts the entire process. You can't be the referee and a player as well.

Obviously you make decisions mostly on the basis of what you like, and also on your assessment of the probable outcomes of the choices. You survey your options in any situation and make the choices that seem to offer the most attractive combination of expected reward and risk. These decisions are analogous to what’s called a portfolio management decision in finance. A portfolio manager considers the range of investment opportunities and selects holdings based on analysis of average return and risk. (The fact that many portfolio managers and most individuals do this task badly is a topic for another book.)

Risk management comes at these decisions from a complementary perspective. It cannot tell you whether reading or clubbing is wise, nor opine on the merits of government versus venture employment, nor express a preference for stamps versus mountains. Neither can it tell a portfolio manager which stock to buy or whether interest rates are likely headed up or down. Instead, risk management estimates the overall level of risk that has the best chance of success.

The risk manager lets the portfolio manager select an optimal portfolio, then computes the appropriate level of risk. Should the manager put 10 per cent of his funds in the portfolio and hold 90 per cent cash in order to reduce risk, or borrow money to lever the portfolio up to a higher degree of risk? A risk management approach to life would make decisions according to taste and expected outcomes, but then step back and ask if the overall level of life risk is too low or too high. Too low a level of risk leads to a virtual certainty of dissatisfaction – a boring, wasted life. Too high a risk level can mean virtual certainty of disaster.
The secret of risk management is finding the appropriate level of risk. Selecting the wrong level of overall risk, whether in your life or in your financial portfolio, isn’t merely risky, it’s just wrong. It nearly always fails. With the right level of risk, you may still fail, but you may succeed.

Courting danger
Continuing the sporting theme, consider the risk of a player getting injured. This risk isn’t the sense of risk associated with financial risk. You don’t dial this type of risk up or down to accomplish a goal. For one thing, it has only bad outcomes. Players rarely have sudden improvements in health while playing. For another thing, injuries aren’t measured in the same units you use for sport (points, goals, wins, championships and so on) or financial success (money). In fact, injuries aren’t measured in units at all. You can’t determine how many goals a broken collarbone is worth, or even whether having two players with broken collarbones is better or worse than having one player with a broken leg.

If you can’t aggregate outcomes in common units, you can’t express an opinion about overall levels of risk. Suppose a tactic reduces the chance of either team scoring, so it improves the chance of winning for the team that is currently ahead, but increases the chance of player injury. You can’t find a meaningful way to say that this tactic is risk increasing or risk reducing.

In this book, I use the word danger, not risk, to describe one-sided uncertainties with only bad outcomes that cannot be measured or that can’t be measured in common units with other uncertainties.

Two of the most common risk management errors are treating risks like dangers, and treating dangers like risks. The first is called cowardice, exhibited by shying away from any uncertainty because the outcome might be bad and you lack the psychological or institutional ability to offset losses with gains. Always making the safe choice isn’t the safest strategy because such a strategy usually has a negligible chance of success.

An example of the latter error – treating a danger as a risk – is the famous Ford Pinto Memorandum. This document estimated that fixing the defect in the Pinto’s design would cost £76 million ($121 million), while the cost of settling lawsuits for a projected 2,100 fires caused by the defect (including
180 burn deaths and another 180 serious burn injuries) would be only £31 million ($50 million). For the record, this memorandum did exist, but it was not used by Ford to make the decision not to fix the Pinto; it was a theoretical response to a government request. Nevertheless it remains a perfect example of treating a danger (setting your customers on fire) as a risk (the dollar payout in lawsuits). Burn deaths are one-sided, no one likes immolation, and the outcome cannot be measured in dollars or other common units.

Although treating risks like dangers earns you the coward tag, in practice people are often lauded for such decisions. The practice is practically a job requirement for democratically elected politicians. Treating dangers as risks has no common name (inhuman or heartless are the best I can come up with), but this error results in universal and instinctive condemnation.

The first job of any risk manager is to distinguish the dangers from the risks and to ensure that dangers are treated as dangers and risks treated as risks. The topic of this book is risks, but I have a few things to say about dangers as well.

### Exploiting opportunity

A parallel concept to danger is one-sided events not measured in common units that are only good. I call these opportunities. An example of an opportunity in sports is the chance for a player or team to break a record. In baseball, for example, it’s common for a manager to leave a pitcher in the game if he has a chance at a no-hitter (pitching a complete game without allowing any hits) even if he is tiring and a replacement pitcher would result in a better chance of winning the game. The opportunity for a no-hitter is considered too valuable to lose.

A common theme in popular fiction is inhuman decision makers in business or government treating dangers as risks, playing with human lives as if they were counters in a game. In my personal experience, a far more common and costly error is institutions treating opportunities as risks. I think neglected opportunities suck more happiness out of the world than imprudent dangers.

In any event, the second job of risk managers is to distinguish clearly the opportunities from the risks, and to ensure that opportunities are treated as opportunities and risks are treated as risks.
The name for someone who treats risks as opportunities is *thrill seeker*. It can be a rational response to one-sided compensation schemes in which someone is paid for success but not penalised for failure. For similar reasons, it can be rational for someone playing with other people’s money. This situation is a contributing factor to most disasters, from wars to financial crises.

An example of treating an opportunity as a risk is a company refusing to pursue a promising research idea because if it’s successful the new idea would cannibalise sales of existing products and lead to lower profits. Large institutions – governmental, religious and corporate – have an almost irresistible tendency toward minimising opportunity.

### Choosing Your Goal

If you don’t know where you’re going, you probably won’t get there. A lot of risk management errors are the result of having too many goals, or undefined goals, or even no goals. The following sections explain the characteristics of good, workable goals.

### Getting specific

Not everything you want is a goal. Consider a coach asked before the season begins whether his team can win the championship. His answer is sure to be, ‘We’ll take things one game at a time.’ Of course, that doesn’t mean he doesn’t want to win the championship, and he’s sure to have additional goals like helping his players mature, keeping his job and maybe getting a raise or a better job, setting records, getting good publicity, making money if he works for a professional franchise or not losing too much, among others.

What the coach knows is that making risk decisions in terms of a goal that’s too far away leads to errors. To win a championship, you have to win games. To win games, you have to focus on the game. Playing each game while thinking of the championship leads to errors, such as overlooking weak opponents because you’re thinking about the stronger opponent in the next game, or acting out of frantic desperation when losing in an early game, or playing half-heartedly if the chance of winning the championship is slim. In fact, the coach may even choose smaller goals than the game, especially if he has a weak team, such as executing properly for the few moments, or losing by less than the last game. A coach often tells his team to ignore the score and
just focus on playing well.

The first requirement of a goal is that it be specific and clear enough to focus the organisation for success. The goal is what the risk manager dials risk up or down to accomplish. The goal isn’t the only thing the stakeholders of the institution hope to accomplish, but success in the goal is what enables the larger hopes of various stakeholders.

It’s good risk management practice to ensure that all the front-line risk takers are pursuing the same goal. If one player is trying to impress his girlfriend and another is trying to set a record while a third is playing in hopes of being selected by a better team, you don’t have a team focused on its goal. Of course, all these people can want all those things, but the risk decisions should be made with respect to the team’s goal.

Agreeing on a goal may require consensus that doesn’t exist. Inability to set a common goal can be a sign of a dysfunctional organisation, and the schisms you uncover in discussing goals may make it too weak to withstand crises. As a risk manager, always make the effort to get agreement on a goal. If you succeed, great; if not, you discover important things about the organisation that can help you improve your risk management. In some cases, you discover that you should leave and find another organisation.

**Following the rules**

The risk manager’s insistence on selecting a common goal can conflict with regulations. Financial institutions are generally composed of many legal entities, some of which have legally defined goals. Moreover, regulations and laws dictate goals as well.

The second requirement of your goal is that it be consistent with all laws and regulations that apply to your organisation.

An investment manager has a fiduciary duty to his investors, but also has a duty to the owners of the company. This duty generally isn’t a fiduciary one unless he’s also a director of the company.
**Fiduciary duty** is the highest duty recognised in the US legal system. It requires the fiduciary to act only in the best interests of the principal and not to profit from the relationship without the principal’s express informed consent.

As risk manager, you may also have duties to other stakeholders, which makes things even more complicated because there may be many investors with conflicting interests and many legal entities involved as well. And investment management is about the simplest financial business there is.

Speaking as a risk manager, loading a person with lots of duties isn’t a sensible way to run things. Nevertheless, this world is the one we live in, or at least the financial–legal system we work in, so we have to make do. That means you have to work closely with lawyers and compliance officers to come up with a clear consensus goal that satisfies all regulations. This consensus isn’t easy, but is essential. If you don’t push to specify how various conflicts should be resolved ahead of time, you leave the decision to a risk taker making it under pressure, and he’s unlikely to have the nuanced legal education and regulatory knowledge to make it correctly.

As an extra advantage, setting down agreed-upon goals helps in the legal disputes that sometimes arise. If you can show that you had a clear policy and followed it, the argument shifts to whether your policy was reasonable in general, and this argument is one you can win. If the argument instead focuses on the specific decision, you have a much harder time demonstrating that it violated no rules.

**Being successful**

The reason it’s possible to refine a clear goal when many of the parties may be working at cross purposes is that the organisation’s success is in every stakeholder’s best interest. Even if you tried to maximise return for one specific stakeholder, you’d have to keep all the others happy to accomplish it. A financial institution needs delighted customers, motivated employees, happy investors, willing counterparties, supportive partners and satisfied regulators in order to thrive. Although the interests of these groups may be in conflict on specific details – for example, a dollar extra charged in fees takes money from customers and delivers it to investors; a dollar extra paid in
wages takes money from investors and gives it to employees – in a larger sense every stakeholder has the same interest in the institution’s success.

However, the most important requirement for getting all the stakeholders to agree on a goal is that the organisation must actually add value. If an asset manager is picking stocks at random, then every extra dollar paid in fees really comes out of the customers’ pockets and every extra dollar paid to employees comes from investors in the management company.

So, the third requirement of a goal is that it be something that the organisation can actually accomplish and that adds economic value. If you cannot find a goal that meets this requirement, the institution should be liquidated.

**Finding your niche**

Because finance is a competitive field, adding economic value means finding a niche in which you can do better than anyone else. That may mean concentrating on a geographic area, or type of security, or type of strategy. But it may also mean attracting the best of certain kinds of employees, or generating *economies of scale* (that is, growing so big that you can spread your costs on a large base and make solid profits with low fees to customers) or being the fastest to react to events.

The fourth requirement of a goal is that it defines your niche, your core competency, your comparative advantage.

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**Being the imprudent man**

Until modern portfolio theory gained some legal respect in the 1970s and 1980s, the most common legal standard for investment fiduciaries was the *Prudent Man rule*. If a manager bought a stock and it went down, it was almost certainly imprudent. The manager was not allowed to argue that the decision to buy stocks in general was the most prudent way of meeting the needs for growth and income. He was not even allowed to argue that the entire portfolio of stocks he bought made money.

Of course, investment managers should be prudent, but the problem with the rule is that it was applied to each investment on its own (in the few places where the letter of the rule is retained, it has been broadened to apply to groups of investments).
This example is one of a poor choice of risk management goal. The goal is too narrow, because it conceives of risk one investment at a time. Moreover it's entirely negative, risk is defined only as losing money. As a result, fiduciaries invested in the lowest risk investments they could find, primarily government bonds. As a subsequent result, their portfolios were overexposed to risks like inflation, which were invisible to the Prudent Man rule.

**Considering Dangers, Opportunities and Risk**

In devising a goal for your risk-management strategy, you need to ensure that the goal

- Is clear and specific enough to focus efforts and be understood by all stakeholders
- Meets all legal and regulatory requirements
- Is something your institution can actually accomplish to add economic value
- Reflects your institution’s core competency – the skill that defines your institution.

Companies are often defined by their products – an insurance company, for example, or a public mutual fund management company. You can define goals at the product level too – for example, to offer the best disability insurance policies or equity mutual funds. But don’t limit your thinking to products. Perhaps a better goal is to attract the best of a certain kind of employee and give them the environment they need to thrive then trust that whatever product they produce will be high quality.

Perhaps you wish to encourage a certain culture, echoing the famous dictum of J.P. Morgan to do only “first-class business in a first-class way.” Create the right culture and trust that the right people will come and produce the right products.

Products, employees and culture are all internal to the organization. You can also define goals with respect to external entities. You can try to provide the best return to investors, or the best service to clients or develop the best network of partners.
The best advice I have to offer is to think broadly and deeply before deciding how to set a goal, because the goal defines the fundamental nature of the institution.

And remember that defining the goal in terms of one of these elements does not mean that you’re indifferent to the others. The coach who tells his players to focus on one game at a time isn’t ignoring the championship or other goals. If you choose to define your business goals in terms of employees, for example, you do so in the belief that those employees are going to produce great products, earn a good return for capital providers, serve clients well, be great partners and produce a culture to be proud of.

Why not have multiple goals? A business manager may or may not choose to do that for planning purposes; I’m no business manager. But you need to focus on a single goal in order to manage risk. In fact, you need a single goal even to define risk. Actions that are high risk with respect to one goal can be low risk with respect to another. A coach focused on a single game can minimise risk by using the players who are playing best at the moment and adopting a conventional strategy. However, if he focuses on a successful season, or the long-term development of players, he may reduce risk by experimenting more and distributing playing time more broadly.

Generally, the foundation of risk management is considering alternative outcomes. Most people make plans that assume each step goes as expected. Risk managers never do that. The point of risk management is to evaluate plans over the range of plausible outcomes. This task is impossible without a clear goal. An employee-focused company changes its products, or investors or whatever it takes to preserve the accumulated skills and working relationships of its people. A product-focused company hires new employees as necessary to deliver the best product. You can’t make consistent risk decisions without a fixed point of reference. And, in practice, many of the worst risk decisions are justified by shifting that point depending on the outcomes.

**Mitigating danger**
Remember that *dangers* are uncertain events that can only be bad, and that are not measured, or are measured in different terms than you use for everyday decisions. (In particular, they’re not measured in money.) Note that the same possibility can be a danger to one person and a risk to another. Getting into a car crash, for example, is a danger to you but a risk to your insurance company. To you it can only be bad, and you cannot put a price on the possible damage. To the insurance company, this event is an everyday event measured in dollars, and is two-sided because although the accident itself costs the insurance company money, the possibility of accidents is what allows the insurance company to charge premiums. If there were no accidents, there would be no insurance company.

It may even be the case that your danger is an opportunity to someone. Journalists, for example, can often trace major career breaks to covering some disaster. Sometimes dramatic bad events can lead to acceptance of new ideas, which are opportunities for some people. Wars create heroes – and war profiteers.

Therefore, when you start categorising uncertain events, don’t make automatic assumptions based on the type of event. Typical dangers for companies are physical harm to employees or others, which could come from events such as fires or terrorist action; the company or its employees being involved in crimes, such as having a rogue trader or the company being convicted of market manipulation; or being a target of cybercrime such as having its customer data hacked and exploited.

The general rule for dangers is to push the responsibility for minimising them down to the lowest possible level. Ideally, the people exposed to the danger should have the authority to control it, and the responsibility for that job as well. They’re the people you can most trust to care, and the people with the best knowledge. This rule is relatively easy to apply for physical danger, but generally not possible for things like cybercrime.

**Flying the wrong way**

In 1918, the United States Postal Service began the world’s first airmail delivery, using civilian pilots. The program was supported only weakly by Democrats, and fiercely opposed by Republicans and the railroads (who carried most of the mail in those days).
Second Assistant Postmaster Otto Praeger, a tough Texas journalist, dictated a ‘fly or be fired’ policy in which the pilots would be forced to operate their rickety, war-surplus planes in any type of weather. Praeger felt that this was the only way to build the morale and reliability necessary for airmail to succeed. The pilots called themselves ‘The Suicide Club’, and a quarter of them died in the first three years of the service. They eventually went on strike.

This tale is a classic example of treating a danger (pilots being killed) as a risk, and attempting to manage it from the top down. It led to both excessive deaths, and a near breakdown of the entire venture.

The solution? After negotiation, Praeger agreed that only the flight supervisors at the airfields were authorised to order pilots to fly. That was a major improvement, pushing the decision down to a person with knowledge of the conditions (and who was generally a pilot himself), who had to look the pilot in the eye and give the order. But the real genius was an added rule that after being ordered to fly, any pilot had the right to demand that the supervisor accompany him on a test flight around the airfield.

Fast-forward to 1999 and fears that the Y2K bug would cause massive computer failures at midnight on 31 December 1999. A survey of global technology company executives found that 63 per cent said they would not be willing to be on an airplane at the moment the new millennium begins. Zhao Bo, Y2K head of the Chinese Ministry of Information Industries, is quoted as saying, ‘We have to make sure there are no problems in aviation.’ So he ordered all Chinese airline CEOs to be in the air on their planes at midnight on 31 December.

Normally risk managers prefer to push the responsibility and authority for the decision down to the people exposed to the danger. But the opposite solution works too, push the danger up to the people with responsibility and authority.

Suppose, for example, a company driver is killed in an accident while driving for work. You don’t want the accident to be the result of a decision by a senior vice president to reduce the number of brake inspections or to mandate shorter rest periods between drives. You want the drivers themselves and their immediate supervisors to be making decisions about equipment safety and fatigue. You cannot make these decisions at a high level on an aggregate basis because dangers do not aggregate. Therefore, decisions should be made where the information is, and where the consequences are. Moreover, people – both people exposed to dangers and the public – are more apt to accept bad events when the injured party had control over the danger.

As a risk manager, your job isn’t to manage dangers. In fact, let me make that stronger: Your job is to not to manage dangers. Dangers shouldn’t be managed; they should be minimised. That minimisation is subject to constraints because it’s too expensive and impractical to
reduce dangers to zero, but a danger should never be increased for its own sake.

Rather, your job is to identify the major dangers and ensure that they aren’t being managed. You work to push responsibility and authority down as close as possible to the level of the people exposed. Where that isn’t possible, you try to bring exposure up to the level of the people with responsibility and authority. Where neither of these things is possible, you work to make sure that responsibility and authority are in the same place and that everyone knows where they are.

Don’t make the mistake of trying to learn too much about the specifics of the dangers. In my experience, it actually makes things worse if the risk manager considers himself an expert in IT security, or fire safety or how terrorists work. Far better for the risk manager to be unbiased, and to approach mitigating dangers purely as a matter of organisation. People assuming that the risk manager has responsibility and authority over dangers is a bad thing.

Although you need to stay out of the specifics of dealing with dangers, limiting yourself to making sure that the right people are doing that job, you do have an interest in accurate, timely, transparent and informative reporting on dangers. Bad events and near misses should be reported immediately to the risk manager, and the person responsible must never make the decision about whether or not to report. Generating reports is usually the easy job; the hard job is getting people to look at them regularly and take action when appropriate.

**Seizing opportunity**

*Opportunities* are uncertain events that are only good, but like dangers, they’re not measured in money or other terms that can be aggregated. The key property of opportunities is that they’re not diminished by sharing. You want to push dangers down as close as possible to the people exposed, but you want to push opportunities up to the highest and broadest levels.

A frequent movie plot is a soulless corporation that inflicts great dangers on the world while its evil executives do not care. I haven’t seen a lot of this plot in real life. What I do see a lot of is corporations run by unimaginative
executives who neglect great opportunities.

When people think of opportunities in business, they tend to think about things like finding a cure for a disease, or inventing a clean and cheap energy technology. However, in my experience, the most common opportunities in business are to create an organisation that enriches lives. It doesn’t have to cure cancer or save the environment; it is enough to create a pleasant and satisfying work environment that allows employees to develop and gain financial security, and investors to prosper, and that serves customers, suppliers and the community. These things have tremendous value. If you can save lives and the planet along the way, so much the better.

In my life, I have worked for some good organisations I’m proud of, and I’ve also had some less satisfying employment experiences. The difference is independent of how the job treated me, whether or not I had a good time there or accomplished my career goals (of course those things matter to me as well, but they matter only to me). The biggest single difference is that in the good places, everything good that happened to anyone was appreciated by everyone. If one of the company’s products won an award, or a group of employees did volunteer work, or if an intern got accepted to his first-choice school; everyone knew about it. I don’t mean the companies were perfect or that only good things happened, I mean that opportunities were recognised as valuable and shared freely. That made people proud to work for the organisation.

These same places tended to be open to other opportunities like innovation. New ideas, whether new ways of doing things or new product concepts, were treated with respect, not suspicion. They were not always adopted, of course, but people tried to think of ways to make them succeed, not reasons to supress them. At less friendly places, people would quit and take their new ideas elsewhere rather than run the gauntlet of entrenched opposition to change.

Another sign that opportunities are valued is what happens when you speak to someone in the organisation that you don’t know. At bad places, the two of you have a preliminary discussion to figure out how you relate in the chain of command, who outranks whom and what strategic gains and losses are possible. At good places, people try to help you on the grounds that you all have the same employer and are all working in the same interest.
Risk managers don’t manage opportunities any more than they manage dangers. They do try to identify them, to protect them, and to push them out as broadly as possible.

**Optimising risk**

After dealing with dangers and opportunities, you can turn to the core of your job – managing risk. Risk is the two-sided uncertainty that can be measured. Risk is what you dial up or down to accomplish your goals.

**Getting risk right – when you can**

The first principle is that it’s hard to get risk right. That’s why they call it risk. What you can do is work to define the risk as precisely as possible beforehand, make your best judgement and measure outcomes rigorously afterwards. Such discipline can lead to long-term success. Lack of discipline can sometimes lead to the extraordinary success for a lucky fool, but sound risk management is the superior strategy.

Most of the value added from good risk management isn’t in making better initial risk decisions, but in learning from outcomes and refining future risk decisions based on results.

A related principle, call it the first-and-a-half principle, is no under-the-table risk. Discuss all risk taking openly ahead of time, and evaluate outcomes impartially afterwards. One of the most important powers of a risk manager is to give permission to fail. You must tolerate authorised failures, but never accept unauthorised failures. Scrutinise authorised failures carefully for valuable lessons; don’t use them as occasions for finger pointing.

**Setting parameters**

The second principle is to try to cast risk decisions in terms of size rather than yes or no. Almost any risk is worthwhile if taken in small enough size. If you cut the size of a risk in half, you cut the expected return in half as well, but you retain most or all the experience value, the learning value.

The increase in your total risk goes down by more than half. Taking the risk at half the size may add only one-quarter as much to your overall risk as taking the risk at full size. Thus the ratio of return to risk goes up as you decrease the size of the risk.
For the same reasons, almost any risk is undesirable if taken in large enough size. So risk managers tend to lobby for many, many small risks and only a few, very carefully chosen big risks.

**Keeping risk constant over time**

The third general principle is to keep risk levels constant in time. People have a strong tendency to hedge decisions by planning to take more or less risk in the future. ‘Let’s just try to muddle through today,’ they may say, ‘and we’ll think about trying new things or expanding tomorrow.’ Generally, tomorrow never comes. If you’re afraid to take risk today, you’ll find reasons to be afraid tomorrow, too. Risk is always more palatable in the future.

At other times people are apt to say, ‘Let’s go for it, and if it doesn’t work, we can retrench.’

In both cases, your job is to argue for one consistent level of risk – today and tomorrow. For one thing, doing so is the most efficient way to distribute risk over time. But much more importantly, it forces hard and honest decisions without evasions.

**Encouraging risk**

The fourth general principle is to encourage intelligent risk taking by everyone associated with the company. Risk taking is a skill, and people improve with practice. Cross-training in non-business applications is particularly valuable. This value applies to employees, customers, suppliers, partners and investors.

Encouraging risk doesn’t mean that everyone involved with the company has to spend weekends gambling in Las Vegas or running *Mission Impossible* capers. Many forms of risk taking are available, from travel to meeting new people to taking courses in new fields – the range is infinite. Some of these forms are socially favoured, such as learning a new language, and some are socially disfavoured, such as making money gambling. To a risk manager, they’re all ways to learn and hone risk-taking skills. It’s hard to have an intelligent conversation about risk with a person completely unfamiliar with the concept, or worse, really bad at managing it.
Chapter 4
Managing Financial Risk

In This Chapter

- Interacting with financial markets
- Thinking of finance as a game
- Staying balanced
- Managing to survive the market

Risk managers don’t work in a vacuum, and they aren’t omnipotent dictators. As a risk manager, you need to set up a system for managing risk; you can’t make it up on the fly. You need to think about the data you’ll rely on, the calculations you’ll do, and the actions you’ll take. Doing so requires planning and accommodating a range of factors including budgeting, staffing, information technology (IT) resources and more.

At the same time, you don’t want to let the system degenerate into a bureaucratic box-checking exercise. Systems and planning are essential, but by themselves they’re worthless. The point isn’t to let the process dictate everything you do, but to take care of the routine details so you’re free to use your brain for creative thought.

Think of a system of sentries watching the perimeter of a military camp. If you do nothing else, the sentries don’t help. They won’t stop an attack of any significant force, and stealthy attackers can always find a way to evade the sentries. However, if you set up a good system of sentry routes, and you make sure the sentries are vigilant, you get warning of almost any attack. If you also have plans to make use of the additional warning time, you have reduced your risk. Setting up systems of limits and reports and other tools is the same. By itself, the system does no good, and a sign of weak risk management is over-attention to formal rules. On the other hand, if the systems are designed well and taken seriously, they can be combined to deliver strong risk management.
Looking at Financial Markets

Academics who study finance but don’t actually work in the field have developed two main views of financial markets:

- **Information aggregation:** Economists tend to treat financial markets as mechanisms for evaluating information and using it to set prices, which in turn regulate economic activity.

- **Random walk:** Finance professors tend to treat markets as random walks. In a *random walk*, future price movements don’t depend on past movements. The metaphor is a drunk person taking each step in a randomly chosen direction, as opposed to a sober person whose steps can be predicted by the path she’s on. Of course, these finance professors don’t deny that markets process information and set prices, but if today’s price incorporates everything known today, then the move to tomorrow’s price must be unpredictable, or random.

A third view of financial markets is seldom taught in universities, at least not in economics departments and business schools. This third view holds that financial markets are a game – a claim usually made by critics of markets. Financial markets are a casino, a legalised form of gambling with financial institutions getting rich by taking a small edge from everyone’s bets; or financial markets are a rigged game designed to separate customers from their money; or financial markets are a playground for rich insiders to wreak havoc on the real economy.

Although all three views have their uses in risk management, the information aggregation and random walk views are more suited to trading, portfolio management and other risk-taking businesses. Modern financial risk management is more concerned with the game-like aspects of financial markets. More important than preferring any one view, however, is to make sure that you keep all three views in mind at all times. Concentrating exclusively on any one view guarantees that you are blindsided by one of the others.

If you believe that markets aggregate economic information, you expect
prices to reflect reality. They move in response to news and to changes in
supply and demand. These movements may be hard to predict before the fact,
but they should be explicable afterwards. Most of the time prices should
move smoothly, and the range of possible movement should be calculable.
The big risks are sudden changes such as crashes, liquidity squeezes and
realignments; deviations from rationality such as bubbles, panics and
intervention; and miscalculation. This view of risk is popular in academic
circles, mainly because it provides a lot of material to teach. However, it
remains a minor aspect of practising financial risk managers.

If markets are random walks, there’s no point is trying to predict price
movements beforehand or to explain them after the fact. Instead, risk
managers should focus on the probability distribution of future price
movements. The big risk is getting an extreme outcome that was assigned
negligible probability beforehand. Front-line risktakers have responsibility
for accurately estimating probabilities for known risks. Risk managers
concentrate on the plausible extreme outcomes, which are events too rare or
too extreme to put faith in any probability calculation, but that may happen
and that would have extreme impact if they did.

In both of these views, the financial market is impersonal. It doesn’t know
who you are or what you want. However, financial markets are composed of
people, and some of those people do know who you are and what you want.
Moreover, groups of people can interact to produce results that aren’t
explainable in fundamental economic terms or in terms of random draws
from impersonal probability distributions.

Risk management in a game can be quite different than managing
impersonal risks. When nature is choosing the outcomes, you can
usually tell how to reduce risk. When playing with people, on the other
hand, building a defence may invite attack, and success can encourage
others to ally against you.

Most investors in the stock market are long investors – they buy stocks they
think will go up, so they can sell them later at the higher price. Short sellers
reverse the order; they sell stocks they think will go down, so they can buy
them back later at a lower price. If you think of markets as aggregators of
information, short sellers are the same as the long investors; they’re just
expressing opposite opinions about whether the stock is overvalued or undervalued. If stock prices are a random walk, the short seller’s return has the same probability distribution as the long investor’s return, just with the sign reversed. So, short sales and long investments are managed the same way with respect to risk.

However, anyone involved in equity markets knows that short sellers have much greater risks than long investors. One major reason is short squeezes. These squeezes occur when market participants decide that short sellers are too weak to accept large losses on their positions and that if the price starts to go up, short sellers are forced to cover – that is, to buy back the stock they sold earlier, closing out their position. This stock purchase pushes the price up higher, which forces more short covering, and eventually results in large profits for the buyers and large losses for the short sellers. Notice that the short squeeze has nothing to do with the economic value of the company, and it was not a random walk of any sort. It was based on perceived weakness of the short sellers.

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**Gambling with risk**

I write a lot about gambling in this book, which begs the question, ‘Why do financial risk managers have such a reputation for being enthusiastic gamblers?’ I don’t mean gambling in the broad sense, I mean in the narrow sense of playing poker, betting on sports, going to casinos and so forth.

To some extent, this makes sense. No one would hire a risk manager who would go into a casino and lose or someone who was afraid to walk into a casino. If you can’t beat the house in a casino, or hold your own at the poker table, or beat the spread in sports betting, you’re not going to have much success at the more difficult risk problems that occur in business and life.

On the other hand, gambling is usually a pastime of people who like risk – thrill seekers. Risk managers should have a sober and prudent view of uncertainty; and in fact plenty of risk managers don’t gamble (in the narrow sense) at all.

Gambling is still important to risk management. Gambling is important historically because the people who invented the field and the prominent early practitioners all learned their early lessons gambling. However, none were drawn to it by thrill seeking; instead, casinos were valued as laboratories for exploring ideas about risk. Probability theory was originally based on betting games, and going to real casinos, and real card tables and real horse races taught a lot of details the theory missed. Moreover, gambling gives you reliable feedback – if the casino pays you money, it does so not because your ideas sounded good or stroked egos or supported conventional wisdom; it pays you money because your ideas are right. In addition, the casino gives you lots of feedback – thousands of results a day, much more than you get in other activities, even most financial trading.
Finally, gambling is important for credibility. You can imagine what a trader thinks of a gal who wants to give advice about billion-pound portfolios, but who won't risk £10,000 of her own money on her financial projections or a sporting contest. Alternatively, imagine what anyone would think of someone who claims to be the firm’s expert on risk but can’t be bothered to enter the office NCAA pool.

You don't have to be a gambler to be a risk manager, but it helps as long as your skill in risk leads you to gambling rather than your love of gambling forces you to develop skill in risk.

Playing the Game

Most people who think of financial markets as a game are critics of finance. However, if you think about it, games are important in society. How do we decide legal disputes? We have a trial, a game in which both sides contest the verdict. We promise people a fair trial, which is a game concept; we don’t promise the court will always reach the correct decision. We select juries by lottery as we would in a game, we don’t try to find the most knowledgeable judges. We don’t allow double jeopardy, because it would be unfair to replay the game after someone has already won, even if new evidence clearly shows that the original outcome was wrong.

Bigger questions are decided by elections, and again we promise fair elections, not wise results. Campaign rallies are festive and playful; with music, chants, food treats and drink. They’re not sober gatherings to discuss issues. Even bigger issues are settled by wars, which are neither fair nor fun, but are unquestionably contests with winners and losers.

In all these cases, the reason for the game is to get social agreement on questions that cannot be answered rationally to everyone’s satisfaction. We don’t know whether A murdered B, but we can’t let some people treat A as a murderer and the others treat her as innocent. Historically, that leads to someone killing A in revenge, and someone else regarding that as an unjustified murder, generating a cycle of violence. So we play a game. If A loses, she’s treated as a murderer by everyone; if A wins, she’s treated as innocent by everyone. The verdict may be factually incorrect, but it solves the social problem.

Similarly, we don’t want some people taking direction from one person, while others follow a different leader. We play a game, pick a leader and everyone is supposed to go along. We don’t know how to always get the best person for
the job, but we need a process to select someone. When elections and other social mechanisms for enforcing agreements break down, no choice remains other than war.

Remember that the game doesn’t mean we don’t care about justice in a trial, or choosing the best person in an election, or who is right or wrong in a war. The first two games at least are designed to find the right outcome if it can be done. Getting the right outcome, however, is less important than being fair to all sides (which is the only way the losing side is going to accept the verdict), and being fair is less important than delivering a clear answer.

**Relating poker and risk management**

‘Sometimes you got to play your hand, sometimes your cards ain’t worth a dime if you don’t lay ‘em down.’ So goes an old blues line in a song about poker. Most of the time, money is won or lost in poker without any player revealing his cards. Player make bets and form judgements about other people’s likely cards from their bets (plus whatever information they can glean from body language and other observations). This situation is known as *playing your hand*. On most hands, all but one player gives up before showdown.

But sometimes, you have to *lay down your hand* (that is, expose your cards) or *muck your hand* (throw your cards away and concede the pot). That’s when ‘your cards ain’t worth a dime if you don’t lay ‘em down.’

Risk management is usually like the series of relatively small, calculated decisions that go into playing your hand. But never forget that showdowns happen in life as well as poker, and then only your cards matter.

**Inventing the market**

Imagine a world with no organised stock market. Companies issue stock and people buy it, but they don’t buy much. Companies cannot easily find buyers for their stock, and those buyers cannot count on selling the stock if they need the money later. No one likes to transact, because it can be hard to estimate the value of the securities. The economy is stalled because businesses don’t have easy access to cheap capital, and investors don’t have easy access to attractive diversified investments. This scenario describes most of the world for most of human history.

A bunch of people gather somewhere, say under a buttonwood tree in lower Manhattan. Some of them are portfolio managers who own stock but would like to trade it for stock in another company. In other words, they think that
stock A is worth more than stock B, but without knowing the absolute price for either stock, they have trouble transacting. Other people have information. That is, they think that stock A will be worth more tomorrow than today, but they don’t know the value today, and they can’t be sure of finding a buyer tomorrow. Even if they can find a buyer, they aren’t sure that the price tomorrow will fairly incorporate their information. The result is that no liquidity, no price setting and no information are brought to market.

One other person happens to wander by that day – a gambler. She knows even less about the value of stocks than anyone else, but she’s a keen judge of people. More importantly, she enjoys taking a risk. Meandering through the crowd, noticing body language and voice tone, she concludes that there were more people there who wanted to buy stock A than to sell it.

She picks a price at random, and starts offering to buy stock A for £10. No one was anxious to transact, but everyone was interested in observing a live buyer. The fact that she could find no sellers for £10 told everyone that stock A must be worth at least that much, which added to the crowd’s net buying interest.

Eventually the gambler bought some shares for £12, and started offering to buy for £13. As the price went up, more people sold, but more other people started offering to buy. The price rapidly went up to £60.

At this point, the gambler sensed the mood turning. Many of the buyers already had the amount of stock they wanted, and the holdouts weren’t going to come into the market any time soon. Lots of sellers had been watching the price go steadily up, so the gambler knew that at the first sign of reversal there would be a rush to sell. So the gambler slowly and quietly began to sell her accumulated stocks. The price tumbled down to £25, at which point there was another reversal. After a few wild oscillations, a steady market for the stock settled down around £40, and which point there were roughly equal numbers of buyers and sellers.

From that day forward, stocks were much more valuable, because their value could be determined quickly, and they could be easily converted to cash at a fair price. It paid to bring information to market, so prices were also informed. However, occasionally liquidity would dry up due to sudden news, shifts in investor mood or large uncertainties. So a healthy population of gamblers hung around the market ready to earn money returning it to
liquidity aftershocks.

Of course this story isn’t literally true, but it explains a few important facts about financial markets:

- Traders usually have only superficial information about what they trade, and often not even that. They look and act more like gamblers than like investment analysts.

- Financial market prices are far more volatile than can be reasonably explained by changes in fundamental economic information.

- Market prices are not particularly accurate when measured against economic value calculations or supply-and-demand analyses, but they’re extremely fair in the sense that people find it hugely difficult to make consistent money predicting their future course.

- Wherever they’re introduced successfully, financial markets touch off explosive economic innovation and growth.

The other important takeaway from this story is that markets serve their function by setting prices investors regard as fair, whether or not those prices make much economic sense. Of course the situation is better if the prices are rational, but that’s less important than that people accept them for trading – and that is less important than that a price exists at all. With prices and active trading, financial markets are a major driver of economic growth and a means for the majority of the population to earn financial security through their own efforts.

For a financial risk manager, the important thing to remember is that many aspects of financial markets are designed to make trading in them fair rather than to link prices to economic reality – just as aspects of trials and elections are there for fairness rather than to ensure justice or guarantee wise leadership. You can be absolutely correct in your economic analysis and estimate the probability distribution of future price movements perfectly and still go broke because the market outplayed you. In fact, precisely this experience is what led people to invent modern financial risk management.
Assessing accuracy

A good deal of financial risk arises from possible differences between the price of an investment and its economic value.

Think about a stock: In theory, its value today derives from its expected future cash flows. So to value a stock, you need to guess what its future cash flows will be, or how much it will return to investors in dividends or other payments. In addition, you need to estimate an appropriate interest rate at which to discount future flows. Money in the future is worth less than the same amount today due to interest rates. For example, if interest rates are 5 per cent per year, £1.00 today can be turned into £1.05 in a year, so a cash flow of £1.05 in a year is worth £1.00 today. (It also means that £1.00 in 35 years is worth only £0.18 today.) Projecting those future cash flows is pretty daunting when you consider that the discounted future cash flows of a typical stock over 35 years represent only about half of its purchase price. So to set a value on a stock, you need to think about the cash flows it can return over many decades. Imagine going back in time 50 years and guessing how various companies would be performing today.

After you make your guesses about cash flows, you have to set an interest rate. Some theoretical approaches can help in doing that, but none of them gives reasonable values. The only practical way to approach setting the interest rate is to look at what people pay for other stocks, or sometimes for other risky investments. That can tell you whether one stock is worth more than another, but not what the absolute value of either stock is.

Another way to think about it is to consider what happens when accountants go through and add up the value of all a company’s assets. The tangible assets account for only 16 per cent of the value of the average large stock. The value goes up a little more when you add intangible assets that at least can be identified such as patents and brand names. However, almost all the value of a large company consists of its going concern value – the amount the company is worth because the people and assets are organised in such a way that the company makes money. I’m not talking about Internet start-ups that sell for billions despite having no assets, no earnings, no revenues and no solid plans; I’m talking about solid, established companies. Most of the value in the economy comes from things that cannot be seen or measured and that can change overnight without obvious reasons.
What’s true for stocks is true for other financial instruments as well, although perhaps in less extreme form. But how do you set a value for even for the simplest possible financial instrument – a pound note? A pound is worth what can buy, nothing more or less, and what it can buy is what other people value it at. If you can’t come up with a fundamental value of a pound in your hand today, how can you hope to price anything that pays uncertain amounts of pounds over its long-term future?

Now, I’m am overstating things a bit. Ways to try to get estimates of true economic value do exist, but they have to allow for wide variation. The great financial economist Fischer Black thought that markets got the right price within a factor of two about 90 per cent of the time, meaning that a stock selling for £50 has an economic value between £25 and £100 90 per cent of the time (£25 is £50 divided by a factor of 2, and £100 is £50 times 2). Ten per cent of the time the economic value is less than £25 or more than £100. I knew Fischer pretty well, and he didn’t throw numbers like those around lightly; he thought long and hard about them, even though they sound like the kind of rough figures other people would come up with quickly. We argued quite a bit about them, and I pushed for ‘within a factor of two about half the time’.

For most purposes, half the time or 90 per cent of the time doesn’t matter much. If stocks are overpriced by a factor of two when you buy them and when you sell them, you lose because you receive only half the dividends you otherwise would. (If the stock prices were cut in half, you may have bought twice as many shares and received twice the dividends, but it would make no difference to your profit or loss on the sale, as long as the degree of overpricing was the same when you bought as when you sold.) However, it matters tremendously for risk if prices can snap from overvalued by a factor of two to undervalued by a factor of two – that is, go from £100 to £25 just because mood shifted. And ten per cent of the time, the price can move more.

**Playing fair**

People must trust financial markets if they’re to work. I’m talking about an extreme level of trust. People must put their life savings into the stock market for decades, trusting they will get a decent retirement income in return. How can they do that if they may be buying stock at twice its value, and may sell it in retirement at half its value (and ten per cent of the time things may be
worse)? Or how about a person who has to give up her family’s annual vacation in order to pay the heating bill that recently doubled, if the doubling may be merely a whim of energy traders rather than anything to do with supply and demand for heating fuel?

These questions are not of merely academic interest to a financial risk manager. Historically, most of the largest events in finance came less from the internal workings of financial markets than external changes forced by changes in social attitudes. Markets have been abolished, financial contracts have been rewritten by legislatures or courts, outcomes have been changed by taxes and institutions have been reshaped beyond recognition by regulation – not just government actions, either. The attitudes of individual savers and investors determine financial values, and those attitudes can shift suddenly. Also, this situation isn’t true only for major shocks; every day the financial markets respond to ebbs and flows of regulator and investor sentiment.

The bottom line is that people generally trust markets enough to make finance work if the markets are perceived as fair. Yes, an investor may be buying stocks at twice their value, but if no one knows whether stocks are overvalued or undervalued, she’s getting a random coin flip, and she’s willing to take that chance given that there’s no alternative. Yes, the family vacation may be a casualty of some energy trader’s indigestion, but if that indigestion is random and not malicious, she’s as likely to be gaining as losing from the market’s inaccuracy, and over her lifetime the luck probably averages out.

People tolerate evidence that the market is inaccurate – wild gyrations in prices with no economic explanations, prices moving in the opposite direction of calculation, unsustainable prices during bubbles and stupid low prices in panics – but react strongly to any evidence or claim of rigging.

The same thing is true with other social games. In the United States, when DNA analysis showed a shocking rate of wrongful convictions in some of the most serious cases, it didn’t cause a reappraisal of the criminal justice system. But when statistical analysis showed racial disparities in death sentences, it led the Supreme Court to suspend the death penalty for years, even though racial disparities are ubiquitous in society. Similarly, elected officials are exposed as criminals, frauds and incompetents every day, and it does not threaten democracy. Yet when the 2000 presidential election called attention to sloppiness and political interference in vote counting, it nearly led to a
Constitutional crisis.

But even more important than fairness is decisiveness. Courts and elections must produce clear verdicts. Markets must set prices. The biggest market crises come when people cannot transact, or when transactions are disputed, or when market institutions break down or are closed. A person saving for retirement wants a fair game, but even more important than that is the ability to sell her stock when she needs the money.

Fairness isn’t an issue just with the general public. Financial markets have to be fair in order to attract participants. For example, the markets rely on many individuals to bring news to the market by trading. Suppose an engineer analyses a prototype of a major new product and decides it won’t perform well and can’t be readily manufactured. She can bring this information to market by shorting the manufacturer’s stock – selling borrowed stock at today’s price, then buying the stock back later at what she hopes will be a lower price.

But the engineer is in no position to compute the value of the company’s stock in absolute terms or to analyse everything else that may affect the stock price before the bad news about the product spreads widely enough to be reflected in the price. So she knows she’s taking a lot of risk. If that risk is fair, she may be willing to short the stock, knowing that she could be right and lose money. But if she’s right more than she’s wrong, she should make money doing this kind of thing in the long run. If prices are unfair, or if she thinks she may not be able to transact in the future, she won’t bring the information to market.

Maintaining Equilibrium

Equilibrium, meaning the balancing of forces, is an important concept in finance with essential implications for risk management. The simplest example is balancing supply and demand to set a price. If there’s excess supply of something, the price falls. The lower price encourages people to buy more of the item and discourages people from making more of the item or bringing it to market. As a result, the excess supply is bought up, and
equilibrium is restored at the new price – supply and demand balance.

**Feeding feedback**

A concept related to equilibrium is *negative feedback*. The reason you get equilibrium in the simple case is that, when the price is too high, the market generates forces that lower the price; and if the price goes too low, it generates prices that raise it.

Imagine an isolated country with no cars. The first car would cost a fortune to make, it would have to be assembled by hand from general purpose parts by people who made up the design as they went along. There wouldn’t be many suitable roads for it, and no gas stations, mechanics, spare parts or other necessary accompaniments. There would be no demand for cars, even at low prices, and no supply, even at high prices.

But suppose somehow people start building and using cars. As more cars are built, the cheaper each one gets (this situation is called *economies of scale*) because people discover how to do it better and can make things more efficiently on a large scale. The more cars get sold, the more infrastructure is built to support them – roads, gas stations, repair shops and so forth – so the more valuable each car is. Thus more cars means more cars and there’s constant growth rather than equilibrium. This *positive feedback* can lead to instability instead of equilibrium.

Of course, this growth doesn’t go on forever. At some point, demand for cars hits a ceiling. Moreover, you start running into shortages that increase costs, such as space to build roads or oil to power the cars. Of course, this story isn’t just true of cars, but true of almost any economic innovation. Rather than growing slowly and steadily, a new product experiences periods of positive feedback that first act as a barrier, but if the barrier is surmounted the positive feedback can power explosive growth. The growth eventually hits a negative feedback constraint, which may result in a stable equilibrium, or may send things spinning off in a new direction – a new region of positive feedback or a path to hit a new constraint.

This interplay of negative and positive feedback does not occur for one product in isolation. At any one time millions of innovations are pursuing their own chaotic paths, interacting with each other in unpredictable ways.

**Explaining prices**
The market system is far too complicated to predict or control, and yet it exerts powerful influence over everyone’s lives – even if you don’t invest in it. The market determines how rich or poor individuals are, how robust the economy is, how the environment is treated, who wins wars, what goods and services are available at what prices and what kind of work is available for what pay. Individuals can try to go off the grid (sever connections with the global economy and rely on self-sufficient production and barter with local individuals) but doing so is pretty difficult, and the global economy has a way of finding them.

The problem has been addressed by many people in many different ways. I want to separate the political or philosophic resolutions, which you don’t need to worry about for financial risk management, from the practical empirical assertions about how markets work. The reason I even mention the former is that people commonly make the mistake of taking positions for political or philosophic reasons and applying them to financial decisions. This mistake is disastrous. If you want to survive in finance, leave your politics and philosophy at the trading room door.

First, I dispose of all economic theories that don’t allow for financial markets or that ignore them. If you think that you can replace the chaotic interplay of free market prices with top-down organisation, or that the real economy can manage itself without a bunch of speculators playing with other people’s money, then you have no reason to understand financial risk management.

That still leaves a variety of subtle shades of belief, but for financial risk management purposes, I can divide them into three main groups. Each group highlights an important insight for financial risk managers, but blind adherence to any one group leads to overlooking major sources of risk. The three economic views loosely correspond to the three views about financial prices that I discuss in ‘Looking at Financial Markets’ earlier in this chapter.

People who think in economic terms – economists – tend to think of some theoretic set of equilibrium prices that would clear all markets, meaning that there would be equal demand to buy and sell everything. Equilibrium is constantly moving, and although actual market prices are pulled toward the equilibrium, they can be pretty far away for reasonably long periods of time.
In the economic view, there are two types of financial risks:

- The risk of the equilibrium moving, which is a *signal* — a real change that can be expected to persist.
- The risk of actual prices moving relative to the equilibrium, which is *noise* — a meaningless change that can be expected to average out over time.

People who think in financial terms — finance professors — tend to think of an equilibrium of expected future price changes. The expected return on any security should be a function of the degree of uncertainty around the expectation. Again there are two forms of risk:

- The risk that you have the wrong model of uncertainty or have misestimated the parameters, so your portfolio doesn’t have the probability distribution of return you intended.
- You get a bad draw from the probability distribution.

As in the economist view, the first risk persists while the second risk should average out over time, although the time for that can be decades, so the second risk can still matter. Economists usually expect reversion within months.

Economists tend to think about equilibrium between suppliers and demanders of goods and services, while finance professors tend to think about equilibrium between investors and businesses — in other words, suppliers and demanders of capital. Both are no doubt important, but from a risk standpoint, considering equilibrium among market participants is more important. This consideration is what produces the most dramatic and unexpected changes — and the changes you can do the most about. It’s also the aspect of financial risk management that requires by far the most work.

Managing risk that arises in the real economy, or between real money investors and entities raising capital, is pretty much limited to basic due diligence and diversification. You think about what may happen, prepare
for any foreseeable outcome and don’t bet too much on any one outcome. However, managing risk that arises from the interactions among financial intermediaries requires far more complex and detailed strategies. These strategies are how financial risk managers earn their pay – and also how they get fired.

In order to provide fair, liquid prices, financial markets need to attract a number of different kinds of intermediaries including traders, brokers, dealers and asset managers and others, and many types of each. All these people stay in a market only if they get paid on average. The money they make means providers of capital earn a somewhat lower return than the users of capital pay, the difference (called a spread) providing income to market intermediaries.

Financial markets compete with each other to offer lower spreads to end users, better liquidity, more fairness and more accurate prices. You can find many different models, for example some exchanges rely primarily on high-frequency traders (firms that use high-speed data access and computers to make thousands of orders per second) to provide liquidity, while others rely on dealers.

Although each model carries its own specific risks, the large general risk is that the effort to reduce spreads (to lower prices for end users, attract more of them and to increase profits for exchange owners) cuts the return earned by a crucial intermediary and leads to some kind of market failure such as a liquidity squeeze, bankruptcy of key participants, prices out of line with supply and demand or other problems. The opposite risk exists as well. Sometimes a market niche becomes too profitable and gets overcrowded. That never lasts forever, and when the shakeout occurs things can get messy.

A less dramatic problem, but one that actually does more long-term damage, is that the competition among intermediaries within an exchange, and the competition among exchanges and exchange-alternatives, subtly distorts prices in a way that disguises the risks and returns of a strategy.

**Surviving**

If financial market prices were accurate reflections of economic reality, you could survive by putting together economically sensible portfolios and
relying on the actual cash flows and asset values to give you a reasonable return. Your only worry would be that you misestimated those cash flows or asset values and overpaid for your portfolio. Even in that case, however, you wouldn’t expect sudden or extreme losses, as true financial information doesn’t come out all that fast.

If financial market prices were a random walk, then you could survive by never betting more than you can afford to lose and by making enough diversified bets to beat the house in the financial gambling game. You may go through downswings of bad luck, but if you keep your bets small enough and cut them further after losses, you should be able to survive until the luck averages out in the long term.

But if financial markets are a game, you have much more complex worries:

- Sudden and extreme price moves due to no news at all – just a shift in sentiment or the unexpected consequence of some small, faraway event
- The game going wrong and no prices being available at all – a liquidity squeeze
- A period of irrational prices that lasts for minutes (like a flash crash, a short period in which market prices move huge amounts for no obvious reason, and then return to near where they started) to years (like bubbles and crashes)
- Being the victim of some other players’ strategies
- The chance that someone changes the rules, which happens in financial markets

In reality, you need to worry about all these things to survive for the long term. You need strategies backed by solid economics, with lots of diversification and intelligent bet-sizing, that have been stress-tested under extreme conditions and by paranoid people.
Chapter 5
Functions of a Financial Risk Manager

In This Chapter

- Starting with traders and trading
- Dealing with bosses and other higher-ups
- Sharing information internally and with boards and regulators

Risk management is done in institutions – mostly large financial institutions. This fact makes life more complex than if you were risk managing your personal trading. When done for a large institution, risk management goes beyond the normal adjustments everyone makes in their investment portfolio.

Risk management today isn’t quite a profession, with traditions and standards like the ones that lawyers, actuaries or accountants adhere to in balancing corporate needs and professional responsibilities. But it is much more visible than it used to be.

Some features of institutions naturally lead to bad risk management, and this chapter shows you how to stay vigilant against these. It also discusses ways to build good risk management into institutional structures, which is both easier and more effective than trying to manage all risk directly.

Developing from Traders and Trading

Modern financial risk management was developed on small trading desks in the late 1980s. Some risk managers were part of large institutions; others ran small hedge funds or traded their own money. Early risk managers were mostly quantitative traders, traders who rely on sophisticated mathematical analysis to determine their trades, as opposed to qualitative traders who use things like market feel or superior information. However, they borrowed a lot of accumulated wisdom from qualitative traders.
I start this section with risk management in trading situations for two reasons:

- In many ways this type is the simplest form of modern financial risk management, so it’s the easiest introduction to the field.
- Many of the concepts and names that financial risk managers use today were derived from the trading floor. If you learn these ideas and words in their original context, you’ll find it easier to keep them straight.

**Trading types**

Wall Street has many kinds of traders. I mention quantitative and qualitative traders in the preceding section. A more basic distinction is that some traders are primarily or exclusively execution traders (the disparaging term is *order takers*). *Execution traders* get instructions from portfolio managers or other risk takers and are responsible for executing those instructions efficiently. A *market-making trader* executes trades with customers, and makes a *spread* by quoting a slightly lower price at which he will buy than the price at which he will sell. This trader is allowed to run up some positions as a market view or due to unbalanced customer supply and demand, but the amount of risk he can take is limited.

A different kind of trader, a *proprietary (prop) trader*, discovered the need for sophisticated quantitative risk management. These kinds of traders make their own risk decisions and are allowed high levels of risk. The term *prop trader* applies to someone with this job in a bank. The same sort of trading is done by individuals who trade with their own money and in some hedge funds. (In some hedge funds the traders make the key risk decisions; in other hedge funds portfolio managers make the decisions and traders execute those decisions.)

Most traders specialise in certain segments of certain markets. A trader may concentrate on technology stocks, or Asian currencies, or UK interest rates, for example.

Another important distinction is time horizon. Some traders buy or sell hundreds of times a day, and rarely hold positions for more than a few hours. (The last 20 years have seen the development of high-frequency computerised trading that can make hundreds of thousands of trades per day and hold positions for only a few seconds or less.) Other traders put on
positions that last, days, weeks or months.

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**Trading then and now**

Of course people have been trading for millennia and evolved all kinds of sophisticated techniques to manage risk. However, changes in technology, markets, regulation and financial knowledge led to an essentially different trading environment by 1987. The kinds of bets available to the most sophisticated professional traders were much more complex, much larger and with much smaller edge than in the past.

To simplify a bit, a trader in 1960 may have made ten £1,000 bets per day, and won 60 per cent of them. This rate of success leads to an average gross income of £500,000 per year, but even in a bad year the trader is unlikely to make less than £400,000. By 1987 that same trader may have made one £1,000,000 bet per day, and won 51 per cent of them. That leads to ten times the average income – £5 million per year – but in a bad year he could lose £27 million or more.

The actual mathematical underpinnings were more complicated, but the basic concept is correct. In 1960, traders could mostly concentrate on making money. If they followed common sense and well-known rules of prudence, risk was not a big issue for them. (Of course, then and now, common sense isn't particularly common and prudence is even rarer, so traders frequently went broke.) By 1987, this situation was no longer true and success in trading became more about managing risk than finding good trades. However, this insight was initially confined to quantitative prop traders.

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**Findings from tracking trades**

The first thing any quantitative person does when tackling a new problem is to gather some data. The data in 1980s era trading and accounting systems was woefully inadequate, and published financial data was sparse and inaccurate. So the proto-risk managers of the day, including me, started compiling voluminous data into personal computers.

The first finding that emerged from studying financial data was that virtually everyone, including the most experienced and successful risk takers, bet more when they were wrong than when they were right. This bias is a strong behavioural one that has been documented among all sorts of risk takers. Therefore, almost all traders would be better off making every bet the same size, instead of betting more when they were more confident.

Two other major findings about trades and traders are less universal:
It was easy to spot better and worse trades ahead of time. A risk manager analysing the past results of a trader could make useful suggestions about which ones to make bigger, and which ones to make smaller – or not make at all.

Most traders consistently underbet. That is, they could be more successful with less risk if they made larger trades on average. It may seem counterintuitive that making larger trades can reduce risk, but making larger trades when they’re attractive can build up extra capital to survive drawdowns when trades are marginal.

Most of this work was done in 1988 and 1989, and it was exclusively focused on prop traders and hedge funds. A person way ahead of his time was Ed Thorp, the mathematics professor who invented blackjack card counting in 1960. Although lots of people know of that accomplishment, not as many remember that the following year Ed addressed the American Mathematical Society with a lecture titled ‘Fortune’s Formula’. The message was that long-term success in blackjack did not require just counting the cards to get an edge, it required that players know exactly what their edge is at all times and make the appropriate size bet given their situation.

By 1990, most quantitative trading desks and the sophisticated qualitative ones adopted the idea that choosing trades and deciding on trade size were two different issues and often benefitted by being assigned to two different people. Proper sizing required careful consideration before the trade about possible outcomes and rigorous checking of those risk estimates afterwards. The goal was not to minimise risk or to prevent disaster; it was to select the optimal level of risk to maximise long-term success.

A whole new set of mathematical techniques was developed for this effort. None of these techniques was from traditional academic areas like probability theory, statistics, economics or finance. Some of them came from old papers on philosophy of probability and logic. Russian applied mathematicians who were flooding Wall Street at the end of the Cold War provided a good portion. Although people today tend to belittle the sophistication of the Soviet Union economy, it required extraordinary skill in applied mathematics to make it run as well as it did, and many brilliant theoretical mathematicians were running the economy (in many cases, barred from top universities because they were Jewish or lacked the proper connections). This body of work survives today.
mostly in financial risk management; the original work was often secret or unpublished and was rarely translated.

**Coaching the risk takers**

The *front office* in a financial institution is any department that generates revenue directly. It can include traders, loan officers, portfolio managers and other risk takers.

Being a manager in the front-office risk management style is like being a coach. You observe the risk takers carefully. A lot of your efforts are devoted to getting risk takers to specify their expectations and goals carefully in advance, then monitoring how well their actions and outcomes match their plans. You try to optimise the level of their risk taking without getting in the way of their decisions, like a coach trying to bring out individual players’ instincts and talents while keeping the whole team in sync. Doing the job well requires three things:

- A deep knowledge of the specific risk-taking application. A coach doesn’t need to have been a great player, in fact great players often make poor coaches, but a manager does need to have a thorough understanding of how to play the game.
- Psychological insight, especially with respect to risk decision making.
- A thorough knowledge of the mathematics underlying financial risk management.

Front-office risk managers make use of the tools described in the rest of this book, but most of their job is done through informal personal interaction. No matter how good a front-office risk manager is in professional terms, he cannot do any good without the respect and confidence of the risk takers.

**Running the Middle Office**

The success of financial risk management in front office departments led in the 1990s to its introduction in the back office, historically a Spartan, unseen place where clerks in shirtsleeves processed transactions. However, risk managers were front office people – many front office risk takers wouldn’t accept back office positions out of Wall Street cultural prejudice and fear that
it would be a one-way career move. It was always easy to move from the front to the back office, but harder to go the other way.

The solution was to create the term *middle office*. The term isn’t well defined, perhaps the most common meaning is departments that require traditional front office skills while doing back office jobs. The only universal agreement is that firm-wide risk management is a middle-office job, but other groups such as treasury, financial control and information technology sometimes stake claim to middle-office status.

Not all risk management jobs are middle office, in fact only a small minority are. Back-office risk management has by far the largest contingent of risk managers, with thousands of employees and offshore contractors in a large global financial institution. Front-office risk management is the next largest, with perhaps hundreds of employees in a large bank scattered throughout the risk-taking departments. Middle-office risk management is generally a small department with responsibilities such as setting risk policy, risk methodology (the quantitative methods used to assess and control risk) and *model validation* (making sure that the firm’s models actually do what the model documentation claims they do).

**Reporting Requirements**

The latest step in the evolution of modern financial risk management came in the late 1990s when regulators began to insist that risk managers be independent. Financial risk managers began organising into professional associations – first the Global Association of Risk Professionals, from which a dissident group later spun off to become the Professional Risk Managers International Association. These organisations gave risk managers professional contacts and support to maintain standards. Another source of external support for best practices came from stakeholders like investors and customers and arbiters like rating agencies and auditors.

Independence meant risk managers reporting to other risk managers up to a chief risk officer (CRO) who would speak directly with the board of directors and regulators. Most firms split off front office risk management and had front office risk managers continue to report to business heads. But middle office and back-office risk managers had their day-to-day activities directed by a chain of command that went up to the CRO, and this direction was also
the source of their promotions, raises and bonuses.

In addition, risk management systems were restructured so that today risk information is in controlled systems and validated independently. Front-office personnel cannot change data in risk databases. To the extent possible, the raw data that the risk department uses comes from the firm’s books and records – official data that is carefully checked and controlled – or trusted third-party vendors; data doesn’t come from front-office departments. All of the above means that many sophisticated financial systems have to be built twice – once for the front-office risk takers and independently (and generally in simpler, more robust form) for the risk department.

**Working with the executive committee**

The term *executive committee* refers to the highest group in the firm that directs firm operations. In the places I’m familiar with the executive committee is usually a small group, perhaps five or six people. Different firms have different names for this group, such as strategic planning committee or management committee, but it generally includes the chief executive officer (CEO) and may include other executive officers and business heads. In most cases, the chief risk officer isn’t a member but reports to the executive committee regularly. Other members of the risk staff may be called in for occasional specific discussions.

Although most risk managers, at least in large organisations, may go through an entire career without ever seeing a member of the executive committee except from the back of a large auditorium, the risk department must be oriented toward the executive committee. This group is the one that sets the risk department’s budget and strategic priorities, and the risk department needs its support to be effective. Independence of judgement and independent authority does not mean that the risk department is independent of firm goals.

One of the issues in large financial organisations arises from the fact that the CRO must be a highly capable bank executive. He must manage thousands of people and a budget in the billions. He must navigate the treacherous waters of the boardroom. Companies can struggle to find someone with these skills who is also an expert on financial risk. On the other hand, financial risk management experts are often reluctant to
report to someone without that expertise. This reluctance creates a
tension that plays out in different ways in different organisations.

In smaller firms, the CRO is a risk expert, often the most accomplished expert
in the organisation. Unless he’s an incompetent manager, he’s able to take
care of the staffing, planning, budgeting and infrastructure demands of the
job; and if he is incompetent, he can have a deputy or chief of staff to take
care of them.

The challenge with respect to dealing with the executive committee in a small
firm is the difficulty of maintaining independence within a small group of
people focused on the same objective. In a large firm, the risk manager finds
it easy to do his job and let others in the firm do theirs. In a small firm, he
may find it hard to avoid mixing risk decisions with the strategic goals of the
firm, and the needs and desires of the other people there.

**Supporting the board**

Financial institutions often have multiple boards of directors. A diversified
institution may have a holding company and multiple operating entities,
which may be different regulatory types such as banks or insurance
companies and operate in different countries, as well as non-operating entities
such as mutual funds that require boards. Some of these entities can share
boards, and some directors may serve on multiple boards.

Ideally the risk manager reports to the board that matches his responsibility.
For example, the risk manager for the bank reports to the bank board, and the
risk manager for the holding company reports to the holding company board.
However, this reporting structure may not be the case, and as a risk manager
you may find yourself reporting to the board of a subsidiary or parent entity –
or even to an unrelated subsidiary of the parent of your entity.

Who you report to doesn’t matter as far as your responsibility to describe the
major risks and the policies surrounding those risks are concerned. However,
your other major responsibility is to assure the board that the risks are
properly controlled and managed – or, if they’re not, to tell that to the board
clearly and in detail. In reporting risks and the policies surrounding them, you
function like a technical expert advising the board. You can describe the risks
and policies without being personally responsible for them. But in the second
case, you’re the one making representations and warranties, which really
should be made by the person responsible.

For example, suppose that a global company operates a subsidiary in a country that requires risk management to be done locally. This requirement is usually met by hiring or transferring a low-level risk manager to live in the foreign country and be the nominal risk manager, while risk management policies and decisions are really made by the parent risk management organisation in the home country. (I’m not suggesting anything is illegal here, just that the formal legal responsibility for risk management is held by a person who lacks the actual authority to manage the risk. This arrangement should be done, and usually is done, with the informed consent of the foreign regulator.) The alternative is to build a full risk management organisation for the subsidiary, which would be expensive, and would create difficulties in coordinating with the global organisation. The trouble with this set-up is that the nominal risk manager doesn’t have the authority or experience to do a good job reporting to the foreign board, and the parent company CRO from the home country isn’t the legal risk manager. This situation is resolved in different ways in different organisations. Usually the foreign company risk manager and someone from the home office attend the board meetings, and the home country person does most of the talking.

The main advice I have about board reporting is to think of it as an ongoing educational exercise rather than a checklist. Of course you go over the major risk metrics and any incidents that rise to the board level of importance since the last meeting. However, if you do only this, your relation with the board is likely to remain superficial.

I suggest that you take the opportunity at each board meeting to use an event in the firm or in the market to explore one particular concept in depth. For example, you can inform the board about how to use a particular metric or give them an entertaining rundown on exactly what you and your team do day to day. The accumulation of information from these sessions can lead to a much deeper and more productive relationship between you and the board. This kind of relationship is always helpful, and can be the difference between survival and failure in a crisis.

Financial institutions are increasingly adding risk committees to their boards.
Such committees can be a sensitive issue for CEOs. Because risk permeates the entire business of a financial firm, a risk committee can become almost a shadow executive committee. The risk committee usually gets most of its information from the CRO, who is both a lower-level executive than would typically have that kind of board access and an independent executive. The CEO does not have to be a control freak to worry about a rogue supervisory body blurring the lines of authority, reporting and responsibility. And lots of CEOs are control freaks.

These touchy situations reflect the inherent conflict of having an independent risk organisation within an organisation that requires exquisite teamwork to excel.

**Relating to regulators**

Regulators come in many different types and temperaments. Some are impersonal, and require you to deliver specified reports and answer questions. The information flow is all from you to the regulator. Others are informal and personal and may help you come up with plans that work for both of you. Some relationships with regulators are highly productive; others are or become adversarial.

![Remember]

Having a good reputation with regulators is a huge career asset for a risk manager. Regulators talk to each other, and the grapevine has a long memory.

By far the most important characteristic to a regulator is honesty. If you ever lie to a regulator, even in a debatable or minor way, you kill your reputation. Regulators rely on what they’re told, and if you tell them something that’s inaccurate, it can cause them huge embarrassment and problems. So, don’t fudge facts however much easier it makes your life in the short run. Also, if you ever participate in a financial business that isn’t honest at its core, you reveal yourself to be a person willing to tolerate dishonesty. Regulators are always cleaning up after people like that, and they don’t like them.

In the big picture, you both want the same things. If your business is profitable and makes its customers happy and doesn’t cause financial disasters, everyone wins. You may care more about profits, and regulators may care more about disasters, but that’s a matter of emphasis, not kind.
Therefore, if you have a good relationship with regulators, you usually should be able to get to win-win situations.

Regulators are a great source of information – a way to keep from getting too insular in your risk management. Explaining your policies to someone who sees the range of industry practices is a highly useful exercise; listening to their perspective is just as helpful.

Regulatory relations have one delicate aspect. There will be times in your career in which you’ll find it helpful to have regulatory backing for something you want to do internally. For example, if you requested an increase in headcount for model validation, and it was turned down, you may want to enlist a regulator. You can do this explicitly, but more likely, you choose a more subtle approach. A pause or shrug in a private meeting can send a signal that you think that the firm needs more resources in model validation, which can lead to a couple of words changed in a letter, which you can then use as ammunition to get your request approved. Sometimes risk managers don’t even both with the wink-and-nod, they just assert that regulators will be unhappy unless the risk manager gets his way.

People know when you work to get regulators on your side in a difference with your organisation, and it may be bad for your career. The problem is not just that you’re being disloyal but that short-circuiting the process of going through channels within your organisation is bad for the entire company in the long term. It may improve short-term nominal risk management, but it encourages a check-the-box risk culture. The situation is also bad for your career development as you don’t learn the persuasion and managerial skills you need to do your job without relying on external pull. Moreover, regulators may find themselves being blamed for things that you manipulated them into doing, and they will not thank you for it.

However, if a regulator asks you straight out if a problem exists, obviously, you tell the whole truth. If a problem isn’t really evident but you’d like to win an internal turf battle, leave the regulator out of it. But what if you have a sort-of problem that the regulator sort-of asks you about? Or what if you give
a talk at a professional conference or write an article that leads to a regulator asking your firm to do something? If you can navigate these choppy waters well, you can get a reputation as an effective forward thinker who can build consensus. However, you can easily find yourself getting overturned and seen as a schemer who isn’t on the right side of sound regulation or firm profits.

**Communicating with clients**

For most of my career as a risk manager, I had little interaction with firm clients. The only time I had real communication with clients was during crises or when fear of a crisis was high. Also, this communication was backdoor – risk manager to risk manager based on personal contacts rather than officially scheduled meetings or calls.

Today, client communication is a major part of the risk manager’s job at an asset management firm, and significant client interaction also takes place at other types of financial institutions.

Perhaps surprisingly, in my experience anyway, these meetings are not primarily about the firm’s risk policies and procedures. One of the main topics seems to be pumping the risk manager for suggestions on how the client should manage risk. This situation is obviously a reflection of the tremendous growth in financial risk management, as well as the rapid changes in the financial system. Many clients are hungry for information about how other firms do things – not to evaluate the risk of doing business with the other firm, but for ideas about improving their own risk management.

It’s never a bad idea to help clients, and if an informal risk management consulting makes them happy, by all means do it. No doubt clients will always be interested in new risk ideas, but the real focus of client meetings is to evaluate you, the risk manager, rather than to evaluate the firm’s risk management. The latter is better done by written materials and due diligence questionnaires. The other main topic of client risk management meetings today, and likely the only main topic in the future, is what kind of professional the risk manager is.

This focus leads to requests like, ‘Give specific examples when the risk manager changed a decision and go through the entire process.’ Even if clients don’t make it so obvious, they’re usually looking for signs that the risk
manager does anything at all, and whether his actions contribute to positive consensus outcomes or merely add to conflict.

To do well in a presentation to clients, you have to be an effective risk manager, with a clear idea of what you do and how you add value. I like to begin with the metrics I use to measure the effectiveness of the risk department. Debating the metrics is an excellent way to generate productive discussions about what the risk department does, and what it doesn’t do. General statements such as ‘We encourage prudence and courage’ are useless.

You also need some good stories however. Of course, they should be true stories. They have to show independence, that is, you or your staff made a judgement independent of the front-office risk takers. You can relay how that judgement influenced decisions through systematic processes, such as refusing a trade approval or lowering a limit, rather than ad hoc conversations. In the best stories that judgement kicks off a process in which multiple groups, including the risk department and the front office, supplied information and opinion that was integrated into a consensus decision different from both the initial front-office proposal and the first reaction of the risk department. In other words, it was a win all around!

**Sharing with shareholders**

On 28 January 1997, the US Securities and Exchange Commission (SEC) required companies to make quantitative and qualitative disclosures about market risk and derivatives in their financial statements.

The other information in investor reports is accounting information computed by specialists according to rules, legal boilerplate written by lawyers and read by nobody or text written by top executives and their communications staff. There were no legal or accounting rules for the new risk information, and top executives lacked the expertise to compile or explain the highly specific risk information and the quantitative measures.

I’d like to tell you how to use shareholder communications to help shareholders understand the forward-looking risks of the company and the actions taken to manage that risk. Unfortunately, I don’t know how – I’ve never done it successfully. But if you set yourself the lesser goal of explaining
the recent past in risk-sensitive terms, I think that you can accomplish that, and I think that doing so is worth a lot.

**Writing to the rules before and after 1997**

Before the 1997 rule change on reporting risk, as a risk manager I often drafted material for the financial reports. I would be given a specific assignment, such as ‘Describe our foreign exchange hedging policies and the results.’ I would comply, and pass the material to someone who would pass it up and down a long chain where it got reworked and combined with a lot of other stuff. Many weeks later I would see a draft of the report, which I would check to make sure that no errors had been introduced in the stuff I knew about. I had no say in the type of risk information that would be disclosed, and the final report usually differed considerably from my initial explanations.

Post 1997, I had a section in the report all to myself (well, I had to share it with some other people in the risk department, but no one outside the department). I don’t mean that I had complete freedom to write what I chose, far from it. There were still legions of lawyers and communications professionals to wrestle with, and the final version had to be approved by top executives and business heads. But it was the top practising risk people (usually not including the CRO) who laid out the basic disclosure strategy and methodology, and maybe half of what we wrote made it into the final document (as opposed to perhaps 20 per cent in the old days).

As soon as I was in the financial reports, equity analysts and large equity investors wanted to talk to me. In the early days, these were pretty open-ended discussions. They’d ask something like, ‘How about that risk?’ and I’d talk about what I thought was important. Over the next few years as shareholders got more familiar with the disclosures and were able to compare period-to-period changes – and also our disclosures from similar companies – the questions got more specific.

I don’t claim to have had much success in educating equity analysts or shareholders about future risks. They wanted to know what was going to happen, and I didn’t know. Where I think I made a difference is in explaining the events of the prior quarter through the lens of the old risk disclosures. I could point out which material events were expected, which ones had been identified as possibilities but had been considered unlikely, and which ones had been complete surprises. I could also explain how our hedges and other mitigants had performed, where they had worked as designed, and where they had unexpected results. Explaining these things sometimes led to productive discussions about risk policies.
Part II
Measuring Financial Risk

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Head to www.dummies.com/extras/financialriskmanagement for more on risk measurements and methods.
In this part …

- Estimate Value at Risk and use it to make better risk decisions.
- Create and analyse stress tests to prepare for plausible extreme events.
- Role-play scenarios to generate consensus about crisis actions – and to practice them.
- Comprehend the “greeks” – the tools used to quantify and manage everyday risk.
- Become acquainted with the tools used to quantify and manage extreme risks.
Chapter 6
Valuing Risk

In This Chapter

- Defining, estimating and testing Value at Risk (VaR)
- Using VaR in risk decisions
- Understanding variations of VaR

Value at risk (VaR), the amount of money a fixed portfolio will lose over a fixed time horizon with a fixed probability, is the oldest and best-known concept developed in the field of financial risk management. This concept is an essential tool for managing financial risk. However, although practising financial risk managers are unanimous in their reliance on this tool, VaR is highly controversial outside the profession. So while you use VaR to manage risk and to communicate with risk professionals, be wary of using it outside the profession.

A VaR break is when the fixed portfolio loses more than the VaR amount over the fixed time horizon. It’s not a bad thing; if you never have any VaR breaks, then you’ve set your VaR too high. If you estimate a 95 per cent one-day VaR, for example, you expect 5 per cent of days – that is one day out of 20 – to be a VaR break. If you have much more or much less than 5 per cent breaks, you need to fix the way you estimate your VaR.

In this chapter, I begin by describing the simple, pure VaR from the early 1990s when the measure was invented quite by accident. Over the intervening years, the VaR concept has expanded to cover a large range of ideas. I show you how to use VaR and what it can and cannot measure.

Understanding VaR

VaR was invented to separate the normal 95 per cent of days for which you have plenty of data from the large-loss days and abnormal market days where risk is generally managed using long-term and qualitative measures rather
than short-term quantitative ones.

The point of VaR is to make clear, specific, daily predictions of potential losses given normal markets and no trading. The predictions are made every day, even when markets are confused or systems are malfunctioning or important data are missing, and they are never restated afterwards. The important point is what information decision makers had at the time, not what was discovered later. These predictions are rigorously checked against actual losses.

The ability to estimate VaR is far more important than the number itself. To do a good job, you must have good systems and good data, and you must understand the normal day-to-day risks (remember, because VaR assumes normal markets and no trading, it cannot be a measure of risk, since it ignores the extremes). Of course, everyone says they know their positions and understand the normal risk, but publishing a VaR proves it. Actually, far more often, inability to publish a good VaR disproves it, and forces needed improvements.

Measures and metrics

The term VaR is used for both a risk measure and a risk metric. I know that sounds like the kind of academic hair-splitting that you hoped would be absent in a For Dummies book. But this distinction is actually important. When you see the term VaR, you have to know how this term being used.

Suppose you want a number to tell you how safe a particular model of car is. You can think of a lot of different ways to consider vehicle safety. Three obvious ones come to mind:

- Engineering attributes of the car such as braking distance, safety features like airbags, performance in crash tests, and so on
- Statistics on driver and passenger injuries
- The premiums that insurance companies charge owners of the car

Each of these ways is a different risk measure – that is, a different way to define risk. The methods can overlap in some ways, for example a car with good brakes may avoid some accidents and thereby reduce injuries to people in the car and insurance premiums, but conflict in other ways. For example, a high-performance sports car may be well engineered but attract buyers who like to drive fast and recklessly, and therefore look risky to those judging risk of injury or setting insurance premium levels.

Each of the risk measures has many different possible metrics. For engineering attributes,
you can assign points for different characteristics and add them up. For injury statistics, you can adjust per car sold, or per mile driven, or per passenger mile or other ways, and you can assign weights for various injuries in different ways. In addition, you can pick one specific driver and type of insurance coverage or do a weighted average among them.

When people discuss VaR, you have to ask yourself, are they talking about the VaR risk measure or the VaR risk metric? In other words, are they discussing how risk should be defined, or given the definition, what specific number best captures risk?

The *VaR risk measure* is to look at the probability distribution of the value of a portfolio over a fixed time horizon, assuming normal markets and no trading. The *VaR risk metric* summarizes that probability distribution by a single number, the loss amount that will be exceeded a fixed percentage of the time.

### Choosing your time

In principle, you can estimate VaR over any period of time. Initially, one-day VaRs were the norm. Shorter periods were impractical because the financial controllers who computed gains and losses signed off on numbers only at the close of trading. Moreover, with positions trading in different markets and different time zones, it can be hard to add everything up in the middle of the day.

Computing VaR over periods longer than a day has two disadvantages:

- Over longer periods of time, more positions are traded, so the current portfolio bears less resemblance to the one for which VaR was computed.
- A longer measurement period means you need a longer period of time to test your VaR statistically. A general rule in statistics is that you want 30 observations to validate a parameter. With a 95 per cent one-day VaR, you expect one break (remember, a VaR break is when the portfolio loses more than the VaR amount) every 20 trading days, meaning you can form a solid opinion about your VaR in 600 days (about two-and-a-half years). With a ten-day VaR, it would take nearly 25 years to get the same level of confidence.

Regulators generally prefer longer periods as they’re more interested in capturing market events that stretch over multiple days than in statistical confidence. For the most part, regulatory VaRs are estimated over ten days, although periods up to a year and sometimes even longer...
are used as well.

If you’re estimating a VaR for your own purposes, there’s no reason to be bound by either convention. Generally speaking, I recommend the shortest period over which you can get accurate and objective estimates of profit and loss. If you’re trading large capitalization US stocks only, you can get good numbers every minute or even more often. If you’re trading real estate or distressed bonds, even monthly intervals may be too ambitious.

Keep in mind that you’re not restricted to a single horizon. Estimating over two different horizons can give you insight into different types of risk. In theory, you usually expect VaR to increase with the square root of the horizon, so a ten-day VaR would be about 3.2 times a one-day VaR (3.2 is the square root of ten). In practice, the ten-day VaR is usually lower than that, say 2.8 or 3.0 times the one-day VaR. But if the ratio is different – if the ten-day VaR is 2.0 times the one-day VaR, or 4.0 times – you know something unusual is going on either with your positions or in the market, and you need to investigate to find out what it is.

What’s in a name?

The term Value at Risk makes no sense. Understanding how it came about provides useful insight into the concept.

The modern field of financial risk management was jump started by the stock market crash of 19 October 1987. The first big debate concerned how to define risk. Those of us in the value camp believed that risk should be defined by the probability distribution of returns on your current portfolio over a day. That makes sense to an investor who uses borrowed money and has to make daily margin calls in cash – one missed margin call and you’re out of business.

Another large camp defined risk by the amount of capital necessary to support a position. This camp had many differences compared to the value view. To give one example, if you put on a stop loss (that is, you decide in advance to move off your position if it loses some fixed amount of money) the capital camp said you had less risk. You didn’t need to reserve capital for more than the stop loss amount plus some slippage (money lost after your stop is hit, before you can get off the positions). My value camp refused to give risk credit for what you planned to do in the future. We considered a stop loss to be a strategy for dealing with risk, not something that reduced risk.

The capital camp used a metric called capital at risk to represent how much a business could lose and still survive. It was natural to define it as a percentile, because that’s how quantists think of credit risk. For example, bonds with Baa credit ratings may default with a frequency of about 1 per cent per year. So if you held enough equity capital to have a 99 per cent
probability of covering annual losses in your business, your borrowings would be approximately Baa quality. The cost of Baa capital could be observed from bond spreads in the market, so you knew your cost of capital.

In the early 1990s, the focus of financial risk management shifted from extreme one-day moves in one market to longer-term combinations of less extreme moves. A call came out to aggregate risk across all departments of global integrated financial institutions. At that time, the only risk measure available across all businesses was the value measure, but no one knew how to combine probability distributions across different markets and businesses. The only risk metric that could be easily aggregated was capital at risk. So Value at Risk was born as a combination of the value camp measure and the capital camp metric.

Going through the numbers

In addition to the time horizon discussed in the preceding section, the other VaR parameter to specify is the confidence level – the fraction of days you expect a loss greater than VaR.

The trade-off is between using a high number like 99 per cent VaR (meaning 1 per cent of days should have losses greater than VaR) to get information about tail risks (big losses that occur rarely), versus using a low number like 90 per cent (meaning 10 per cent of days should have losses greater than VaR) to speed up acquiring the statistical evidence that your VaR is correct.

For most general risk purposes, 95 per cent VaR, meaning 5 per cent of days should have losses greater than VaR, is a good choice.

Regulators and senior management usually prefer higher values like 97.5 per cent or 99 per cent, or even 99.97 per cent or 99.99 per cent. One way to think about the choice is how many VaR breaks you expect per year. If you use a 99 per cent 10-day VaR you expect a break only about every 1,000 trading days, so 0.25 per year. Unless you’re seeing VaR breaks at a rate of at least once per year, you have little direct, objective, empirical evidence that your VaR is correct. Therefore I wouldn’t pay much attention to a VaR confidence above 95 per cent for a ten-day VaR. For a one-day VaR, on the other hand, you can go up to 99 per cent and still expect two or three VaR breaks per year.

Just as you can choose your own time horizon, you’re not restricted to a single confidence level. Theoretically, you expect a 99 per cent VaR to be about 1.4 times a 95 per cent VaR. In practice, the ratio is usually higher,
perhaps 1.5 or 1.6 times. But if it’s much different from that, say 1.2 or 2.0, there’s something to investigate.

The three main challenges of VaR estimation are

- Getting the right number of breaks, 5 per cent for a 95 per cent VaR – 1 per cent for a 99 per cent VaR – within normal statistical error limits.
- Having the breaks distributed independently in time without periods of too many VaR breaks alternating with periods of too few VaR breaks. That is, you expect about 13 VaR breaks per year for a one-day 95 per cent VaR. You don’t want to see four years with no breaks then one year with 65 breaks, even though the average number of breaks is correct. In other words, you don’t want the breaks occurring at unpredictable times.
- Having the VaR breaks independent of the level of VaR. You don’t want more or fewer VaR breaks when VaR is low than when VaR is high. One type of bad VaR algorithm estimates a low VaR until there’s a break, then it raises the VaR estimate by so much that further breaks are very unlikely. Eventually the VaR goes back down after a long period with no breaks. This results in almost all the breaks occurring when VaR is low.

In principle, VaR should be independent of everything; that is, breaks should be totally unpredictable. But if you can meet the three criteria in this list, you’re off to a good start. Meeting any two of the three criteria is easy; meeting all three at once is what forces you to confront the real modelling issues.

If the one-day, 95 per cent VaR of a portfolio is V, you’ve a 5 per cent probability that the portfolio will lose more than V over the next day, assuming normal markets and no trading.

95 or 5? Inverse numbers, same meaning

I wrote this chapter using the most common conventions for VaR, but others sometimes state it differently. For example, what I call a 95 per cent VaR other people call a 5 per cent VaR, using the probability of having a loss beyond VaR in the name instead of the probability of not
having a loss beyond VaR. Also, some people state VaR as a negative profit instead of a positive loss. These conventions rarely cause confusion when discussing VaR, but they’ve created innumerable bugs when VaR is implemented in computer systems.

If the positions in the portfolio at the start of the VaR period lose more than the VaR amount, this situation is called a VaR break. Some people use the term up break if the positions make a profit of more than the VaR amount. The break frequency is the ratio number of VaR breaks to the total number of VaR periods. The conditional VaR, or CVaR, is the average loss on VaR break days.

**Estimating VaR**

Because VaR is defined by a property it must have rather than a recipe for creating it, there are lots of different approaches to estimating a VaR. In this section I show you some of the simpler ones, and identify some of the issues with them.

One simple way to estimate VaR is to look at the historical losses on a portfolio. For example, £10,000 invested in the S&P 500 would have lost more than £167 on 5 per cent of days from 1928 through 2014. Therefore, setting a one-day 95 percent VaR at £167 for this portfolio gets you the right number of breaks, but you have a problem: During volatile periods in the markets you get lots of breaks; during quiet periods you get none.

**Table 6-1** shows the number of breaks in each of the 20-day periods since 1928. I chose 20-day periods because there should be one break on average in each with a 95 per cent VaR, so it’s easy to see if the VaR is calibrated correctly. If breaks were independently distributed in time you could expect some variation – some 20-day periods with no breaks or two or three breaks, very rarely more. The Expected column shows how many times you expect a 20-day period to have the indicated number of breaks in the first column. The Actual column shows the number of breaks that actually occurred.

**Table 6-1** Expected and Actual VaR Breaks over 20-Day Periods

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<th>Number of Breaks</th>
<th>Expected</th>
<th>Actual</th>
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<tr>
<td>0</td>
<td>7,826</td>
<td>12,874</td>
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<tr>
<td>1</td>
<td>8,238</td>
<td>4,059</td>
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<tr>
<td>2</td>
<td>4,119</td>
<td>1,837</td>
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<tr>
<td>3</td>
<td>1,301</td>
<td>1,132</td>
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As shown in Table 6-1, many 20-day periods had zero breaks. During quiet periods. There were 12,874 of these quiet periods, although 7,826 breaks were expected if VaR breaks were distributed independently in time. Also, there were many periods with four or more breaks (during volatile periods) – 692 four-break 20-day periods, for example, versus 291 expected. On the other hand, normal 20-day periods with one, two or three breaks are underrepresented, there were fewer than you would expect if VaR breaks were distributed independently in time.

If you used a constant £167 as your VaR, people would have no trouble winning money betting against you. In quiet periods they would bet on no break, and win a lot more than 19 times in 20. In volatile periods they would bet on breaks, and win far more than 1 time in 20.

In order to make your estimate sensitive to market conditions, you could set the VaR equal to the biggest loss over the previous 19 days. There’s an elegant logic to this. Suppose that 19 days ago, you were asked the probability that one particular day among the next 20 was going to be the biggest down day for the S&P 500. You might say that you had no idea, you thought each day had an equal chance, 5 per cent. Therefore the chance that today is going to be the worst day among the 20 is 5 per cent, so you’ve a 5 per cent chance that today is worse than the worst of the previous 19 days.

Unfortunately, if you set VaR to the worst loss on the positions over the previous 19 days, you find you get 5.5 per cent break days, not 5 per cent.

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<td>9</td>
<td>0</td>
<td>86</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>13</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
The reason is similar to the reason you get a bad distribution of breaks with a constant £167 VaR estimate as shown in Table 6-1. During times of rising volatility, you get more than 5 per cent breaks using the worst-of-the-last-19-days method. During times of falling volatility, you get fewer. But the dynamics of the stock market is such that the increased breaks outweigh the reduced breaks. In order to get 5 per cent breaks, you have to set VaR to the worst of the last 21 days, not the last 19. If you do this, the problem with the time distribution of breaks largely goes away as Table 6-2 shows.

**Table 6-2 Expected and Actual VaR Breaks over 20-Day Periods**

<table>
<thead>
<tr>
<th>Number of Breaks</th>
<th>Expected</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7,819</td>
<td>7,682</td>
</tr>
<tr>
<td>1</td>
<td>8,231</td>
<td>8,486</td>
</tr>
<tr>
<td>2</td>
<td>4,115</td>
<td>3,911</td>
</tr>
<tr>
<td>3</td>
<td>1,300</td>
<td>1,325</td>
</tr>
<tr>
<td>4</td>
<td>291</td>
<td>344</td>
</tr>
<tr>
<td>5</td>
<td>49</td>
<td>59</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Unfortunately, you now have a new problem: If you test this method over the entire history since 1928, you find that the average VaR on break days is £136, and the average VaR on non-break days is £194. Traders would again make money betting against your VaR, betting on breaks when your VaR is under £167 (its median value) and betting on no breaks when your VaR is over £167.

Executives love your VaR, for a while anyway, because it lets them take risk up when things have been quiet lately, and tells them to take risk down after bad times. This action is exactly what they want to do without risk management. However, a popular VaR is a bad VaR.

People soon figure out that when your VaR says things are safe, the probability of a break is much higher than average; and when your VaR says things are risky, the probability of a break is much lower than average. If you have to make errors in VaR, you much prefer the opposite – exaggerating risk
when risk is high, and exaggerating safety when things are safe. Of course, the best thing is an accurate VaR.

When VaR was invented, those of us involved thought it would be easy to estimate. We were wrong. The experience taught us that we didn’t understand our risk in the centre of the distribution – that is, we didn’t understand what happens on 95 per cent of days. If you don’t understand centre risk (what happens on normal days), your opinions about tail risk (infrequent large losses) are probably worthless.

Conventional statistical methods are pretty much worthless for VaR. I tried them all, and none worked. What proved most fruitful was using methods developed by sports bettors because the VaR problem is more like setting a point spread than it is like standard statistical problems.

That’s a bit convoluted, so let me make it specific. Suppose I have £10,000 invested in the S&P 500 stock index. Looking back over history, that portfolio has lost £167 or more 5 per cent of days, or 1 day out of 20. That makes £167 one estimate of the VaR of my portfolio (this amount isn’t a perfect estimate because the amount is too high on some days and too low on others, but it’s about right on average).

VaR is not a worst-case outcome. VaR is the best-case outcome on the worst 5 per cent of days. A £10,000 investment in the S&P 500 would have lost more than £2,000 – more than 12 times the £167 VaR, on 19 October 1987. The average S&P 500 loss is £282 on the 5 per cent of days when it loses more than £167. (See the upcoming section ‘Abusing VaR’ for more on this.)

VaR isn’t a risk measure. If a portfolio manager makes a trade that would double the losses in the worst 4 per cent of outcomes, it would certainly increase portfolio risk, but it wouldn’t change the 5 per cent VaR. You could combine two portfolios and get a VaR that’s more than the sum of the individual portfolio VaRs, which cannot be true of a risk measure because the risk of combined portfolios is always less than or
equal to the sum of the portfolio risks.

A more basic point is that if you’re concerned with worst-case outcomes or want a risk measure, you can’t assume normal markets and no trading. The worst case probably involves market disruptions and unfortunate trading decisions – and consideration of those things certainly adds to risk. This situation is what led hedge fund manager David Einhorn to compare VaR to ‘an airbag that works all the time, except when you have a car accident’.

VaR can do a lot of damage when you confuse it with worst-case outcomes or risk measures.

The S&P 500 example understates the difficulty of real-world VaR estimation. I produced only one VaR from a simple position with reasonably comparable data going back 87 years. Practising risk managers often compute thousands of VaRs daily, many involving complex positions and market factors with short or no histories. Another problem is the VaR estimate can affect trading and pricing, which can affect market movements. Moreover, you must produce the VARs on time even though errors in the positions and market data exist. Generally speaking, the days on which VaRs make a difference are the days when there is most uncertainty about the data, so a risk manager who gets VaR right on every day with good data and working systems isn’t doing much good.

**Counting breaks**

VaR is only meaningful in relation to a backtest, which means you must compute VaR over a period of time and compare the actual breaks to the expected number of breaks. A single VaR number is merely an opinion. You can never prove whether this opinion is right or wrong, you can only demonstrate the average quality of a large number of VaR estimates.

The basic VaR backtest consists of reviewing historical VaR estimates to check that they

✔️ Show the right number of breaks – not too many, not too few – within normal statistical error limits (breaks and their parameters are covered in
the previous section, ‘Going through the numbers’

- Have the breaks distributed independently in time
- Have the VaR breaks independent of the level of VaR
- Don’t have any other patterns that could be exploited to improve VaR estimates

The backtest must be performed on the VaRs actually used when decisions were made, not some later correction or adjustment. Risk management isn’t about being right in principle after the fact but about being as right as you can be at the time decisions are made.

*Tip*  
If someone shows you a perfect backtest, you can make a confident bet that this backtest is somehow rigged. Real backtests are messy. The problems in backtests is what drives innovation in VaR, and innovation is the key to VaR’s usefulness. A perfect backtest means that the risk manager learned nothing. In theory that could be because she was so smart she knew everything that was going to happen. In practice, it usually means that she designs her reports so they never prove her wrong.

*Remember*  
Therefore, don’t evaluate a backtest by how well it matches statistical perfection, but by whether it demonstrates a reasonable competence and a vigorous willingness to learn.

**Putting VaR to Use**

One of the most common misunderstandings about VaR is to treat it as a measurement. With a measurement, you think of something you’d like to know and then go measure it as best you can. To use VaR properly, you must realize that it’s something different: It’s a number with a certain property (on five per cent of days your portfolio will lose more than this amount). That’s not an obviously useful thing to know. This section will show you how to use this type of number.
Consider a number such as Gross Domestic Product (GDP), defined as the monetary value of all the finished goods and services produced within a country's borders in a calendar year. That seems like a useful thing to know if you’re analysing a country’s economy. However, the more you think about it, the more questions occur to you about what it means. Does it include the service you create when cleaning your own home? How about illegal goods and services, or defective ones, or unsold goods? If you break a window and then replace it, have you added to GDP?

After you settle on a precise definition, you have to figure out how to measure it. The official numbers that government statistical agencies put out are pieced together from a variety of sources and rely on assumptions and approximations.

**Comparing the numbers**

Most of the numbers that risk managers deal with are like GDP – they have constructive definitions and seem obviously useful, but when you think hard about them, they generate difficult questions of definition and measurement.

VaR is a different kind of number. It has an operational definition and isn’t obviously useful. For a portfolio, you want to know about the worst-case outcomes, not the 5 per cent point. The average outcome is also good to know, because that predicts the portfolio’s long-term fate.

Another number with the properties of VaR is the point spread in an American football game. (If the Seattle Seahawks are favoured by three points versus the New England Patriots, the spread is three points, and a bet on the Seahawks pays out only if the Seahawks win by more than three points. A bet on the Patriots pays out if the Patriots win, tie or lose by fewer than three points). A point spread has an operational definition, such that if you add the point spread to the underdog’s score, the contest is even. The number isn’t obviously useful for anything except facilitating sports betting. It doesn’t tell a coach what strategy to use for a game, nor a general manager which players to select. The number is not even a pure football number as it reflects the biases of bettors.

Nevertheless, point spreads and VaRs are objective in a way that numbers like GDP are not. If someone has set a Las Vegas sports line successfully for years, you know that she knows something. You may not be sure what it is
that she knows, but she can’t be an idiot or a fraud and continue to stay in business. The same thing is true of a bettor who makes consistent profits betting against the spread.

On the other hand, a famous economist who specialises in GDP may know something, but you can’t be entirely sure. If she does know something, what she knows is probably important and useful. But without a competitive track record of making accurate predictions, it may be that this economist is simply reflecting popular beliefs. Her skills may be in gaining the respect of other economists rather than in making objectively superior predictions.

Organisations tend to be run by people trained by experts with advice from experts. This fact can lead to reliance on a conventional wisdom that isn’t tested constantly and rigorously against reality, which posting a point spread and taking bets from all comers is. VaR forces risk managers to make daily predictions, usually about hundreds or thousands of events, and to look obsessively for any deviations from expectation, any patterns in the VaR breaks. This search is often the only way to force organisations to admit that their pictures of reality are not completely accurate – at least the only way before the admission is forced by disaster.

**Trusting VaR**

So the first thing VaR does is to weed out risk managers who cannot predict. It also highlights problems with information systems and models. VaR must be estimated every day, before trading begins, even on days when data are missing or systems are down. VaR is never restated afterwards; what matters is the number that people were looking at when decisions were made, not what it would have been if all systems had functioned perfectly. Many times, these kinds of problems can add more to VaR than the risk from market movements.

I cannot overemphasise the value of removing the nonsense – people who can’t make accurate predictions, systems that don’t give accurate information – from risk discussions. When you strip things down to
what you actually know, based on rigorous, objective backtesting, a lot of complex situations simplify into ones in which sound risk decisions are possible. (See the section ‘Counting breaks’ earlier in this chapter.) VaR is the only way I know to banish the wishful dreamers, the overconfident theorists, the one-note ideologues, the office politicians, the me-too thinkers, the meaningless numbers and all the other obstacles to rationality from the table.

Another reason long-time practising risk managers trust VaR is that it has consistently called attention to important developments long before they penetrated the consciousness of non-risk executives. What happens is you notice a pattern in your VaR breaks that cannot be eliminated by more intensive analysis of your existing information. As you cast out for more information, you find yourself talking to people and researching subjects that no one else cares about or has even has heard of. (Risk managers are used to being considered eccentrics studying irrelevant stuff in an obsessive quest to improve their VaRs.) Until something happens and, suddenly, everyone is talking about the thing you’ve been watching for 18 months. It may be high-frequency trading, or subprime mortgages, or Russian domestic debt, or failed trades, or the office cleaning staff, or cyber security, or identity theft or anything else.

Unfortunately, having studied something in advance doesn’t protect you from damage when a crisis occurs. Advance study doesn’t even mean that you’ll know how to respond. But it does put you several steps ahead of people who have to start from scratch.

Risk management doesn’t confer absolute protection, and it doesn’t mean that you always know what to do. However, the risk manager’s job is to think in advance about the things other people want to know in a crisis. VaR is the only way I know to do this consistently. I don’t know anyone smart enough to anticipate everything, but the discipline of estimating and checking VaR every day forces you to learn about an awful lot of stuff, and a surprising amount of that stuff is useful. Not many crises strike totally without warning, but they’re usually not spotted first by the lookout in the crow’s nest scanning the horizon for known dangers. The first clues are usually subtle deviations in patterns detected by the guy or gal who appears to be staring aimlessly into space, but is in fact engaged in meticulous quantitative analysis of stuff too small and irrelevant for anyone else to care about.
Not only does VaR force risk managers to seek out information that others deem irrelevant, it forces constant evolution of analytical methods. Financial markets change constantly, and VaR estimation techniques have to keep up. In the early days, the early 1990s, all the effort was in getting decent approximations to positions in time to make estimates. As systems and communications improved, focus shifted to marks and historical data. At other times the main issues were derivative pricing, curve bootstrapping, quote synchronisation, valuation adjustments and other factors.

The reason for these changes is that VaR refers to unexpected losses. As financial modelling gets more sophisticated, understanding expected losses improves, which changes the nature of unexpected losses. At the same time, financial products and markets are getting more complicated, which introduces new sources of unexpected loss. Unless risk managers are forced to maintain a rigorous VaR system, they find it virtually impossible to keep up their systems and analytics up to the standard necessary to survive.

**Communicating VaR**

Any risk manager who’s been making risk decisions longer than five years has an unshakeable faith in VaR. The repeated experience of getting crucial advance warnings from the discipline of preparing daily VaRs makes believers of everyone. Risk managers who don’t like VaR, in my experience, tend to be those who don’t make risk decisions (such as those specialising in risk reporting or risk policy or managing large departments), or those with short tenures who failed to observe the forward-looking benefits.

On the other hand, risk managers sometimes have trouble answering exactly what it is that they trust about VaR. They trust that they will get the right number of breaks, of course, and that the breaks will occur at unpredictable times; but that’s circular; saying that they trust VaR to be VaR. They trust that the discipline of providing a daily VaR tests the firm’s systems and the risk department’s analytics, but that makes VaR seem like just a quality-control check. If you can catch them in an unguarded moment, late at night, they may reveal that much of their faith is superstition fed by experience. Time after time in the past, little disturbances in VaR have been the only warning that the markets gave of crises to come; and research to make VaR better always seems to pay off later – usually in totally unexpected ways – in making risk decisions.
However, you rarely find anyone but practising risk managers who compute their own VaRs who trust VaR. VaR doesn’t get much respect as a number outside the risk-management profession.

VaR hit global integrated financial institutions like a thunderclap for one simple reason: It’s the only financial risk concept that’s the same on the trading floor as in the executive suite. Integrated global financial institutions were brand new in the 1990s, and no one knew how to manage Wild West cowboy traders who were connected for the first time to the big-money vaults of traditional banking institutions (and indirectly to even bigger money in central banks and public equity markets). Each trading business had a slew of complicated risk measures that could only be understood by specialists, and could not be aggregated across departments.

View from the top

VaR’s meteoric rise to prominence has nothing to do with trust and occurred long before risk managers learned to love it. VaR hit the big time in the mid-1990s, when it was still a clumsy patchwork of ideas, stitched together to fulfil a goofy request from headquarters – an absurd demand to summarise all of a financial institution’s risks in one number, and to have it available immediately after close of business.

The ideas that developed into VaR were stimulated by demands from chief executives for simple, comprehensive risk reports. In 1989, Dennis Weatherstone, chairman of JP Morgan, called for a 4:15 report that would summarise all the bank’s potential for market losses within 15 minutes of the market close at 4 p.m. John Reed, CEO of Citibank, discovered in 1992 that the notional value of Citi’s foreign exchange (FX) derivatives exceeded the bank’s capital, and threatened to close down FX derivative trading unless someone could provide him with an accurate daily exposure number. Similar demands were made from top executives in other firms.

At the time, bank information systems were hopelessly inadequate to supply these kinds of reports. They were controlled, meaning that they were designed to get everything exactly right (or at least, completely consistent) several days after the fact; and in many crucial areas of risk were only taken seriously at quarter end. The systems distinguished between accounting data and reference data. Accounting data, like notional amount or market value, could not begin to describe the risks of derivatives, structured products, contingent commitments and the other large exposures. Reference data, such as option expiry or swap reset frequency, was completely unreliable. It was often stored as text rather than information, was frequently incorrect, and could not be integrated across departments, even for the same instrument.

Quants who worked at these banks had become adept at grabbing information from the
On the trading floor, risk managers explained that VaR was like a point spread. When traders questioned it, managers offered to take either side of a bet at 19 to 1 odds on whether or not current positions would lose more than the VaR amount tomorrow (you can imagine what traders would think of someone who wanted to tell them how to run their billion-pound positions, but wouldn’t risk £10,000 of her own money on her opinion). It didn’t take long to prove that VaR was an accurate number. Traders still considered it irrelevant – ‘I don’t care what my current positions could lose in a day, because I’ll have completely different positions long before the day is over’ was the most common argument but there were many others – but they accepted VaR was what it claimed to be.

In the executive suite, betting was not considered the civilised way to settle disputes. So VaR put on a suit and tie and presented itself as an actuarial projection, like the liability estimates for the company’s health and pension plans or the default predictions on the bank’s credit card debt portfolio. VaR’s reliability was supported by statistical charts. It appeared to tame the wildness of trading, making trading look like a traditional banking business.

In 1997, the US Securities and Exchange Commission (SEC) got into the act. The SEC’s concern was that investors did not understand the risk of the new integrated global financial institutions so it mandated that these banks make some form of risk disclosure. Three methods were allowed, one of which was VaR, and VaR was the one everyone picked. For the first time in history, traders, executives and investors were all looking at the same number for risk; and regulators were beginning to use VaR and VaR-like concepts to set minimum capital levels.

Many people noted the slight problem with all of this – VaR isn’t a risk measure. This inconvenient truth would lead to big problems. But it misses a larger truth, which is that the fact of communication can be more important
than the message. When you’re worried about your loved ones, sometimes all you want to do is hear their voices to know that they’re okay – what they say doesn’t matter. In a financial world of extreme complexity and uncounted layers between the risk decisions of a trader and the stakeholders of a banking institution, a single quantitative concept that was the same for everyone is precious, in the way that a single word understood by everyone would be important at the Tower of Babel.

**Abusing VaR**

VaR, of course, isn’t a worst-case loss, but rather the best-case loss on the worst 5 per cent of days (in a 95 per cent, one-day VaR). You expect to lose more than this amount in one day more than once per month. Over longer periods, you can lose much more. Moreover, VaR only covers normal market days and losses before any position changes, and the largest losses often result from abnormal markets and trading that makes things worse. Nevertheless, you still find people who get outraged when a business loses more than its VaR amount.

A subtler error is to get upset when an institution loses many times its VaR. For example, in 2008, Citigroup had over £60 billion ($100 billion) in credit write-downs, compared to an average daily 99 per cent VaR of £170 ($270 million). That led many commentators to claim VaR is worthless, since Citi lost 375 times its VaR. Lots of problems arise with that comparison (most of the losses were in Citi’s banking book that was excluded from the VaR computation; the VaR computation is for one normal market day without trading, not a year of abnormal markets with frantic trading) but it remains true in one important respect: Don’t think that an institution cannot lose 100 times VaR, 1,000 times VaR or even larger amounts. VaR tells you nothing about worst-case losses.

The other common form of VaR abuse is to treat VaR as a risk measure and use it to set limits or make other risk decisions. Not only is this tactic wrong for theoretical reasons, it suffers from the overwhelming practical issue that VaR systems can easily disagree by a factor of two or more. Anyone who’s worked in risk management is aware of numerous quantitative impact studies and other research that compared VaR estimates for the same transactions from different institutions and found frequent discrepancies of more than 100
per cent among systems with equally good VaR backtests. For another example, in JP Morgan’s London Whale debacle—a bank trader, Bruno Iksil, lost £3.9 billion ($6.2 billion) in 2012—critics seized on the fact that a minor change in the bank’s risk model cut the VaR of the London Whale trades in half, allowing Iksil to continue trading. Later the bank changed models again, and VaR doubled. If VaR were a risk measure, this doubling would be nearly impossible. The risk of the same positions does not decline by 50 per cent or rise by 100 per cent overnight without any change in the markets. But this situation isn’t at all unusual for VaR.

VaR is validated by backtesting over many positions and long periods of time. You can’t validate VaR for a particular position on a particular day. Two VaR systems can have equally good backtests and disagree dramatically about individual positions.

Consider the example of two sports bettors with 60 per cent winning frequencies over thousands of bets against the spread on football games. They may well disagree by a lot on individual games. In fact, you rarely find that all the smart money bets the same way on a game, typically it may be split something like 70/30.

The biggest problem with using VaR as a risk measure is that it depends on subtle choices by analysts, which can be consciously or unconsciously manipulated. Even if you somehow prevent manipulation, you can’t manage businesses with a number that jumps around all the time for reasons unrelated to markets or positions. Good VaRs are always noisy, in the sense that their daily movements cannot be easily explained even after the fact. They give lots of false alarms, but they’re valuable because they rarely fail to give some warning of real events. A good VaR system is invaluable, any particular VaR number – even from the best system – is worth little.

The flip side to this problem is that if people start using VaR for limits or other official purposes, strong pressure is going to arise to control it and rationalise it. You can’t produce a good VaR in a controlled system – VaR needs to be free to use whatever data seems to work, including unreliable and uncontrolled data. You can’t produce a good VaR if you have to explain changes all the time – that kills the unfettered creative process and ensures
that VaR methodology lags behind market developments. The pressure created when VaR is used for official risk decisions are fatal to the qualities that make VaR useful.

**Adding Flavours to VaR**

You often see VaR modified by an adjective. The addition of the adjective means that the VaR is no longer a VaR. The adjective specifies how the number is computed, giving the VaR a constructive definition rather than an operational one. This difference is an essential one.

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**Operational definitions**

The definition of VaR is operational rather than constructive, which means that it specifies a property that VaR must have, but it doesn’t tell you how to compute VaR. Therefore, it’s possible to have two VaR systems that seem to work equally well but produce different values for VaR at any one time. To determine which one is better, you have to run statistical tests over long periods of time. Even then, you may fall into the trap of picking a VaR system that worked better in one particular situation but that fails to work in the future.

Another feature of an operational definition is that isn’t always obvious how to change VaR. If you want to reduce the gross notional amount of your portfolio, you close out positions. That’s easy, because gross notional amount can be defined constructively: You add up the notional amounts of all your long positions and subtract the (negative) notional amounts of all your short positions. However, closing out a position may cause VaR to go up in one VaR system but down in another VaR system.

Keep these facts about VaR in mind when people suggest using it to set limits. Limits should be based on clear, objective measures, not operational definitions. Moreover, risk takers must know what actions to take when limits are breached. Similarly, VaR is a poor choice to determine how much capital to hold.

These flavoured VaRs are useful, and they’re much easier to estimate than unvarnished VaRs. They can be embedded in controlled systems and used for limits or in capital computations. They don’t have the revolutionary advantages of real VaR, but are also much less likely to be abused. As a result, they’re relatively uncontroversial.

**Historical simulation VaR**

I use an historical simulation (HSIM) VaR in ‘Estimating VaR’, when I set VaR equal to the worst loss in the previous 19 days. HSIM VaR estimates are set by computing the losses a portfolio would have suffered over some fixed
past period. A typical implementation sets the VaR equal to the 25th worst loss the portfolio would have suffered over the last 499 days.

**WARNING:**

HSIM VaRs virtually always suffer from two disadvantages:

- They have too many breaks.
- The breaks all come in periods of increasing volatility.

These disadvantages mean that HSIMs are not true VaRs, but they can still be useful.

In some cases, HSIM VaR can be a reasonably good single number to measure the size of the exposure in a complex position. For example, suppose that a trader holds long positions in 250 of the 500 S&P 500 stocks and short positions in the other 250 stocks. You want to know how much risk she’s taking relative to another trader who holds a long position in 500 stocks. An easy way to judge this risk is to compare how much each trader’s position has lost in the past. Although it’s not a perfect comparison, it’s easy. You can use this method to compare any two positions for which you can get good daily price histories going back far enough, and whose risk levels can be assumed to be reasonably constant over that time interval.

One problem with HSIM VaR is that some positions don’t have history – newly issued stocks, for example. Another is that some securities change character over time. A bond with one month to maturity, for example, was a bond with two years to maturity 499 days ago, and would have had much more volatility. Or a one-month call option to buy into the S&P 500 at 2,000 (the index is at 2,080 as I write this) would have a lot more value than a one-month call option to buy into the S&P 500 499 days ago (when the S&P 500 was at 1,650).

A more subtle version of this problem is illustrated by a merger arbitrage strategy, taking long and short position in stocks in the process of merging. Company A offers to buy company B, exchanging one share of A for two shares of B. A merger arbitrage strategy may short one share of A and buy two shares of B. This position is a low risk because, if the merger goes through, the positions cancel out. Some risk is involved, primarily if the deal does not go through or gets renegotiated. But looking at the history of these
two stocks over the previous 499 days, most of which predate the merger announcement, is clearly silly.

Another problem is that it’s easy to construct positions that have misleadingly low HSIM VaRs just by picking combinations that had few bad days over the last 499. Even if traders aren’t trying to game HSIM VaR, *momentum strategies* (strategies that buy securities that are going up) have HSIM VaRs that understate their forward-looking risk, while *value strategies* (strategies that buy securities that are cheap relative to their fundamental values) have HSIM VaRs that overstate their risk.

You can adjust for these effects but they can add hidden assumptions to what seems like a transparent measure.

**Parametric VaR**

To estimate a parametric VaR, you make some assumption about the shape of the probability distribution of returns. A common assumption is that the return distribution has the normal shape (the familiar bell-shaped curve). In this case, you can set a 95 per cent VaR by multiplying the standard deviation of the distribution by 1.64 (the standard deviation is a parameter of the normal distribution, hence the term, *parametric estimate*; in a normal distribution, 5 per cent of the observations are more than 1.64 standard deviations below the mean). (I talk about the normal distribution and standard deviation in Chapter 9.)

In this case, you’re obviously not using a VaR at all. You’re using standard deviation as your risk measure. Multiplying it by 1.64 doesn’t change the information content; the process is like converting a temperature from Fahrenheit to Celsius. It doesn’t make anything hotter or colder, it just changes the number scale.

Other parametric VaRs make assumptions other than a normal distribution and use parameters other than the standard deviation. Now, you can’t be blamed for making a bunch of assumptions and estimating risk, but you also have no reason to call it a VaR. VaR is essentially non-parametric. Loss amounts cannot even be defined on all days, which is why VaR excludes
abnormal days. Proper probability distributions must account for all days. VaR requires only that you be able to tell break days from non-break days and does not mandate that you can define a precise gain or loss on every day.

Nevertheless, much as I personally dislike the term *parametric VaR*, it’s well established in risk management. Many of the VaRs you see are parametric VaRs.

**Variance covariance VaR**

*Variance covariance VaR (VCOV VaR)* is a parametric VaR, but I treat it separately because it has an additional approximation step. Most parametric VaRs model a set of market factors – things like the US ten-year treasury interest rate, the price of gold and the GBP/EUR exchange rate. The profit or loss on any position is computed by using these market factors to estimate the change in value of the position. This is known as *full reval or full revaluation*.

In VCOV VaR, each position is individually modelled with a volatility and a correlation with every other position as part of a multivariate normal distribution. That sounds pretty technical … okay, it is pretty technical. But what it amounts to is that VaR is estimated using linear approximations. You estimate what would happen for a small movement in market prices, then scale it up to a large move. In the process, you miss all the risk that only appears in large moves. It can be like calculating the injury if you hold your breath for one minute (small, you have to take a few rapid breaths afterwards to get your oxygen levels back up) and multiplying by 60 to estimate the injury if you hold your breath for one hour (you’ll have to take a few hundred rapid breaths to get your oxygen levels back up?).

Despite that criticism, VCOV VaR can give reasonable results for some types of portfolios some of the time. It was the form in which VaR was first introduced to the world when JP Morgan put the necessary covariance matrix online for free in 1994.

You can find other forms of parametric VaR that are not full revaluation. Another name for VCOV is *delta normal* VaR, *delta gamma* VaR also exists – this form uses quadratic approximations (which allows risk to go up with the square of market move, so holding your breath for an hour could be 3,600 times as bad as holding it for a minute). Many more sophisticated approximations also exist.
**Monte Carlo VaR**

Another modelling approach to estimating VaR is to construct a large number of potential future market scenarios and value positions in each one. In the simplest version, the scenarios are considered equally probable, so if you use 10,000, you pick the 500th worst as your 95 per cent VaR. In most practical applications the scenarios have different probabilities attached, and people average results over a range of bad scenarios to estimate the VaR.

The term Monte Carlo was chosen as a code name when mathematician Stanislaw Ulam came up with the idea of using random simulation to make calculations during the Manhattan Project to build an atomic bomb during WWII. It has become the standard term for the counterintuitive idea of deliberately adding randomness to a problem in order to make the solution easier.

Monte Carlo VaR is most useful for portfolios whose risk is mainly from the interaction of moderate moves in different market factors than from extreme moves in any one factor. All the value, however, comes from the Monte Carlo part – the generation of scenarios. Once you have them, you gain little advantage by summarising them with a VaR number.

**Stress VaR**

The term *stress VaR* is used for a number of different ideas. The most useful is to estimate VaR using any of the methods described in the preceding sections under the assumption that the institution is under stress. After all, these are the times when losses hurt the most.

Another idea is to estimate VaR using data from the worst historical period for the portfolio. A stress HSIM VaR, for example, doesn’t look at the last 499 days, but the 499-day interval in the past that includes the biggest crash for the portfolio. A stress parametric VaR doesn’t estimate standard deviation using recent data, but looks for the maximum standard deviation observed in the past.

Still another idea is to postulate a set of plausibly extreme future scenarios
and compute VaR over these scenarios. This idea is similar to Monte Carlo VaR, except that the future scenarios are designed to be extreme rather than to match the expected future distribution.

**Conditional VaR**

*Conditional VaR (CVaR)*, also known as *expected shortfall*, uses the VaR risk measure in a different fashion. It uses the average loss on VaR break days or, sometimes, the average loss on VaR break days minus the VaR. In other words, sometimes it tells how much you lose on average VaR breaks, sometimes it tells you how much you lose beyond the VaR amount.

In one respect, conditional VaR is contrary to the spirit of VaR. If you have enough high-quality data or enough confidence in a theory to estimate a CVaR, there seems little point to using VaR in the first place.

Nevertheless, CVaR can be a useful number to know, and it has the advantage over VaR in that it can be used as a risk measure.
Chapter 7

Stress Testing for Success

In This Chapter

- Looking at the benefits of stress
- Creating plausible stress scenarios
- Making use of stress test results
- Composing stories to use with scenario analysis
- Validating stress test and scenario analysis results

You may find it easier to understand the stress tests and scenario analysis I describe in this chapter if you think about them in a home environment instead of a financial institution. To stress test your home, think of a plausible extreme event: Say a sudden storm knocks out electric power and communication and temporarily makes travel difficult or impossible. Imagine that it happens right now and you haven’t assembled an emergency kit or bought the generator you’ve been thinking of getting. Assume you haven’t made any preparations.

A stress test consists of discovering and listing your assets and liabilities. Your assets are the things you have that can help in an emergency. Your liabilities are the things you must do during an emergency, or even just an unexpected, event. Keep in mind that it’s not enough to know that your assets exist; you must be able to access them and make use of them. Can you find what you need even in the dark, or if your basement is flooded or you have a broken arm? Will your assets work? Do you know how to use them? Did your brother-in-law borrow them when he visited last year?

In a scenario analysis, you break an emergency event down into stages. What do you do when you first hear a forecast of bad weather? What do you do when the power goes out? What do you do when a tornado picks up your house and drops it on the Wicked Witch of the East? During a scenario analysis, you ask what-if questions: What if the power goes out? What if the market plummets? What if a sister organisation fails? And, more importantly,
you and your colleagues come up with answers.

Don’t gather your assets and assess your liabilities once and then forget about them. Things change. Batteries lose power. You get a new pet and maybe a new prescription medication. The local doctor, whose home office you could conceivably drive to even in a bad storm, moves away, and the nearest emergency room is too far away to contemplate and closes in bad weather anyway. And, don’t do your stress test all by yourself on a computer; involve everyone affected and any essential service providers to make sure that everyone is on the same page.

In this chapter, I walk you through designing and executing stress tests and scenario analyses for your financial organisation.

**Testing for Stress**

Rigorous stress testing and scenario analysis is a cornerstone of any risk management program, including financial risk management.

A stress test posits a plausible extreme event and estimates the effect on a balance sheet or portfolio. It asks, ‘If Event A happens, what shape will the assets and liabilities be in?’ Scenario analysis is applied to an organisation. It asks, ‘If Event A happens, what do we do? If Event B follows, what do we do then?’

Both stress testing and scenario analysis begin with a plausible but extreme situation; in other words, something that might happen, but that doesn’t happen often. It may be any type of event, or a combination of one or more, including:

- Business (failure of a major bank, merger)
- Criminal (terrorist attack, rogue employee)
- Market (stock market crash, oil price shock)
- Natural disaster (hurricane, fire)
- Political (election, coup)
Financial risk managers use all kinds of stress scenarios but pay most attention to market movements and portfolio-specific events.

In imagining stress events, people tend to think of bad scenarios first, but sudden changes that may be good in general can also impose organisational stresses.

Stress testing and scenario analysis are intimately related. Scenario analysis relies on stress tests: In order to figure out what to do, managers need to know what assets they can call on and what liabilities they must meet. But in the process of making contingency plans, managers can discover additional detail they need from the stress tests. Scenario analysis creates the need for further elaboration of stress tests. In a working risk-management organisation, stress testing and scenario analysis are both continuous, reinforcing processes. They’re also the most inclusive part of financial risk management, the part that involves the most people from outside the Risk department.

**Imagining Stress Events**

Creating a list of stress events seems a daunting task. Even if you restrict yourself to historical disasters – things that have already happened – you’re looking at dozens of major examples and hundreds of minor ones. Moreover, you may be the risk manager for hundreds or thousands of legal entities or portfolios, all with different exposures. When you add in hypothetical disasters, it may seem that you need full-time staff merely to list the things that might happen.

The happy secret of stress testing is that the vast array of potential events plays out in a fairly small number of ways. Most financial institutions face just three big issues:

**Organisational status:** Decision makers need to be available and in
communication with each other and essential staff. Key people should be aware of the positions (the securities owned and money owed) and cash balances and other essential data and necessary systems.

✔ **Ability to act:** You need systems in place so that the organisation can move cash, trade positions and access financing.

✔ **Portfolio value:** You need ways to establish the market value of your positions, the cash value and the key accounting values. For example, a broker dealer cannot open for business unless it has sufficient capital according to a regulatory calculation. You need to be aware of the *redemptions* (the money investors may ask to be returned) or other outflows that you have to service.

**Deciding on the type of stress test**

Doing three good stress tests that cover different stress situations one at a time probably gives you 80 per cent of the value of a full stress testing program. That is, if you have a good idea of your ability to handle a spring flood, you’ve probably done most of the work necessary to plan for a summer tornado, autumn hurricane or winter blizzard. The details matter a lot to risk managers responsible for employee safety or building operations, but not so much for financial risk managers. If your portfolio falls 20 per cent in value and needs to meet a 10 per cent redemption in 24 hours, whether the fall happened because stocks crashed, interest rates rose or an Iranian nuclear reactor blew up is probably of secondary importance. And although preparing for combinations of stresses is important, knowing that you can handle each aspect individually is a prerequisite, and valuable in its own right.

Start with three good stress tests – or two or five – that probe the key issues in your financial organisation. After you perfect those, think about exploring a few combinations or variations or perhaps more exotic events. Some of the most popular stress tests for financial organisations are the following:

✔ Equity market crash combined with credit collapse, institutional failures and liquidity squeeze, modelled on the same circumstances that occurred in autumn of 2008.
Physical disaster leading to communication problems, system failures and closed institutions. This involves elements of the issues the United States faced in the wake of terrorist attacks in 2001, Superstorm Sandy in 2012 and the power outage in the Northeast in 2003.

Sudden and unexpected liquidity event leading to massive price movements without fundamental economic news, combined with doubts about financial data and trade executions. This type of flash crash occurred in May 2010 in equity markets and October 2014 in treasury markets.

Scandal or rumour that leads to sudden loss of confidence in your institution, sparking withdrawal of capital and credit and restrictions on your ability to trade.

Your positions become unsupportable due to size, attack, market moves or rule changes. Sample of each type of event are Silver Thursday (27 March 1980), Black Wednesday (22 September 1992), Metallgesellschaft in November 1993, Long Term Capital Management in September 1998 and Amaranth Advisors in September 2006.

Your top three executives are killed in an airplane crash (assuming that you allow the three to travel together).

Depending on your institution, certain scenarios may not apply to you. A typical pension fund, for example, may be affected by the first event but be much less affected by the others. A high-frequency trading shop pays most attention to the third possibility. In these cases it makes sense to consider other types of stresses or to subdivide the stress into variations. Don’t run a stress just because it would be a headline event in the Wall Street Journal, run the stresses that are most meaningful to your organisation.

When do you stop? In general, four to seven main stress events is all you’re going to get serious organisational attention for. More than that can result in a mindless box-checking exercise. One test is whether someone from the risk team has a serious conversation with everyone in the organisation (including third-party contractors, cleaning people, building management and other non-employees) about at least one of the stresses. If not, you’ve left something out.
On the other hand, feel free to run lots of variants of the main stresses, even hundreds of tests, just don’t waste a lot of time making them precise. These alternative tests are easy to do after you set up the main test, and they can provide insight about secondary risks. Also, people outside the risk department like to see that you’ve considered a large selection of historical and hypothetical stresses. When a board member asks, ‘Have you thought about the risks of a global pandemic?’ or some other movie plot, historical disaster or Internet meme, you’ll like being able to say ‘yes’, and show your corresponding plan, or stress dashboard (a computer screen, usually with fancy graphics and animations, to show the definition and result of a stress test). It may be nearly identical to a dozen other stress dashboards, but it has ‘global pandemic’ in the title. That’s not deceptive; you actually thought about it, you just realised that the financial impact has overlap with other disasters.

### Planning for *Invasion, Zombie Apocalypse and The Blob*

Risk management doesn’t have to be boring, and constructing a stress event is one of the most obvious ways to liven it up. Lurid movie plots can make better stress tests than historical events. You have more fun, and you may get useful cooperation from people who wouldn’t speak up if you asked about a systems crash or a building fire. They also encourage people to think outside the box. I often start stress-test discussion sessions by showing an appropriate disaster movie. I find that it helps to loosen people up and get them in the right frame of mind. I like short, silly drive-in movies from the 1950s more than big-budget recent releases.

The most important benefit is that these movie disasters have well-known rules. Applying them takes people out of the rut of assuming that things are going to work as they always have, which of course is one of the main contributors to foolish actions with catastrophic consequences.

I don’t recommend using these movie disasters for your official stress tests, as narrow-minded people may think that you’re not serious. But serious planning for fantastic events can be a useful exercise.

### Sizing extreme events

Everyone agrees that plausible extreme events should be used in stress testing and scenario analysis. No one agrees what *plausible extreme* means.
Don’t think of plausible and extreme as opposites pulling the stress-test event in two different directions. Think of them as two desirable things that can logically go together but often don’t – healthy, good-tasting snack and good-looking, humble person, for example. Risk managers know that plenty of plausible extreme events exist, people just don’t like to think about them. In fact, awareness of the extremes that are plausible could be a definition of the risk management mindset.

Plausible isn’t the same as likely. What plausible means is that people generally agree on what the assumption means. A blizzard that dumps six feet of snow in 24 hours is plausible – as the residents of Buffalo, New York found out in November of 2014. People know what a winter storm means and can predict the effects. A hundred feet of snow in Miami in July isn’t plausible. Neither is it impossible, but the possibility is useless for stress testing because no one can predict the effects, and no one knows what other things would accompany such an event.

Extreme does not mean the most extreme event that’s plausible. It means far enough beyond everyday events to test the organisation’s risk preparations. Some rules for a useful concept of extreme are events that might happen two or three times per decade on average, or are three to ten times the size of the main Value at Risk (VaR – see Chapter 6) the organisation uses.

Suppose, for example, that you want to do a stress test based on the size of the intraday move in the stock market. On a typical day, the difference between the high and low prices of the S&P 500 is about five per cent of the difference between the high and low prices of the S&P 500 over the previous year. So sizing the test at five per cent wouldn’t be any stress. This would be a typical day, and if you want to know what happens on a typical day, just look around.

For a true stress test, you may size the stress at 50 per cent of the difference of the high and low S&P 500 prices over the last year. That actually did happen: On 19 October 1987, there was a 26 per cent difference between the high and low S&P 500 prices for the day, while over the previous year the difference between high and low prices was 43 per cent, so the one-day movement was more than half (59 per cent to be precise) of the one-year movement. But because this situation happened only once, you don’t have
much data to use to predict how markets would react; not to mention that the event was from more than 27 years ago when financial markets were rather different.

If you instead size the stress at 20 per cent or 25 per cent of the one-year movement, you have more historical events to analyse for information about market effects (32 days if you pick 20 per cent; 9 if you pick 25 per cent). These days are scattered throughout the last 50 years, so you can distinguish consistent implications from particular effects due to different eras.

This stress is the type I find most helpful – an event that your more experienced staff may have seen a few times in their careers, but that are well beyond normal days.

If you’re doing stress testing correctly, the precise size of the event doesn’t matter much. The two important points are to make your stresses plausible enough that you can gather useful and reliable information about them and extreme enough to test rigorously risk precautions that go beyond normal day-to-day events.

**Staying away from worst-case scenarios**

A tiresome obsession of amateur risk managers is doing stress scenarios for worst-case events, which is just silly. For any event, someone can always suggest a worse one. Moreover, doing a worst-case scenario leads to a classic risk management error – doing nothing because you can imagine a situation so bad that nothing helps. Why wear a seatbelt when a giant meteorite may vaporise your car? Why keep extra cash in the vault for emergencies when someone may rob the vault?

Whenever an event occurs that is more extreme than the stress scenario you used, armchair critics take it as proof that risk management failed. However, they don’t ask the right question, which is, ‘Were the limits and contingency plans designed by the stress testing and scenario analysis adequate?’ If so, risk management did its job well. If not, there was a failure and if the institution survives and the risk managers are not fired, improvements to the stress testing are indicated. But improvements to the process don’t necessarily mean making the stress events more extreme. A bad outcome isn’t proof of bad risk management, and a good outcome isn’t proof of good risk
management.

For a specific example, consider the 11 September 2001 terrorists attacks in the United States versus Superstorm Sandy in 2012. Obviously, 9/11 was a more extreme stress scenario, but that extremity made it easier to deal with in important respects. The Federal Reserve (Fed) flooded the market with £60 billion ($100 billion) of liquidity and authorised essentially unlimited discount window borrowing and overdrafts after 9/11. Most markets shut down for a week. That combination meant that there was plenty of liquidity and much less than usual need for liquidity.

After Superstorm Sandy, the New York Stock Exchange (NYSE) closed, so most money market funds closed early on Monday and remained closed the following two days. But the banks and the Fed were open, so investors were required to meet margin calls. Had there been a large market move, it may have resulted in massive failures of levered investors, leading to a toppling of dominoes throughout the financial system.

A lot of people ignore the closure of the NYSE while banks and the Fed remain open in their stress testing because it happens every year on Good Friday, and the reverse (banks closed, NYSE open) on US holidays Columbus Day and Veterans Day. But those are well-known planned events, which isn’t the same as having them happen unexpectedly.

Another classic risk management error is to reason, ‘It’s happened frequently in the past, and nothing has ever gone wrong.’ That’s always true until something does go wrong. You won’t find any rule that says institutions must waive margin calls on Good Friday – it’s just a custom.

The point is that planning for overly extreme events can make you miss issues that show up in less extreme scenarios. Everything shutting down isn’t the worst case for a financial risk manager. The dangerous cases, and the ones for which advance planning matters, are the intermediate ones when some things shut down but others don’t.
**Building Your Stress**

Stress events aren’t built in the risk manager’s office. They require getting out and talking to people. You must be both open-minded and sceptical.

Think about how business processes evolve: Someone sets up a process, probably on a model used at another firm. The process is tweaked until it works smoothly on ordinary days. Sometimes people do a good job and build in features that help it work well on extraordinary days as well. Sometimes they don’t. Even if they do, people move on, the world changes, safeguards get ignored or watered down or cut in the name of efficiency and the process is liable to fail under stress.

**Building stress events**

If your stress test is to be any use, you have to figure out exactly what the realistic options are in the stress scenario. If you ask a general question, you usually get a superficial answer. You need to ask specific questions of the people doing the work. You need to listen hard to their answers (be open-minded), and you need to challenge their answers (be sceptical). These things are what risk managers do. If you’re unable or unwilling to exhibit these qualities, then you should find another profession.

I often begin to build a stress test by asking the person in charge of the process being tested to go through a normal scenario while I watch. Then I pick a step that would be affected by the stress event and ask what would happen if a specific step failed. For example, I might say, ‘Okay, what are the options if after you click the Approved button, you get an error message saying there wasn’t enough cash in the account to make the transfer?’

I then ask about options that have been used in the past or have been tested in realistic drills. I also try to have some examples of past failures, such as, ‘Why didn’t this work when Lehman Brothers tried it in September 2008?’

As you do your interviews, you refine your stress event. For example, your stress test may imagine the sudden failure of a second-tier European bank. In the course of asking how that would affect assets and liabilities, you may discover that it matters what time of day the announcement is made, or whether the bank is active in wholesale funding markets. Be sure to listen for these distinctions and make your event more specific.
Asking useful questions is a labour-intensive process but a valuable and necessary one. You get everyone in the organisation thinking about what they do. You remind them of the larger picture and that someone open-minded and sceptical cares. The risk team develops a solid understanding of what is necessary and what is possible in the stress scenario. At the same time, the process forges links of communication and respect with the people who use it every day.

Don’t be intimidated and feel that you have to do a perfect stress test. Do the best you can given your resources and experience. As with most things, you can get 80 per cent of the benefit with 20 per cent of the work. Every conversation plants a seed, and some of those seeds sprout. And you can always work to improve things over time.

**Storing stress events**

After you build the stress event, you need to record and archive the test and results. Of course, you have a detailed qualitative description of the event, and you attach all your interview notes as subsidiary material. However, if you stopped there, your event may well end up stuffed in a drawer and forgotten.

The key to making stress events useful is to summarise them in quantitative reports that are useable by the systems your organisation uses. For example, financial stress events usually include a set of movements in market prices. These moves may be static (such as global equities falling ten per cent) or dynamic (such as bond yields dropping to their lowest level in three years). In both cases, you need the stress events and results stored in such a way that you can easily generate the effect of these market moves on quantities such as:

- Liability value
- Portfolio cash
- Portfolio net asset value
- Portfolio required cash outflows
Vous voulez avoir des informations utiles sur d'autres aspects quantitatifs du scénario de stress. Les plus importants sont probablement liés au liquide. Le liquide, bien sûr, n'est pas un nombre, mais beaucoup de choses différentes y compris la devise, les dépôts bancaires, le dépôt en excès, les actifs à court terme que vous pourriez convertir en liquide, les transactions de titres non réglés, la capacité de prêts et ainsi de suite. Votre test de stress indique lesquelles de ces choses vous pouvez compter sur elles et lesquelles vous ne pouvez pas. Vous avez également à faire face à des paiements en retard – les paiements qui sont dus. Ici aussi, le test de stress identifie les conséquences si les paiements ne sont pas effectués.


**Utilisation des scénarios de stress**

Dans cette section, je vous dis ce que vous dites faire avec le test de stress que je vous dis comment le construire dans les sections précédentes. Les tests de stress sont les plus utiles lorsqu’ils sont combinés avec l’analyse des scénarios, mais vous pouvez les utiliser directement sans inclure une analyse des scénarios. Au cours de la construction du test de stress, vous trouverez naturellement des choses à faible coût ou gratuites que vous pouvez faire maintenant qui peuvent améliorer la situation après le scénario de stress.

En outre, vous devez prendre en compte les conséquences du scénario de stress relativement à la taille du stress. Cette jugement est nécessairement qualitatif. Si le portefeuille de l’entreprise perd cinq pour cent quand les actions mondiales perdent dix pour cent, et que ce niveau de perte est trop élevé, vous pouvez peut-être avoir besoin d’un limiter plus serré sur l’exposition aux actions. Si l’échappement d’un grand contrepartie (une institution financière que vous commerciez avec) assassine votre entreprise, vous avez probablement besoin d’un limiter plus serré sur l’exposition à la contrepartie.

Tip : Les tests de stress sont les meilleurs moyens d’établir des limites. J’ai passé par de nombreuses arguments sans résultat dans ma carrière en écoutant les discussions...
about things like an appropriate minimum cash level for a portfolio and the maximum leverage ratio that should be allowed in a balance sheet. People often talk past each other, inventing criteria for the decision. Stress tests provide concrete data that decision makers can use to set limits and ratios.

The right way to have the limit discussion is to present a plausible extreme event and project the consequence of a decision. People may have different opinions about whether the consequences are acceptable given the size of the stress, but at least they’ll be arguing over the same tangible facts. Discussing the effect of the limit change before the change is made is pointless; the focus has to be on the effect of the limit change in the future scenario when it matters.

Naming the Seattle Slugs

I was born and raised in Seattle, Washington. When I was a kid, the city got a professional (American) football franchise and held a contest to name the team. Even as a youth, I realised the mistake most people make when choosing team names. They pick a name that sounds good when the team is winning: Kings, Giants, Lions, Conquistadors and the like.

But any name sounds good when you win! When you lose, boastful names lead to humiliating headlines like ‘Kings Abdicate’, ‘Giants Cut Down to Size’, ‘Toothless Lions’, ‘Conquistadors de Nada’.

I proposed to name the team the Seattle Slugs. No one makes fun of a slug for losing. Slugs endure.

I didn’t win the contest, but I did get mentioned in a newspaper story of the stupidest suggestions. I didn’t win the booby prize, though, as the reporter felt my choice was at least honest because slugs are the dominant form of wildlife in the city. In his estimation, that fact notched Slugs above equally stupid names that had nothing to do with Seattle.

I still think that I was right, and this spirit is what underlies scenario analysis. Tell the story with the unhappy ending, the season filled with losses, injuries, scandals and embarrassments. Think about the name you want then. The championship seasons take care of themselves.

Telling Sad Stories during a Scenario Analysis
A scenario analysis is a story – a story with an unhappy ending. Of course, most people prefer stories with happy endings as you can tell by looking at the bestseller lists or highest-grossing movies. The love of happy endings is even more evident when people construct personal stories. They daydream about getting the good-looking romantic partner, winning the big game and coming up with the perfect riposte. Happy endings are good for motivating people. Coaches tell players to imagine holding the league trophy, to keep their eyes on the prize, to go for the gold, to follow their dreams.

Unfortunately, over-attention to good outcomes can cause a narrow focus that leaves people and organisations vulnerable to risk. You may have a plan that looks great on paper where success in each step leads naturally to the next step. But what if a step fails? Do you have contingency plans that allow longer routes to success if you have mishaps along the way?

The only way to tell whether your plan is worthy is to run through scenarios. If the scenario results in success, fine. If it ends in failure, you back up until you can find something you could do at an earlier step that would allow you to stay alive and keep trying. The process is complete only when you cannot find anything else that you could do at any stage to improve your chances of success.

**Running scenario analyses**

Like stress tests, scenario analyses are built around plausible extreme events. The difference is that stress tests are thought of as instantaneous changes, whereas scenario analyses trace through the history of events before and after an incident. Another difference is that stress tests are created through individual interviews with people actually doing the job, but scenario analyses are run in group meetings with executive decision makers.

For example, most organisations have both stress tests and scenario analyses modelled on the September/October 2008 financial crisis when the stock market crashed and many of the largest financial institutions in the world either failed or required massive government support to stay in business. In the stress test version, you say things such as ‘Equities are down 40 per cent and credit spreads have blown out 200 basis points’. Then you compute the effect on your portfolio. In the scenario analysis version, you start back at the beginning of 2008 and describe the situation. Then you fast forward to a precipitating incident, such as Bear Stearns failing, and ask what people want
to do. You move forward in time, perhaps a month or two at a time, and the group reaches consensus decisions at each point. The effects of those decisions are realised at the next point.

The stress tests you run help you create detailed and accurate scenarios. Scenario analysis without stress testing often leads to unrealistic situations or to presenting the group with options that wouldn’t actually be available if the scenario were to occur.

You don’t have to be a Hollywood screenwriter to run a scenario analysis, but you do need to build in enough detail, suspense and characterisation to make participants believe it. Among other things, that means that you can’t follow historical events too closely – you have to throw in a few surprises.

If your scenario isn’t convincing, people are likely to act the way they think that they should and quickly agree on sensible-sounding solutions. But these easy solutions won’t approximate how real events would play out, so the contingency plans built from the scenario analysis are likely to be ignored (and are likely to be flawed as well).

On the other hand, if you can get people into the spirit of the game, they eagerly thrash out the real issues involved with making decisions under uncertainty. Disagreements can be revealed under calm market conditions in a conference room instead of in the heat of an emergency situation. You can then identify people or policies that work at cross purposes. The experience of working through the entire scenario highlights errors made in early steps.

Why do you want to focus on an unhappy ending? Scenario analyses should be run to the death – that is, to the point where the organisation has no decisions left to make. Although that may not seem like much fun, ask yourself whether you want to design a contingency plan that, when things get really bad, reveals a blank last page. So keep the group making decisions until all hope is gone.

**Writing contingency plans**

The point of running scenario analyses is to create contingency plans. You usually run several scenario analyses for each plan, partly because you discover things and refine the scenario each time, and partly because you
want to get the perspective of different groups of executives.

I don’t recommend recording the sessions or having non-participants take a lot of notes. Valuable as those records may be, they inhibit the freewheeling honesty you need for good scenario analyses. Therefore, you need to pay close attention and to have a good memory. Keep the sessions short; a 40-minute meeting with 30 minutes of active discussion is about right. More than that leads to fatigue instead of fun and means that you’re likely to forget too much.

In the ideal world, a clear consensus emerges from the scenario analysis sessions that you can distil into simple rules to govern things like the conditions under which you would reduce positions, or what level of credit default swap (CDS) spread (the premium you have to pay for insurance against an entity defaulting) would cause you to stop doing business with a counterparty. Everyone would understand those rules because they thought through the scenarios that justify them, and would accept them because they participated in their creation.

Of course, we don’t live in an ideal world. There will be disagreements about all aspects of the rules: how many there should be, how much leeway should be allowed, how complex they should be and how aggressively risk should be reduced when trouble brews on the horizon.

Don’t worry about that. Those are real business issues, the kind the organisation must resolve. Your job isn’t to resolve them. You get a vote, but so do others (and some people get more votes than you do). Your job as risk manager is to ensure that a resolution is found and that everyone understands and accepts it. The alternative is to leave the resolution to the future, when you don’t have time for careful deliberation and inclusive consensus.

Contingency plans are not straitjackets. No future event will match any of your scenario analyses exactly. Future decisions will necessarily take into consideration the actual facts at the time.

The point of a contingency plan is to say, ‘Here’s what we all agreed when we were calm and had plenty of time. Does anyone have a good
reason to change it now?’ This question leads to a productive discussion about facts. A crisis is no time to have open-ended discussions of risk management principles. Those should be agreed beforehand so crisis debates can concentrate on immediate facts.

**Working Backwards**

Stress testing and scenario analysis help you devise plans to cope with possible contingencies. You can reverse both processes to help avoid unwanted outcomes.

**Reverse stress testing**

A stress test posits a plausible extreme event and estimates the effect on a balance sheet or portfolio. You can reverse the process and posit an effect, then try to figure out what event may cause it. This process makes sense when you’ve a well-defined event to avoid.

**Example**

Say the chief investment officer (CIO) of a public pension fund is given three years to get the funding level from 94 per cent up to 100 per cent. However, if the funding level drops below 90 per cent, the legislature steps in, which may lead to an acrimonious political showdown and perhaps a strike by public employees. So the CIO asks the risk manager to come up with the stress events that may cause funding level to drop below 90 per cent. The CIO isn’t planning what to do if that happens; he knows he’ll be looking for a new job. He wants to know if the events are implausible enough to be ignored and, if not, how the portfolio can be hedged against them.

**Pre-mortems**

A *pre-mortem* could be called a *reverse scenario analysis*, but nobody does that. Like a scenario analysis, you gather a group together to discuss a story. The difference is that you tell them the end of the story, and ask them to work together to write the most plausible plot. Traditionally, a pre-mortem is done with the same top executives who do scenario analyses, but I have found pre-mortems to be effective at all organisational levels.

In a post-mortem, everyone runs around asking, ‘Why wasn’t this precaution
taken?’ or ‘Why did no one ask about that?’ The idea of a pre-mortem is that it makes more sense to think about things before the disaster, so the precautions can be taken and the questions asked (and answered). If done properly, you get the benefit of experience without the cost of having the experience.

A typical pre-mortem ending is, ‘The firm has failed and you’ve all been fired, with black marks on your résumés, due to a cyber attack.’ The group can discuss the most plausible ways this could happen. Was it a criminal gang for profit? A teenager who thought it would be cool to see if he could bring down the financial system? A disgruntled former employee? A foreign government retaliating for sanctions?

After the group settles on the villain, it moves on to methods: Social engineering? Infiltration of third-party systems? Physical access pretending to be cleaners? The group discusses why security precautions didn’t detect and defeat the effort and how the attack may lead to a failure of the firm.

Exercises like this turn up lots of questions. They can’t prevent a cyber attack – at best they can make one a little less likely.

No risk manager can promise to prevent disaster. However, when people ask questions after a disrupting – even disastrous – event, do enough stress tests and scenario analyses so that you can answer calmly, ‘We did think about that, and we did take precautions. We did ask those questions, and we got good answers and made sure that everyone knew them. The risks we took we took deliberately. Your money was lost, but it was not lost recklessly or foolishly.’

**Systematic stress testing**

One obvious gap in stress testing is that it only covers events that have happened or that people have imagined. Those are exactly the things that people guard against, or at least think about, even without risk managers. How can you expand your stress tests to cover plausible events that haven’t happened and haven’t been thought of?
People use a number of mathematical techniques to help plan for unthought-of disasters. Monte Carlo cluster analysis is one. The Monte Carlo cluster generates lots of equally probable events and looks for clusters with unusually high losses, sometimes called *holes in the profit and loss distribution*.

Another common technique is to group past periods into groups by various criteria. You compute average events for each group, then scale them up to the largest plausible event of the type. You know the event is directionally plausible, as it is the average direction of a large number of periods. You know its magnitude is plausible as well. Therefore, even though it has never happened, and no one has suggested it might happen, it could very well be plausible.
For non-nerds in finance (I, myself, am a card-carrying nerd from way back), nothing is more terrifying than Greeks. I don’t mean the ones bearing gifts, nor the 300 Spartans blocking the only mountain pass to Thessaly, nor the government in Athens with its troublesome budgets. I mean those letters used for fraternity names and to chase cool students out of mysterious courses in arcane financial arts.

Taken one at a time, each Greek letter represents an important financial concept that can be appreciated without advanced mathematics. Each one was developed for a specialised subfield in finance, but they’ve grown to express general concepts that all risk managers must master. They’re valuable because they allow complex portfolio risks to be reduced to a manageable series of numbers, communicated with single words, which allows managers to aggregate and monitor risks without having detailed knowledge of positions, and is useful for setting limits.

However, using Greeks has a dark side. A single number cannot capture all aspects of risk and Greeks (the letters, not the people) have a way of falling apart when trouble starts. They’re peacetime risk-management tools, helpful for fine-tuning risk taking in good times, but not reliable to prevent disaster in bad times.

I’m not going to pretend this chapter is fun, but it isn’t too complicated.
I begin, naturally enough, with alpha, 00391, and beta, 00392, not only the first two letters in the Greek alphabet, but the ones that named it. Alpha and beta are also the first two Greek letters to make it into modern finance by way of statistics.

In the simplest formulation, the so-called *single factor model*, you divide the expected return on any portfolio into three components:

- **Risk-free rate of interest**: What low-risk assets such as treasury bills pay. This rate does not have a Greek letter, people just call it the risk-free rate of interest, or sometimes r-f, rfr or r-zero.
- **Beta (β)**: A return other market participants willingly and knowingly pay the portfolio owner to bear some risk.
- **Alpha (α)**: A return earned from other investors who do not know they are paying it.

Although alpha and beta were invented to describe investment and portfolio management, the general concepts apply to all risky human activities whose goal is some kind of profit. The risk-free rate is what you get for showing up, regardless of what decisions you make. Beta is what other people voluntarily pay you for the risks you assume. Alpha is what you wrest from others in competition and is zero in the aggregate. You need to understand sources of expected return clearly in order to manage risk.

If an exposure is beta, the firm is selling a process. It undertakes to get a certain exposure a certain way. The risk manager monitors the process, not the outcome. If an exposure is alpha, the firm is selling results. It undertakes to win, and if its process isn’t producing the desired results, the process must change. Seeking beta and seeking alpha are both valid business models, but the risk manager cannot allow people to keep one foot in each one, changing the story as the results come in. Risk managers don’t care about the Platonic ideal of beta and alpha, just consistency (within reason, of course; clear-cut beta should never be sold as alpha, and clear-cut alpha should never be sold as beta).
Angela, a portfolio manager, goes out and spends £100 million buying stocks she thinks are good. If treasury bills yield 1 per cent per year, she expects to make 1 per cent, or £1 million per year, for any investment she makes, including this one. This is the risk-free rate. She also expects to earn the equity-risk premium for investing in stocks, say this premium is 3 per cent per year, or £3 million. This is the beta she earns for accepting the risk of loss when the economy does badly and stocks decline. Companies that issue stock pay this equity risk premium willingly, that is, they know that equity capital costs more than debt on average. They like equity capital because it allows them to continue operating during bad times when debt may otherwise force them into bankruptcy. Finally, Angela expects to earn even more because she picked good stocks and didn’t invest in bad ones. This is the alpha which comes from other investors who picked stocks they thought had alpha but ended up holding the stocks that Angela ignored and not holding the stocks that Angela bought.

Angela may think that she has two per cent alpha per year. She may be right … or not. Without knowing anything about her, I call it a 50/50 shot.

The actual return that a portfolio earns is not the sum of the risk-free rate plus beta and alpha. That’s simply an expected return. The actual return is always different – probably by a lot. Only over long periods of time – far longer than any individual portfolio manager is in the market – do actual returns average out to expected returns. In fact, the period of return is so long that you can regard expected returns as abstractions and matters of opinion. Nevertheless, they matter for risk management. Just remember that you can manage your alpha and beta to perfection, and still have a terrible outcome because actual returns came in much less than expected. It happens a lot and to the best investors.

Some financial managers mischaracterise the risk-free rate, alpha and beta returns. People like to claim that money from the r-f is a result of their skill. Losses are always blamed on beta – the market took your
money. Gains are always labelled after the fact as alpha and touted as evidence of the manager’s competitive skill and used as the excuse for charging excessive fees. Risk managers have to learn to look through the evasions and marketing fluff.

The first portion of expected return, the risk-free rate, isn’t a concern of risk managers because, well, it’s risk-free. So I turn attention to beta and alpha in the following sections.

**Betting with beta**

Beta is respectable finance – honest profits paid for real risk taking. Beta risks exist in the real economy; they aren’t created by the financial system. They arise from uncertainty about technological change, consumer preferences and general unpredictability. Someone has to accept them if the economy is to run, therefore they carry a built-in reward in the form of an expected return above the risk-free rate. Some common examples are:

- **Investing in an equity index fund:** In the long run, equity investors earn a return above that paid on low-risk bonds in exchange for agreeing to take losses when the economy does badly. Investors’ willingness to bear these losses makes economic growth possible. Spreading that risk widely, instead of concentrating it among a small group of entrepreneurs with limited capital leads to exceptional economic growth in the long run. Investing in an equity index fund is distinct from the specific risk of individual businesses or industries or even economic sectors doing well or badly.

- **Selling insurance:** People are willing to lose money on average by paying insurance premiums because the policy pays off when they need the funds – when their houses burn down, when they have large medical expenses, when a family breadwinner dies young. Investors willing to take the other side of these bets make money on average.

- **Real assets:** Some investors buy physical assets such as real estate, commodity stockpiles and capital equipment. They may rent or lease out these assets to earn income or sell them when demand exists in the real economy. Businesses are willing to pay these investors a profit on average because they can get the assets when they need them and not pay for them when they don’t. A business reduces its risk by leasing office space rather
than buying a building because it can lease additional space or reduce costs as needed. Therefore, the net lease income on a building is, on average, more than the risk-free rate of interest times the cost of buying the building. The same is true for other assets.

Financial risk managers don’t concern themselves with beta risks – those belong to line risk takers, the people who make the actual risk decisions in the business. Portfolio managers worry about the beta risk of their portfolios, actuaries manage the uncertainty about the level of claims under insurance contracts, asset managers take care of the risks of holding physical assets. These line risk takers deliberately accept these risks in exchange for compensation. There is no right or wrong level, the only question is whether the risks were accepted at the right price, which is a business judgment not a risk issue.

Eating the trade

There’s an old joke about two sardine traders who worked next to each other for years, buying and selling millions of cans of sardines. One day one of the traders forgot to bring his lunch, so he opened one of the cans and put a sardine in his mouth. He immediately spat it out, exclaiming, ‘This sardine is inedible!’ His friend looked at him and replied, ‘You fool, those are trading sardines, not eating sardines.’

You probably didn’t think that was funny. It’s not, but it’s a folksy way of communicating an essential bit of financial wisdom: never confuse the things that pass through your business with your business itself. If the sardine traders in the joke had to take their profit in inedible sardines, their activities would have been pointless.

A clearer example is a company that prints paper money for the government. If someone asks the manager, ‘How much money did you make today,’ she has to distinguish between the £100 million of bills she printed and shipped to the public treasury and the £100,000 of net profit to the business. If she forgets this distinction, she goes to jail.

Now think of an investment management company that runs an S&P 500 index fund. It promises to take investor money and use it to buy the S&P 500 stocks. Whether that portfolio goes up or down is a risk but not to the investment manager. It’s the product the investment manager is selling. The risk manager’s job is to make sure that the actual risk is consistent with what was promised to the investor – and that all stakeholders understand and agree with the risks – not to have an opinion about whether it is the right amount or type of risk for the investor.

It can be more difficult to disentangle things with more complex financial institutions, such as a large bank that engages in lending, securities trading, securitisation, asset management and lots of other businesses all over the globe. Risks from one business have a way of spilling over into others and customer risks get enmeshed in company risks. Basically, you find people eating the trading sardines and trading the eating sardines.
Nevertheless, the principle is the same. Risk managers work constantly to sort out the risks. They try to make sure that customer risks are properly packaged and labelled – sort of like weights and measures inspectors. Those risks should be communicated clearly to the customer, and excluded from institutional risk management. The customers should be insulated from the remaining risks so customers do not inadvertently bear losses that should be borne by the firm and its creditors and shareholders. These risks are the ones that the risk manager manages, the ones for which she has an opinion about the appropriate amount and type.

This management can be devilishly difficult in complex financial institutions. Even simple institutions manage to screw it up sometimes. But the effort is central to the fiduciary aspect of finance. It’s impossible to do a perfect job, but any risk manager who does less than her best is betraying her profession.

One job of the financial risk manager with respect to beta risk is to understand who’s paying the risk premium. All too often line risk takers, including thoughtful and experienced ones, assume that because a risk premium was paid in the past, it will continue to be paid in the future. A more extreme version of the error is to assume that the risk premium is a constant. Either version of this fallacy leads to sloppiness about figuring out why the risk premium is getting paid and monitoring to ensure that it is being paid.

When a financial risk manager identifies a risk as a beta risk, the next step is to figure out why it’s being paid. This figuring out requires quantitative and qualitative research and both economic and statistical judgement. You need to talk to the actual people paying the premium and not rely on second-hand reports or theories. You want reliable real-time measurements of the payment, not historical averages.

Markets change rapidly and quietly (the noisy part comes months or years after the change when inattentive people discover it). Yesterday’s premium for beta is today’s sucker bet.

A financial risk manager’s other job with beta risk is to ensure that your business has the resources and contingency plans to deal with extreme beta outcomes, which I tell you how to do in other chapters of this book. My point here is to encourage you not to interfere with beta risk decisions. Beta risk is what financial institutions buy, sell and repackage. It’s the product, and a risk manager shouldn’t meddle with it any more than the risk manager of a food processing company should
have an opinion about what flavours are going to be popular. Risk managers are not portfolio managers, actuaries nor experts in physical asset risk.

On the other hand, risk managers should not accept the judgments of line risk managers about the potential for *tail events*, plausible extreme outcomes such as stock market bubbles or housing busts. The financial risk manager is responsible for making sure that resources are available to handle the events. That means the risk manager makes independent judgements about the potential extreme events, assesses resources that will be available, generates contingency plans and – most importantly – makes sure that all stakeholders are aware of the limits. No institution can survive all conceivable events, and no risk manager should undertake to guarantee that. What you can do is make sure of a consensus among affected parties about what can be done in bad scenarios and what levels of failure are possible.

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**Tasting different-flavoured betas**

You need to understand beta in a single-factor framework to understand the key principles of risk management. But you also hear people add adjectives to beta: *Fama-French betas*, *exotic* betas and *smart* betas, for example. These refinements are not necessary to understand risk management, but they can deepen your appreciation for beta and alpha.

**Fama-French betas:** Gene Fama and Ken French are two of the greatest finance professors in history. Fama has a Nobel prize and is known as the father of efficient markets. He is the clear leader among the finance researchers who churned out the massive empirical research supporting the efficient market hypothesis and the capital asset pricing model (CAPM) in the 1960s and 1970s. More than any other individual, he is responsible for convincing people that single-factor beta is a bedrock of financial theory.

Therefore it was a shock to many people when Fama declared in 1992, ‘Beta as the sole variable explaining returns on stocks is dead.’ This statement is a pithy way of summarising work he had done with French on factor betas. Fama and French proposed a three-factor set up – some other factor beta models use more. Adding multiple factor betas means is that strategies that had previously been thought of as alpha strategies were now designated as beta strategies – earning risk premiums for bearing factor risk.

**Exotic beta:** This type of beta refers to the excess return realised from popular hedge fund strategies including convertible arbitrage and merger arbitrage. These strategies used to be considered alpha techniques, but as they became well known, they started to look more like a risk premium paid for the inherent risks of the strategies rather than a prize wrested from other investors by competitive skill.
**Smart beta:** As the name implies, this technique involves earning the market risk premium in a smarter way than by just buying all assets in proportion to their market capitalisation. Doing that guarantees that you overweight the overpriced assets and underweigh the underpriced ones; or that you load up on government bonds from countries that are profligate issuers and hold few from responsible countries that are more likely to repay. One simple approach to smart beta is to invest in companies in proportion to their revenues rather than their market capitalisation.

Risk managers should avoid having strong opinions on these issues. They should be happy to manage any intermediate cases as either beta or alpha. The important thing is that the choice be made beforehand and communicated to all stakeholders.

### Advancing with alpha

If beta is the respectable part of finance, alpha is its ne’er-do-well, playboy cousin. When critics rail against ‘speculators’, ‘casino finance’ and even the ‘great vampire squid wrapped around the face of humanity, relentlessly jamming its blood funnel into anything that smells like money’, they mean people chasing alpha. Beta is about taking risks that arise naturally in the economy and sharing them in the most efficient way. Alpha is about creating risks that didn’t otherwise exist so that winners can take from losers.

For more or less the same reasons as it’s criticised, alpha is also the glamorous, exciting part of finance. It puts the billion in hedge fund billionaire and the master in master of the universe. Alpha is the background both to swaggering winners and to pictures of dispirited laid-off employees carrying their personal effects away from the office in cardboard boxes. Beta helps the everyday economy run more smoothly; alpha leads the charge for disruptive innovation and creative destruction – things most people like in theory but hate in practice. Beta is a public mutual fund offering average returns to everyone for 0.1 per cent per year fixed fee; alpha is a secretive hedge fund that won’t take your money, and would charge you 2 per cent per year plus 20 per cent of profits if it did, and that may have your job in its crosshairs.

If you strip away the hyperbole, however, you find that alpha is just beta waiting to happen. Aggressive individuals scour the world looking for undiscovered niches to mine alpha. In the process they build the legal framework and generate the data necessary to make the niche accessible, and their trading creates the liquidity and price data that more cautious investors need. As the cost of entering the new market declines, more capital flows in,
and the expected return falls. When the expected return reaches the average market level, alpha is zero and you have a pure beta investment – one more drop in the ocean of the market portfolio. The accumulated efforts of generations of financial alpha seekers is what makes the returns for passive equity investors so high.

The risk management rules for alpha are nearly the opposite of the rules for beta. Therefore, it’s imperative to know which type of return you’re dealing with.

When things are going well, people like to claim that everything is alpha so they can take credit for the gains. When things aren’t going well, people are apt to treat everything as beta, so they can blame the market for losses. Risk managers must force people to specify in advance what they’re aiming for and hold them to that answer when the results come in. People have strong tendencies to be *closet indexers*, claiming that their strategies are alpha so they can swagger and charge high fees, but really running beta strategies so they can be like everyone else. (In the words of economist John Maynard Keynes, ‘Worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally.’) If the risk manager is fooled by such things, it can lead to ill-advised risk-management decisions.

With beta, the financial risk manager leaves management of the underlying risk to the front office, and works contingency plans for extreme events. The risk manager also tries to understand and monitor the other side.

Because the person paying you to take beta risk wants to pay you, you must be as transparent as possible, and keep communication open. A successful business doesn’t hide from its customers. If you can’t find the people paying you to take beta risk, you’re probably not being paid.

Alpha is won by people who don’t know that they’re paying you – in fact, they probably think that you’re paying them. You don’t want transparency or communication. In fact, you usually don’t know who they are. You detect their presence indirectly through trading patterns or effects on returns. The people on the other end of your beta trade are your willing customers, and you want to understand and help them. The people on the other end of your
alpha trade are competitors, and you want to beat them. You don’t particularly care why they do what they do, you just want to be sure that you get warning before they stop doing it.

With alpha trades, you don’t prepare to survive tail events; you work to prevent them. You institute stop losses, and rigorous sizing algorithms. You rely on drawdown control and limits, not capital or cash buffers. (I discuss these methods in the chapters in Part III.) You don’t ignore the underlying risk; you analyse it obsessively.

The risk of a beta trade is the extreme event that wipes out your investment before you can realise the long-run positive expected return of the strategy. The risk of an alpha trade is that you’re wrong, that you don’t have alpha, and that your long-run expected return is negative. Beta trades blow up. Alpha trades suffer from long-term attrition.

**Deriving Greeks**

The next set of Greek letters comes from derivative pricing rather than portfolio management. These Greek terms have to do with the mathematical structure of risk rather than its economic basis. Over the last 30 years, the concepts have spread from derivative trading shops to all parts of finance.

**Dealing with delta**

The simplest kind of risk is delta ($\Delta$) exposure. Despite its relative simplicity, delta risk is by far the largest risk in finance and has caused the biggest disasters (see the sidebar, ‘Feeling delta force’).

*Delta risk* is linear exposure to a market factor. For example, if you buy one share of stock, you make a pound if the stock goes up a pound in price, and you lose a pound if the stock goes down a pound in price. You have a *delta one* exposure to the stock price. In other cases your delta exposure can be a number other than one. For example, if you buy 100 shares of stocks you make 100 pounds if the stock goes up 1 pound per share. As long as there’s a constant ratio of your gain and loss to the change in the underlying market price, it’s a delta exposure.
Feeling delta force

Jérôme Kerviel was a delta one trader who cost his employer, Société Générale, over £4 billion ($7 billion) in 2008 – the largest rogue trading loss in history (or at least the largest publicly admitted!). Delta one meant he was supposed to transact in securities that had only delta risk, then hedge those positions with futures contracts which exactly offset the delta for riskless positions. In his case, it meant either buying or selling all 50 stocks in the Eurostoxx 50 index, then taking the opposite position in Eurostoxx 50 futures. In theory this situation allowed Société Générale to capture small price discrepancies with zero risk. In practice, Kerviel did not offset his trades, so the bank had a huge loss when stock prices declined sharply.

Three years later, Kweku Adoboli did essentially the same thing for UBS, although only to the tune of £1.3 billion ($2 billion). Nick Leeson destroyed Barings Bank in 1995 by losing £1.3 billion ($2 billion) in Japanese stock through delta one trading.

But the purest example of delta one disasters was instigated by Joseph Jett of Kidder Peabody in 1994. A US Treasury bond promises a series of cash flows. For example, a $1 million, 2 per cent, five-year treasury note pays $10,000 every six months ($1 million × .02 / 2), plus $1 million at maturity, for a total of 11 payments. Upon request, the Treasury will strip your bond into 11 individual payments or, if you collect the 11 individual payments, will reconstitute it into the original note. Both notes and strips trade actively in the financial markets, and sometimes you can earn a small profit by buying notes, stripping them, and selling the pieces, or by buying the pieces, reconing (reconstituting) them, and selling the note.

This was Jett’s job. However, he discovered that if he told Kidder’s accounting system that he was planning to strip a bond, then that he was planning to recon those pieces, it generated a small profit. So Jett didn’t even have to trade, he could just enter his intention to make future trades – trades that had zero economic substance and exactly offset – and he could be Kidder’s star trader and be paid a £5.8 million ($9.3 million bonus). Jett created £225 million ($350 million) of fictitious profits, which of course never materialized.

These cases are just the headline ones. Many smaller examples that don’t get much attention can also be found, as well as examples that are never disclosed at all.

Why does the simplest kind of exposure seem to lead to so many gigantic losses? One reason is that the profits from such simple activities are so small that you need to do them in huge amounts. Another is that they’re considered so simple that the weakest traders are assigned to them, overseen by the weakest risk managers. People are slow to suspect trouble, because the trade is so simple.

The risk management lesson is clear: Manage risk where the risk is, not where you think it ought to be. Simple and transparent losses hurt just as much as complex and opaque ones – and they’re apt to be bigger and to make you look more foolish.

In principle, you can add a delta exposure for every position in your portfolio. That isn’t useful, however, as your delta exposures would be simply a list of your portfolio holdings. You’re better off aggregating so you have a manageable number of delta risks to track.
For example, you can aggregate all your equity investments into a single delta exposure to the stock market, all your bond investments to a single delta exposure to interest rates and all your commodity investments to a single delta exposure to commodity prices. This aggregation allows you to see the main bets on market direction using three numbers, and to separate the result of those bets from the tracking error, defined as the difference between your actual portfolio returns and the return on a portfolio of index funds with the same delta exposures.

Different financial institutions aggregate delta exposures in different ways. An active manager who invests only in equities probably doesn’t use a single delta exposure to the stock market but thinks of her portfolio as having exposures to industries, countries or other market factors. A US treasury fund doesn’t have a single delta to interest rates, but deltas to different maturity bonds like two-year and ten-year. Some managers, generally hedge fund managers, run market neutral or absolute return portfolios that try to make deltas zero (that is, on average over time, most of them allow conditional positive or negative deltas as long as they average to zero). Other managers benchmark to a specific delta, or to the delta of a liability stream.

A risk manager’s first job is to ensure that deltas are properly computed and communicated – not to have an opinion about the amount of delta exposure. Your second job is to limit the exposure to factors that cut across the measured deltas. In 2007, for example, many institutions thought they had zero delta exposure to subprime mortgages, because they didn’t deal in that asset class. Too many of them discovered that they had catastrophic levels of subprime delta exposure.

Going with gamma

Gamma (γ) exposure is the risk from changing delta exposure. If you buy a stock, your delta exposure to that stock doesn’t change as the stock goes up and down in price. You make the same £1 when the stock goes from £20 to £21 as when it goes from £50 to £51. But that’s not true of all assets. For example, if you buy a bond in a sound company, the price of your bond isn’t affected much by the ups and downs of the company. Your payments are fixed. But if the company does badly, your payments are threatened, and your
bond starts moving up and down in price depending on the company’s success. This situation is **negative gamma exposure** in which you can lose a lot if the company does badly, but you don’t win a lot if the company does well.

Positive gamma exposure is also possible. If you buy a convertible bond and the company does well, you can convert the bond to stock and take advantage of the increase in stock price. If the company doesn’t do well, you can hold on to your bond and collect your fixed payment. Of course, if the company does really badly, you may not get that fixed payment, but for many convertible bonds there’s more positive gamma from the conversion option than negative gamma from the default possibility.

You can also generate positive or negative gamma with a trading strategy. If you’re a **momentum investor**, buying more when you win and selling back when you lose, you have positive gamma. Big up moves make you lots of money because you keep buying into the increase. Big down moves don’t cost you much because you sell off on the way down. Of course, a cost applies to this strategy. If the price goes up and back down, you lose because you buy after it goes up, and suffer more from the loss. You also lose in the opposite case, when the price goes down and you sell, and therefore get less benefit if the price goes back up.

A **value investor**, someone who buys after the price goes down and sells after the price goes up, has negative gamma. She makes money when prices bob up and down without moving much net but loses when prices make big moves.

In general, positive gamma investors like big moves and negative gamma investors like lots of volatility without much net movement (when prices don’t move at all, few financial professionals are happy, although everyone outside the industry thinks calm markets are good). Some financial institutions are naturally positive or negative gamma, or possibly positive gamma in some market factors and negative gamma in other market factors. Other institutions manage their gamma exposures according to current market views.

At first blush, you may think that positive gamma exposure is good risk. You can make a lot, but you can’t lose a lot. If there’s an unexpected, dramatic event, good or bad, you win. This intuition is fine, so hold onto it, but you can
think in another, equally important, way about gamma exposure: positive gamma assets or strategies pay a cost on the ordinary days when nothing much happens. This cost is like an insurance premium or buying a lottery ticket that doesn’t win. The strategies are designed to repay the accumulated premium losses or ticket purchase prices when a big move comes along. But what if they don’t pay off? That is, what if the insurance company finds some fine print to refuse payment or the lottery commission goes broke? From this perspective, the negative gamma strategy that pays you cash every day seems safer. When the big move comes, you won’t be looking for the market to pay you off, so you can’t be disappointed.

As with delta exposure, financial risk managers make sure to measure and communicate all gamma exposure. But they have more of an opinion about it. Good or bad delta exposure doesn’t exist, line risk takers should pick the exposures they want within limits set by institutional policy. But good gamma risk does exist, and it pays more than it costs; and bad gamma risk also exists, and it costs more than it pays. If line risk takers are taking positive gamma, the financial risk manager counts up the cost and makes sure that the anticipated benefit is large enough and secure enough to cover the accumulated costs. If line risk takers are taking negative gamma, the financial risk manager makes sure that the revenue is accumulated in a reserve account large enough to pay off the occasional large losses.

The extreme of bad gamma exposure is forced gamma exposure. If losses force you to reduce positions, you’re buying positive gamma, and your purchase is virtually guaranteed to be at a time when positive gamma is wildly overpriced. This situation is the opposite of risk management – your risks are managing you. This problem comes from running a negative gamma portfolio without sufficient capital reserves. You can also lose the opposite way. If you run positive gamma at a level that you can’t afford, the everyday losses may force you out of the market before you can collect.

Unfortunately, for reasons I discuss in other chapters, bad gamma risk management feels good and often looks good in the accounting system. Without rigorous and disciplined quantitative risk management, institutions can easily become addicted to gamma to the point where it becomes toxic. The apparent steady, easy, riskless profits of negative
gamma exposure can lead to a blow up when an unexpected big move occurs. Alternatively, reporting systems that make the speculative future profits from positive gamma exposure look like cash in the bank today can lead to sudden discoveries that the firm is insolvent.

**Vying with vega**

Okay, vega isn’t a Greek letter. Some anonymous trader, around 1985 or so, thought it was. Or maybe she had no idea the other Greek terms were Greek letters, so she thought she could use any name she wanted. For reasons I won’t go into here, vega is also a confused mathematical term, not analogous to delta and gamma. But misnamed and confused as it is, vega is a key type of exposure that emerged in the mid-80s options markets and has since spread to all financial markets.

Vega is similar to gamma (see the preceding section), but it operates on market expectations rather than actual moves. If you have positive gamma exposure, you want big moves. If you have positive vega exposure, you want other people to expect big moves. Of course, the two often go together – a big move makes people think other big moves are coming – but they’re not always the same. In fact, a lot of financial strategies are based on exploiting the difference.

**Why does gamma have this twin exposure (vega), but delta doesn’t?**

If people expect an asset’s price to go up, they buy the asset, and its price goes up. There’s no difference between expectation and reality (that’s not always exactly true, for example in futures markets, but the difference is material only for some specialised kinds of trading). But if people expect a price to move a lot, but don’t know in which direction, there’s no reason for the price to move now. Therefore, you have to distinguish carefully between positions and strategies that profit from big moves, and ones that profit from expectations of big moves. Even experienced professionals have been known to forget this.

Risk management of vega exposure is necessarily more subjective and less quantitative than risk management of other Greeks, because vega depends directly on market psychology. Vega is the easiest Greek to exploit for profit, and the most unpredictable one, especially for quantitative risk managers like
Vega is the reason that the same financial institutions can be on the top of the world for generations, despite gigantic mistakes and scandals, and also the reason those institutions can disappear overnight for no obvious short-term reason.

Most profitable financial strategies are short vega. The folk wisdom version of short vega is, ‘Buy when there is blood in the streets’, which means bet against the panicked people who expect gigantic change. This short vega bias is a direct result of the fact that psychology tends to make people more comfortable in long vega positions, and institutional forces push institutions in the same direction. Unfortunately, this bias means that when everyone decides things are risky, most financial institutions are losing money just at the time when liquidity problems, investor over-reaction and panic are likely to occur.

Because no one has discovered the holy grail of long vega, consistently profitable positions (at least not with sufficient capacity to make much difference to the financial system as a whole), the risk management response is to accept the risk of short vega, but put in some tail hedges for the extreme events. These tail hedges are expensive and unpopular, which is a good thing. They force those at the highest level of institutions to discuss tail events with the focus that only paying out large amounts of money brings.

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**Toasting to my lost billion**

I started my financial career as a trader, and traders always track their *number* for the year, the total profit or loss of the accounts for which they have direct trading authority. I remember the first time, 20 years ago, when I had more than a billion dollar loss for the year.

I’ve had similar losses several times since, to the point where I wondered if I would end my financial career with more trading losses than anyone else in history (I concluded it was unlikely, but not inconceivable).

As a risk manager, my number isn’t relevant – most of my accounts are hedge accounts, and hedges are generally expected to lose money. Moreover, risk managers don’t judge success by how much money the hedge made or lost, but by whether it accomplished its purpose. So, I know that it shouldn’t matter, but I still drink a sad, silent toast to the lost money on New Year’s Eve. I have never made $1 billion on portfolios for which I had direct trading responsibility, and the good years I have had are (of course) some of the worst years for the financial system, so I’m not about to celebrate.
**Timing with theta**

Risk management is mostly about uncertainty. Theta (θ) is exposure to the passage of time, one of the few certain things in the universe (at least as perceived by macroscopic humans who don’t travel near the speed of light).

It has another, older, name: *carry*. Most financial strategies look for positive carry. For example, people like to borrow money in low-interest-rate currencies and invest it in high-interest-rate currencies. That way if prices don’t move, you make a profit, which makes it seems like the game is rigged a bit in your favour. In fact, negative carry assets are also known as *wasting assets*, which sound like something that no one wants.

The risk management of theta is similar to gamma (see the section ‘Going with gamma’). If you have positive theta, if you’re earning net carry, the risk manager looks for what risk you’re accepting in return for that carry. In the case of borrowing in low-interest-rate currencies and investing in high-interest-rate currencies, the obvious risk is that the value of the high-interest-rate currency will fall relative to the low-interest-rate currency. Another important consideration is whether you can *monetise* the carry, or receive it in cash. If the carry accrues in paper profits but cannot be easily converted to cash, the risk manager should be suspicious.

If you’re paying net carry, the risk manager needs to evaluate the security of the payment you expect to get in return.

Risk managers traditionally dislike carry trades. The chief risk officer of a major global financial institution used to have direct reports stand up and shout together, ‘I hate the carry trade.’ The reason isn’t that carry trades are bad – carry is one of the most consistent money-makers in finance – the reason is that they’re so simple and popular that people and institutions get addicted to them. It’s a good bet that lots of dumb people can be found in carry trades, meaning that when markets are stressed, they all run at the same time.

**Wrestling with rho**

*Rho* (003A1) is the exposure of a portfolio to changes in short-term financing rates while holding long-term interest rates constant. Most financial institutions are naturally *short rho*, which means that they lose money when financing is expensive. Short rho is really dangerous if your risky asset
positions are illiquid. This situation is one of the classic ways to blow up.

Even with liquid positions, traditional risk managers nearly always prefer to limit how much short rho exposure the institution takes. You can accomplish this limitation by borrowing money on a term basis and keeping the proceeds in cash. The 2007–2009 financial crisis changed that calculation somewhat, as the risks to holding cash can exceed the risks to losing financing. So today rho is treated as a two-sided risk, limited on both the long side and the short side.

All the Greeks have a habit of falling apart in a crisis. You think that you have a controlled net exposure to a single market factor, and you discover that instead you have dozens of exposures to specific positions which aren’t moving together the way your models predict. Rho is the worst of the Greeks in this respect. In crises, financing and reinvestment rates can diverge wildly in different markets and participants or become undefined altogether.

**Bonding**

The set of Greeks in these sections are older than modern finance as they were developed in the early years of the 20th century. That was before mathematics came to finance, so none of them is represented by Greek letters. However, I cover them in this chapter because they’re the same kind of aggregated market exposures as the modern portfolio theory and derivative pricing. Originally developed for bond portfolios, people quickly realised that they’re relevant to all financial instruments.

**Enduring duration**

*Duration* is weighted average time to payment or receipt of cash flows in a portfolio. Unlike the other Greeks in this chapter, duration isn’t concerned with changes in the market value of a portfolio. This fact is what distinguishes it from a delta exposure to long-term bonds (I talk about delta earlier in the section ‘Dealing with delta’).

Imagine that you run a pension fund that buys bonds that promise specific cash flows at various times in the future. Your pension fund also has liabilities it must pay to beneficiaries. The safest way to arrange things is to make sure that at every point in time in the future, the bonds generate at least as much cash as the liabilities require.
But suppose you don’t match your liability cash flows exactly. In that case, you have two kinds of risk:

- **Reinvestment risk** occurs when the cash comes in before the liability is due, and you don’t know what rate you’ll earn reinvesting it.
- **Price risk** comes in when the liability comes due before the cash comes in, so you have to sell the bond before maturity, and you don’t know what price you’ll get.

If the duration of your assets matches the duration of your liabilities, your reinvestment risk offsets your price risk. That doesn’t mean that your position is riskless. Different interest rates can change different amounts. But generally you have less risk with matched durations than if you have systematically more exposure to reinvestment risk than price risk or vice versa. Also, it certainly makes sense to track asset and liability durations in order to know what levels of reinvestment rates and bond yields your pension fund can tolerate.

A real pension fund does much more sophisticated modelling of its cash flows than is suggested by duration, although duration is still a useful metric. But what about more complex portfolios and organisations? They hold all kinds of assets with hard-to-predict cash flows, and they trade them all the time, and they have complex liabilities as well.

In the end, however, it all comes down to cash. A complex instrument or strategy may be valued using Monte Carlo analysis (which I talk about in Chapter 7), generating thousands or millions of potential future sets of cash flow, but those cash flows are still discounted to a present value.

If the duration of your liabilities is less than the duration of your assets, then you’re counting on either raising capital or selling assets to survive. If the duration of your liabilities is greater than the duration of your assets, then you’re counting on finding opportunities for reinvestment.

Complex financial institutions have both situations in different businesses, different currencies, and different legal entities. This probably means that the institution is counting on transfers among businesses and legal entities and currency conversions. Treasury is the department responsible for tracking all of this and planning ahead to meet obligations. Risk managers look to simple
aggregate measures like duration as an independent check on this process.

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**Show me the money**

A lot of the most destructive risks in finance show up in the gap between real cash flows and accounting systems. In the book *Too Big to Fail*, Andrew Ross Sorkin describes JP Morgan CEO Jamie Dimon’s reaction to AIG’s claim about the amount of cash it had on hand. He told AIG CEO Bob Willumstad that his cash number came from ‘a f***** up process … You guys need to get a handle on the numbers. The real numbers. You need to sit down with those numbers and figure out the size of the real hole, not the made-up hole …real work…. This isn’t like, you know, you’re going to be late on your credit card bill.’

While this is a particularly dramatic example, the same thing happens at lower levels every day. Line risk takers present information they read off a computer screen. The risk manager insists that all information and calculations be traced back to actual cash flows. As I have often put it, ‘We’re not playing video games here.’ Risk managers shouldn’t argue about traders’ marks (the valuation a trader puts on a position), they should insist that the trader sells a portion of the position to remove all doubt. And that sale must be to an unrelated entity for real, immediate cash.

Some risk takers have no difficulty doing this. They know every step of their business from cash in to cash out. Others have only vague (and often erroneous) ideas about how things settle into actual cash, or even what actual cash is (hint: it's not a vault filled with pound notes). There is an important risk management advantage to having everyone understand the whole process, not just their part in it.

It’s also true that when you compute Greeks to actual cash flows, they’re quite different from accounting systems or model Greeks. But real cash is what you need to know about when any of this stuff matters. The models are better at making things pretty when risk management doesn’t matter much.

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**Conquering convexity**

Convexity is to duration what gamma is to delta. Convexity is the exposure from changes in duration. Go back to the pension fund example in the preceding section, and assume that it has a stream of projected liabilities that go out over the next 50 years, with a duration of 10 years. The assets are all invested in a ten-year, zero-coupon bond. That’s a bond that pays a single lump sum in ten years.

Duration is the weighted average time to cash flow, weighted by the present value of the cash flow. A ten-year, zero-coupon bond always has a duration of ten years, because all the cash flow is at that time. But if
interest rates go up, the present value of the distant liabilities fall relative to the near liabilities, meaning that the distant liabilities get less weight in the weighted average, meaning the duration of the liabilities shrinks. When interest rates go up, both assets and liabilities fall in present value in proportion to duration. Because the asset duration is ten years, and the liability duration has fallen to less than ten years, the assets fall more in value than the liabilities and the pension fund loses net value. If interest rates fall, the duration of the liabilities increases, and the assets increase in value less than the liabilities. Either way, the pension fund loses. It has negative convexity exposure.

It’s a pretty good general rule that convexity is overpriced in the market, meaning that you want to earn the spread from being short convexity – paying the sharp losses from occasional big moves in interest rates. That makes it similar to carry (due to the sign conventions, that means short convexity is similar to being long theta, which I talk about in the previous section, ‘Timing with theta’). It’s an important and generally reliable source of profit in a wide variety of markets, but is also a popular position for foolish people with weak hands who bail out when it turns against them.

**Optioning spreads**

Option-adjusted spread (OAS) is also not a Greek letter. OAS is an attempt to get a little more sophisticated about cash flow timing risk than relying on duration and convexity. It was invented for mortgage securities in the late 1980s and is now used in many markets.

I thought hard about whether or not to include it in this chapter. OAS is more complex and model-dependent than the other Greeks. Greeks are supposed to be measurements of exposure, not opinions about them. OAS is a little bit of both. I decided to compromise by mentioning it, because you may see it on risk reports where duration and convexity used to be. I don’t explain how to compute it, because for one reason, it’s beyond the technical level of this book; and for another, no two people compute it the same way.

OAS is the yield on a portfolio after the expected losses from short convexity are subtracted out (or, in principle, after the expected gains from long convexity are added back, but I have never seen an application with long convexity). That makes it the analogue of alpha for cash flows.
Risk management is similar to alpha risk management. The risk manager must analyse it in detail to understand both the source of the OAS and the model the OAS is derived from. It should be monitored and controlled tightly with stop losses, draw-down control, rigorous sizing and limits. If the actual cash doesn’t match the model predictions, the risk manager must address the situation immediately.
Chapter 9
Accounting for Extremes

In This Chapter

- Understanding the two types of extreme events
- Avoiding common errors
- Accounting for multiple dimensions

Understanding extreme events is an essential part of financial risk management, and you don’t need maths for it. As risk manager, you need to be sure your company has the resources in place to survive dramatic changes such as stock market crashes or bank failures. But maintaining these resources is costly. If you insist on too high a level of protection, you can strangle the business. You need clear insight into which extreme events are plausible enough to affect your contingency planning.

When a civil engineer designs a bridge, he must think about the maximum stresses it will face: the heaviest loads, the biggest earthquakes, the highest floods and so on. Risk managers face the same issue when approving products and businesses and when setting limits and making contingency plans. Of course, financial risk managers are more concerned with political and market events than with physical risks (although physical risks pop up from time to time).

You must maintain focus when considering stresses and extremes. Don’t be foolish and ask, ‘What’s the most extreme thing that can happen?’ because anything’s possible. No one can build a bridge guaranteed to last forever, and no one can make a financial decision guaranteed not to be regretted.

Extreme event analysis is about calibration. You wouldn’t design a bridge to withstand the biggest earthquake likely to occur in a million years that can’t withstand an expected ten-year flood. You also wouldn’t plan a bridge so
solid that it would survive disasters likely to wipe out the roads on both sides of it. Neither do you want to make your wealth management plan so solid it can withstand any and every extreme market factor – if putting the money under a mattress would earn you a better return!

**Distinguishing Extremes**

People use the term *extreme event* in two different senses in finance, and this dual use often causes confusion:

- ✔️ The first sense is the normal English meaning of dramatic, high-impact event – usually bad. Risk managers ask questions like, ‘How likely is an equity crash of 50 per cent or more, and if it happens, how low can the market plausibly go?’

  Risk managers of all types care about extreme market events. For example:
  - A pension fund manager wants to know the plausible extreme decline in the funded status over a quarter due to investment portfolio losses and increases in obligations to beneficiaries.
  - A bank treasurer wants to know the plausible extreme credit losses that can occur in the bank’s investment portfolio over a year.
  - The manager of an oil refinery wants to know the maximum plausible change in the spread between crude oil and gasoline prices that may occur in a week.

  ✔️ The second sense of extreme event is calmer. It comes from mathematics where *extreme* merely means the biggest or smallest element of a set. The extreme need not be particularly dramatic nor need it have high impact, and there’s no connotation of good or bad.

  Risk managers care about the cumulative impact of the biggest events, even if none of those events has a large individual impact.

In some businesses and strategies, long-term outcome is determined mainly by the everyday ups and downs; in others, long-term outcome depends mainly on a small subset of extreme events. For example:

- ✔️ An investment of £1 in the S&P 500 index at the beginning of 1927 was
worth £307 in 2014. But all of that gain comes from the best 90 days in the stock market – roughly 1 day per year. All the other days net out to zero gain. Most of those 90 good days were 5 per cent gains – good days but not particularly dramatic. In inflation-adjusted terms, just 39 days represent the entire real gain in the stock market; all the other days just make up for the 93 per cent decline in the value of the dollar. Losses are more concentrated than gains, just five days cut the total return since 1927 in half. If an investor had avoided those five days, he’d have £602 instead of £307.

On a typical day, out of all the 500 stocks in the S&P 500, the one with the largest effect (the stock with a large weight in the index that moves a lot on the day) accounts for nearly 10 per cent of the total move in the index. Usually these are not even dramatic events for the company involved, and by definition they’re not caused by dramatic, economy-wide events.

Around 100,000 banks exist in the world, with around £60 trillion ($100 trillion) in assets. The 100 largest banks have nearly 90 per cent of the total assets. Banks in the top 100 have frequently failed in the past without dramatic global consequences. But anything that affects all these top banks, even though they represent only 0.1 per cent of all banks, pretty much affects the entire global banking system. If the other 99.9 per cent of banks all failed, it’s not obvious that it would have a large impact on the global economy. No doubt the failures would cause a lot of local confusion and pain and may touch off a chain of events with global consequences, but the immediate direct impact on the financial system may well be less than the effect of one top-ten bank failing.

In situations in which a small number of extreme events have a large impact on overall results, risk managers must consider the statistical properties of the extreme events. These often differ from statistical properties estimated from the many ordinary events.

For example, on extreme days the correlation among stocks is high. If you estimate the advantage of diversification by looking only at ordinary days, you give it too much credit as a mitigating factor for risk on extreme days when most or all stocks act the same. Because those rare extreme days are important to your total return, even over long investment horizons, you
seriously underestimate the risk of investing in stocks if you don’t take into account the similarities during extreme events.

More generally, any time that extreme events dominate long-term outcomes creates uncertainty about statistical projections. A year of daily data about stock returns may seem like a reasonable sample. On average, however, that sample contains only one extreme day. If it contains zero or two or more extreme days, any statistics generated from the sample may be misleading. Even if the year contains exactly one extreme day, that day may not be a typical extreme day.

So, a risk manager is forced to go further back in time to analyse market behaviour in the hope of getting a good representative sample of extreme events. But he has no guarantee that even that will help. It may be true that more and more extreme events dominate outcomes at longer and longer time horizons. Moreover, older data may not be representative of current market conditions, or it may not be available at all. So you want to be sure that extreme events dominate long-term outcomes before you embark on this path.

Many extreme events consist of unusual combinations of non-extreme moves. For example, an oil refinery’s profit depends on the price it can sell its refined products for minus the price it pays for crude oil. If both prices go up or down together, it makes little difference for the refinery. But if the price of refined products goes down while the price of crude oil goes up, even if neither price movement is particularly big, the refinery may be unable to operate at a profit.

**Spotting Extreme Fallacies**

Extreme event analysis is one of the most mathematically intense parts of financial risk management. With everyday events, you have enough data that no amount of fancy mathematical assumptions can change your conclusions much. Speculating about events far beyond any historical experience requires theory (and likely, overconfidence), not maths. But when you’re looking at a few of the largest past events and trying to think about plausible extreme future events, there’s just enough data to support enthusiastic mathematical modelling without having enough data to rein in wild ideas.
Fortunately, you don’t need a PhD in mathematics to spot the logical errors that people make when thinking about extremes. These errors are as common among sophisticated mathematical types as seat-of-the-pants flyers. So don’t be intimidated by complex jargon and cryptic equations, and don’t automatically defer to people with lots of practical experience. Just keep your head on straight and ask the simple questions.

**Using the past as a predictor – Just say no**

A man falls out of a 40th-floor window. As he passes the second floor he thinks, ‘Well, so far, so good.’ Think of this man whenever someone tells you not to worry about potential disaster because nothing bad has happened in the past.

If you prefer a more intellectual example, consider philosopher Bertrand Russell’s famous example of the Christmas turkey. Every day for a year, the farmer feeds the turkey at nine in the morning. The turkey observes that the farmer is solicitous of its welfare, provides for all its needs, protects it from predators, is concerned when it’s sick and so forth. The turkey looks forward to a long life of luxury. Then on Christmas Eve, instead of feeding the turkey, the farmer slits its throat.

The point isn’t just that the turkey relied too much on past evidence, it’s that the turkey made too simple an extrapolation. ‘What happens today is likely to be the same as what happened yesterday,’ isn’t always sound reasoning. You have to think about why the farmer is helping the turkey. Does he love it and want it to be healthy and happy? Or does he plan to eat it and want it to be fat? The turkey should consider these and other hypotheses and try to do experiments that distinguish among them.

Similarly, suppose that someone shows you a trading strategy that made money in the past without experiencing large draw downs. That may be because the strategy is a good one, likely to continue its attractive risk-adjusted performance. Or it may be a bubble in which good returns are attracting more investor money, pushing up prices and returns and attracting more money in an upward spiral that precedes a gigantic crash. When the giant crash comes, the losses are many times more than the worst losses during the run up. Another hypothesis is that the trading strategy is ‘picking up pennies in front of a steamroller,’ a strategy in which large losses wipe out frequent small gains – there just hasn’t been a large loss in the recent past.
Risk managers have to consider a range of hypotheses as they consider arguments based on historical data. Lots of people look at recent historical data, form a conclusion, and then consider things that may render the data irrelevant or unreliable. However, it’s hard to be properly sceptical about the data after you form an attractive hypothesis, so the order is really important. Before searching for riches, ask questions like:

- Who pays the money that becomes the profit in this strategy?
- Why do they pay it?
- What other people are doing this and why?
- What other people aren’t doing this and why not?
- Can this strategy succeed at a steady rate forever and, if not, what happens when it stops?
- Have there been analogous strategies in the past, and what happened to them?

A simpler way to say this is: Consider the economics before you look at the statistics. In finance, you can find no better example of this maxim than Bernie Madoff’s investment record. He reported returns of over 10 per cent per year for 17 years, with only 4 small down months. In this case, the lack of losing months was a danger sign rather than a reason for investors to relax.

The wrong lesson to learn from these stories is to look for opportunities that have often crashed in the past. The right lesson is to consider the present and future before examining the past. Financial risk managers ask, ‘If we wanted to get out of this strategy and monetise all of our reported historical gains, could we do it?’ If the answer is ‘no’ or ‘I’m not sure’ or ‘yes, but it would take a while,’ then the lack of historical losses is more cause for worry than reassurance. The other question is, ‘Can this business continue indefinitely, or is there a practical, clearly understood exit strategy?’ If the answer is ‘no,’ then you need a plan for when the music stops, not just a plan for the worst
losses that have been observed in the past.

**Assuming a normal distribution – You know what it makes you and me**

Another way to make errors about extreme events is to assume a normal distribution, also known as a bell-shaped curve or Gaussian distribution.

A *statistical distribution* is an assumption about the shape of some data. Consider the amounts by which the pound sterling has appreciated or depreciated versus the US dollar over the last 43 years. **Figure 9-1** shows the actual data as columns and a smooth curve that fits the data to a normal distribution.

![Figure 9-1: A bell-shaped Gaussian distribution curve.](image)

The curve in **Figure 9-1** seems like a pretty good fit to the data. It’s easy to imagine that it’s the true probability distribution of annual exchange rate...
changes, and that the difference between the curve and the actual realizations in the columns is just random noise. If so, you may prefer the smooth curve to the noisy data to predict the probability of future exchange rate moves. The curve also has the advantage of making predictions for tail events not observed in the data, such as a depreciation of more than 20 per cent or appreciation of more than 15 per cent.

Before considering the dangers of making that assumption, consider another data set – the average number of goals scored per game in World Cup matches. In three of the 20 competitions, there were between 2.0 and 2.5 goals per game (the 1990 World Cup in Italy, the 2006 in Germany and the 2010 in South Africa). In 11 World Cups, the average was between 2.5 and 3.0. There were no World Cups with an average between 3.0 and 3.5; two had averages between 3.5 and 4.0; and so on up to one World Cup (1954 in Switzerland) that averaged between 5.0 and 5.5 goals per game.

Although the normal distribution curve isn’t a good fit to this data, it actually has the same average value (3.1 goals) and the same 0.9 standard deviation (a measure of the spread of the data around the mean). In this case, it would obviously be very foolish to use the fitted distribution instead of the actual data. For example, the normal distribution assumption implies there’s better than an even chance that more than 3 goals per game will be scored in the 2018 World Cup in Russia. The actual probability is far lower than that.

There are an infinite number of other shapes I could have assumed, some of which would fit the data much better (that is, the curve would be a closer match to the columns). The normal distribution, with its bell shape, is a very popular choice, sometimes even when it doesn’t fit the data well. Moreover, many quantitative methods assume a normal distribution implicitly, and an analyst is not even aware of it.

Nassim Taleb, a trader and philosopher who wrote the bestsellers *Fooled by Randomness* and *The Black Swan* (both published by Random House), calls the normal distribution *GIF* for *great intellectual fraud*. I won’t go that far; situations do exist in which normal analysis can give insight, and professional statisticians know how to guard against some of its dangers.

Assuming a normal distribution does far more harm than good in risk
management, especially when amateurs do it, and even more especially when they do it unconsciously.

**Deviating wildly**

Risk expert Philippe Jorion analysed the 1998 collapse of the hedge fund Long-Term Capital Management, and said that the fund had been hit by an 8 standard deviation event. Another risk expert, Hillary Till, said that hedge fund Amaranth Advisors failed in 2006 because it was hit by a 9 standard deviation event. During the 2008 financial crisis, Goldman’s chief financial officer, David Viniar, said, ‘We were seeing things that were 25 standard deviation moves, several days in a row.’

These standard deviation comments are a more or less random selection about extreme events. What's strange about them is big standard deviation moves are not necessarily unusual. Eight standard deviation days can happen 1 day in 64, about once every 3 months. Nine standard deviation days are rarer; they can't happen more than 1 day in 81, about once every 4 months. And 25 standard deviation days? No more than 1 every 625 days, about once every 2.5 years.

Why do people hyperventilate about these not-so-unusual events? Because they’re implicitly assuming that events follow a normal distribution, in which case 8 standard deviation events are expected once every 3 trillion years (more than 200 times the age of the universe), 9 standard deviation events once every 17 quadrillion years (1.2 million times the age of the universe) and let's not even talk about 25 standard deviation events. Just saying those numbers tells you how ridiculous the statements are.

There are two kinds of five standard deviation events. Suppose you're flipping a fair coin and get 25 heads in a row. That's a five standard deviation event that virtually never happens. In general, you need to flip $n^2$ heads in a row for an $n$ standard deviation event, 25 for a five standard deviation event, 36 for a six standard deviation event and so on. These are the only type of 5+ standard deviation events if you assume a normal distribution. If someone claims to have observed one of these in practical finance, tell them from me that he either misestimated the standard deviation, or he wasn't looking at a normal distribution.

But here’s another kind of five standard deviation event: Put one two-headed coin and 25 fair coins (with both heads and tails) in a hat and pick one at random. Flip it 25 times and if you get all heads, it was a five standard deviation event, yet it will happen one time in 26 (in general, for an $n$ standard deviation event, mix one two-headed coin in with $n^2$ fair coins). So if someone claims a 5+ standard deviation event in practical finance, and they’ve measured standard deviation correctly, you know this is the kind of event you’re looking at.

The normal distribution is actually not normal at all – you never run into one in real life, even when people try to create one. A normal
distribution has many special properties that mislead people whether they know they’re assuming a normal distribution or not.

For one thing, in the normal distribution the *mode* (the most commonly observed value), the *mean* (the average value) and the *median* (the value that half the observations are below and half are above) are all the same. If you have even a few everyday observations, you can get a good idea about the mode and the median, but it’s a gigantic assumption to think that these values give a good estimate of your long-term mean.

In studying household wealth in the United States, you quickly find that the most common values are under $10,000 – about 8 per cent of households have negative net worth (owe more than they own) and another 14 per cent have small positive wealth, less than $10,000. But median wealth is about $150,000. Mean net wealth is about $650,000, and unless you take a particularly large sample, you probably get not enough or too many of the few wealthy households that skew the distribution. If you go into the project assuming that wealth has a normal distribution, you almost certainly get a bad result from anything other than a huge sample, and worse, you have far too much confidence in the bad result.

But the error is more basic that assuming the mean, median and mode are all the same. The big problem arises from assuming that everyday events, or typical households, tell you anything at all about the extremes. Many things follow an approximate bell shape in the centre of the distribution, but in most cases the extreme events have entirely different causes than the things that determine everyday variation.

For example, the average height of adult males in the United States is 69 inches (5 feet, 9 inches) with a standard deviation of about 3 inches. The normal distribution is a reasonable fit to heights within two standard deviations of the mean on either side – from 5 feet 3 inches to 6 feet 3 inches. But there are far too many unusually tall and unusually short people compared to the normal distribution. These extremes are often caused by growth disorders, or nutritional deficiencies or unusual
genetics, not by the normal interplay of genes and environment that determine height for most people. You cannot study height extremes by examining the 95 per cent of people of near-average height.

**Finding invisible people**

One feature of the normal distribution is that it assigns some probability to all possible numbers from negative infinity to infinity. Students sometimes object that if human height followed a normal distribution, there should be some people with negative height. Of course, such people exist, but you can’t see them.

That was a joke. I hope you noticed. But the invisible people are a good way to remember the problem of missing data, what statisticians call a *censored sample*, and Nassim Taleb has dubbed *the silent evidence of the graveyard*. Sometimes extreme events are missing from your data. For example, the worst-performing investment funds usually are closed or merged into other funds, and it can be hard to find information about them. You often see statistics on investments that ignore financial markets that collapsed and went out of business and countries whose governments collapsed.

It’s not just a question of missing data, though. Sometimes people have the data but exclude or they recategorise extreme events (they call them *outliers*, meaning aberrant data suspected to be either an error or some unusual case that should be analyzed separately). If you want to study extremes, you first have to find *all* the extremes – including people with negative height if they exist.

Study what you want to know about. If you want to know about extreme events, study extreme events, don’t make a strong mathematical assumption — such as that your data follow a normal distribution — or use everyday data to make statements about extremes. Never say, ‘We were hit by a 25 standard deviation event,’ say, ‘We were hit by events that are pretty typical of extreme market days, only we didn’t know that until they hit us.’

**Slimming the tails**

A common complaint about the normal distribution is that it has thin tails. In a *thin-tailed distribution*, the most extreme observation isn’t a lot different from the second-most extreme. In a *fat-tailed* distribution, you see much more difference between adjacent extremes.
For example, say I tell you that today’s stock market return was the worst of the past year. If stock returns followed a normal distribution, on average today would be ten per cent worse than the previous worst day. However, on average the worst day of the year for the stock market is 50 per cent worse than the second-worst day. So stock returns have fatter tails than the normal distribution. The normal distribution is symmetrical, so it predicts the same ten per cent on the upside, if today was better than the best day of the previous year. But in fact, today averages 35 per cent better than the previous best day. So the upside stock returns also have fat tails, but not as fat as those on the downside. The technical term for this is *asymmetric*.

Even when you don’t explicitly assume a normal distribution, you tend to underestimate the probability of events much more extreme than any observed in the past.

However, not everything is fat-tailed, some things are even thinner-tailed than the normal distribution. If you look at athletic records, for example, improvements tend to be smaller and smaller, presumably because people are pushing up against physical limits. From 1966 to 1999, when the men’s 1,500-metre record was broken, the improvement averaged 2 seconds. Since 2000, the average improvement has been under 1 second. You get the thinnest possible tails when you have a natural limit to observations, such as a test with 100 questions. After one person scores zero and another person scores 100, no larger extremes are possible.

**Theorising about tails**

A subfield of statistics called *extreme value theory* involves fairly advanced mathematics and requires strong assumptions. I like it because it makes statements about the tails by studying the tails. I don’t like its strong assumptions, and I rarely find it useful in practical financial risk management. However, people write about it frequently, so I include it here.

A simplified version of extreme value theory is the assumption that the tails follow a *power law*. In the simplest power law, the frequency of events is proportional to their size, so a 20 per cent stock market crash occurs half as
often as a 10 per cent crash. A lot of phenomena seem to exhibit frequency patterns that are variations of this.

Power laws are reasonable general assumptions to make when you have little else to go on. However, the tricky part about power laws is that it’s almost impossible to use them to make useful predictions beyond the range of observed values. Unless you have some physical theory to back up your analysis, use power laws to estimate the cumulative impact of extreme events within the range of observation, not to estimate the probability of extreme events outside the range of observation.

**Painting swans black – Not accounting for the unexpected**

Another fallacy is illustrated in Nassim Taleb’s definition of a *black swan*, a rare, high-impact event that happens because it is not anticipated. Nassim has defined it in other ways, but this is the version of most use in risk management.

Before the attacks of 11 September 2001 in the United States, intelligence agencies had lots of data on airline hijackers, and all the previous hijackers wanted to survive. The data on suicide bombers showed that they were generally troubled young men with low skill levels who had simple plans and struck close to home. As a result of these assumptions, defences were inadequate to stop a well-organised group of competent suicide hijackers with significant outside resources. This extreme event occurred *because* it was unexpected. Had security agency personnel expected it, they would have had security in place to defeat it, and something else would have happened.

Many of the most damaging extreme events happen because they’re unexpected. This fact imposes a limit on the value of extreme event analysis. If your analysis works, you expect the extreme event, so a different extreme event occurs.

**Making errors of omission – not asking the right**
An easy mistake to make is to use extreme event analysis in the opposite of the right way, excluding more extreme events rather than considering a specific extreme event.

Investors in US public mutual funds can redeem their investments for cash by 4:00 p.m. every business day. Therefore, managers of these funds must think about extreme redemption events. Perhaps an analysis shows that a plausible extreme event is for five per cent of holders to redeem on the same day without warning. The right response to this analysis is to make sure that the fund has a solid contingency provision at all times for funding five per cent redemptions. The wrong response is to assume that there will never be a six per cent redemption day and to make no plan for this event.

The final common mistake is to focus too much on unconditional answers. Most extreme events are foreshadowed by warning signs, or they occur in times of generally heightened volatility. Rather than asking, ‘What’s the most extreme event I expect to happen sometime in the next century?’ ask, ‘What’s the most extreme event that could happen in quiet markets with no prior danger signs?’ Then think about the possible impact of things like market volatility, warning signs and special events – days the Fed (the US Federal Reserve Board) meets, election days, days a fund makes distributions. If you try to be constantly prepared for the most extreme thing that could happen, you waste resources most of the time and are underprepared at the most dangerous times.

Of course, you should always be alert for surprises. Not every extreme event happens at the time you most expect it. But don’t wear out your defences by constant use. Strive for a reasonable level of baseline defences that can be ratcheted up quickly when a storm begins to brew. Extreme event analysis should spend at least as much time considering likely warnings as it does considering the maximum plausible size.
Adding Dimensions

Mathematicians, usually not thought of as a superstitious group, refer to the curse of dimensionality, by which they mean that adding more dimensions complicates your task exponentially.

Suppose that you’re looking for a friend who’s waiting for you somewhere in the borough of Manhattan in New York City. If you know that he’s on a specific street, say Broadway, you have a one-dimensional problem. The average Manhattan street is about six miles long, with average luck you’ll find your friend halfway along the street in three miles, which might take you about an hour.

But suppose he can be on any street. Now you have a two-dimensional problem: You have to find his north-south avenue plus his east-west street. Manhattan has over 1,500 miles of streets, so you’ve got about 10 days of looking ahead of you if you look 24 hours per day. Doubling the number of dimensions doesn’t make the problem twice as hard; it makes it 250 times as hard.

Now add a third dimension. Your friend can be anywhere in the city: below ground, on the street, or on the 20th floor of a building. Adding a third dimension – height – means you’ll be lucky to find your friend in a lifetime of searching.

Chasing the fugitive

Probably the most memorable scene in the 1993 movie The Fugitive is Tommy Lee Jones as Marshal Samuel Gerard giving instructions to his searchers: ‘Alright, listen up, people. Our fugitive has been on the run for 90 minutes. Average foot speed over uneven ground barring injuries is four miles per hour. That gives us a radius of six miles. What I want from each and every one of you is a hard-target search of every gas station, residence, warehouse, farmhouse, henhouse, outhouse, and doghouse in that area. Checkpoints go up at 15 miles. Your fugitive’s name is Dr Richard Kimble. Go get him.’

The fictional location of the search is a semi-rural area in Illinois. Such an area is likely to have a density of 1,000 residences per square mile (the scene was filmed in near Dillsboro, North Carolina with 317.2 residences per square mile). The formula for finding the area of a circle is \( \pi r^2 \) (pi times the radius squared), which shows that the marshal is talking about 113 square miles and 36,000 houses, even using the lower figure from the rural area of filming.
That means about 100,000 buildings of all types. Gerard is talking to about 25 people, so he’s just assigned about 4,000 searches to each one – months of work.

One lesson from this is that confident people with loud voices and clear plans are not necessarily the ones who should run things in a crisis. But the lesson I want to emphasise here is how dimensionality makes problems much more difficult. If Kimble had to stay on a road, that’s a one-dimensional problem. With 12 miles of road, each of Gerard’s people has to search about half a mile, which could plausibly be done in an hour or less.

With two dimensions, each of Gerard’s people has to search about 4.5 square miles. That would take maybe a week, even if you assume that Kimble isn’t hiding or moving, just lying on open ground asleep, wearing a blaze orange jumpsuit. The existence of buildings and other hiding places adds a third dimension, because there are lots of places to search in each location. That’s why it would take months to do what Gerard asked, even if Kimble is considerate enough to stay in one place the whole time.

Thoroughly searching a six-mile radius is a terrible strategy for catching a fugitive, not least because it’s impossible with the resources Gerard has. A one-dimensional strategy of following Kimble’s trail requires more skill, but is far more practical nonetheless. Another one-dimensional strategy of setting up checkpoints around the perimeter could work as well. If Kimble chooses to hide inside a nearby outhouse, searchers will catch him by following his trail, or when someone notices him and reports his location or when he comes out to get food. One of those things will happen long before the searchers can complete a ‘hard target search’ of 100,000 buildings.

How does thinking about dimensions relate to financial risk management? Suppose you want to identify extreme events that may threaten your firm. You can easily think about one dimension – how high or low can stock prices go? Two dimensions is more complicated – what combinations of stock price and interest rate movements may cause problems? For complex products, strategies and institutions, dozens or hundreds of financial variables may be relevant and you could spend your life looking for the plausible dangerous combinations, at least if you just wander around looking randomly.

The techniques discussed in the next sections can sometimes help a little, but no one has yet come up with a good general solution to the problem in finance. You simply have to accept that big disasters can occur without big causes. Sometimes a bunch of ordinary causes happen to align unfortunately – what some people call a perfect storm. Intensive analysis, mostly beyond the scope of a For Dummies book, might identify a few potential perfect storms, but no one knows how to find all of them.

**Defining extremes in multiple dimensions**

When your data has a lot of dimensions, no points are similar to other points,
and every new bit of data is different in essential ways from anything observed in the past. Suppose that I have a list of daily stock market returns. However many days I have, there will be one lowest return and one highest return (ignore ties). If I have 99 prior observations, the chance that today’s return is outside the range of previous observations is 1 in 50 (assuming that there’s nothing special about today relative to the past). Ninety-nine days ago there was 1 chance in 100 that today would be the best day of the next 100 days, and 1 chance in 100 that today would be the worst day; these events are equivalent to today being outside the range of previous events.

But suppose instead I have a two-dimensional graph of the last 99 days of stock market returns on the horizontal axis and interest rate changes on the vertical axis. Now I have more than two extreme points. If I connect the dots of extreme points such that all the other points are inside the shape, I typically have about nine points on the exterior. That means I have roughly a 9 per cent chance that tomorrow’s combination of stock price and interest rate movements is outside anything that’s been observed in the past 99 days.

As the number of dimensions increases, the number of points outside the shell increases, until every day is outside the range of any recorded history. Of course, most of these extreme days are only outside in some trivial sense. But without exploring all possibilities, how can you be sure that some plausible extreme days are not fatal to your institution?

**Hoping for normality**

One bad way to attack the problem of multiple dimensions is to enlist the normal distribution. In addition to all the misleading things I criticise about normal distributions (see ‘Assuming a normal distribution – you know what it makes you and me’ earlier in this chapter), the normal distribution with multiple variables has a special, highly important property never found in real data. In the multivariate normal distribution, if you know how each pair of variables affects each other, you know all there is to know.

To see what that means, suppose I make ten loans, and each loan has a 10 per cent chance of defaulting. If the loan defaults are uncorrelated, what is the chance of all ten loans defaulting? A careless person will answer $0.1^{10} = 0.0000000001$ or one chance in 10 billion. But this answer is only true if the
loans are independent. In fact, the chance may be as high as 1 in 100.

Suppose I take 100 pieces of paper, and write the names of loans on some of them. I put the papers into a hat and draw one out at random. The names on that paper determine which loans default.

Because each loan as a 10 per cent chance of defaulting, I have to put each loan on ten pieces of paper. Because the loans are uncorrelated, the chance of any pair of loans defaulting is \(10\%^2 = 1\%\). So each pair of loans must be on one piece of paper.

I can satisfy these conditions in many ways: I can write all ten loans on one piece of paper; write each loan individually on nine other pieces of paper and leave nine pieces of paper blank. Now I have 1 chance in 100 of 10 defaults, 90 chances in 100 of 1 default, and 9 chances in 100 of no defaults. Yet each loan has a 10 per cent chance of default, and all defaults are uncorrelated.

I could instead write each of the 45 pairs of loans on one piece of paper each, write each loan individually on 1 piece of paper each, and leave 45 pieces of paper blank. Now I have no chance of ten defaults, 45 per cent chance of 2 defaults, 10 per cent chance of one default and 45 per cent chance of zero default. Yet the individual chances of defaults and the correlations are the same as in the preceding paragraph. Many other distributions are possible.

In real life, things are even worse. I don’t know the exact default probabilities or the correlations. I have to pull pieces of paper out of a hat, and guess what is left in the hat by analysing what I see. Moreover, I have no reason to assume that the papers in the hat stay the same between draws.

Nevertheless, I can form somewhat reliable opinions by analysing the papers I have seen to date. I can make guesses about default probabilities of individual loans. But I can’t say anything at all about the possible rare, extreme events that remain in the hat. No amount of mathematics can change that, unless I have a strong theory about the data, and in finance, you never have strong theories.

The problem isn’t just with the normal distribution. All distributional assumptions suffer from one of two fatal flaws. Some, like the normal, make strong assumptions about extreme combinations from information
about low-dimensional probabilities, and give unreliable predictions as a result. Other distributions have so many parameters to fit that they never give useful predictions at all.

**Gambling at Monte Carlo**

There is only one proven general answer to the curse of dimensionality – the beautiful idea of Monte Carlo. If you look randomly instead of systematically, the number of dimensions you need to consider doesn’t matter. (I discuss the Monte Carlo method in Chapter 6.)

To see how it works, change the problem of looking for your friend in Manhattan to estimating the height of the tallest person in Manhattan.

To get an exact answer, you’d have to measure 2 million people. But suppose that instead you decide to measure 100 people and try to extrapolate from that. Issues arise with this solution, of course, but they’re the same issues you have with estimating extremes in one variable. They don’t depend on whether you want the tallest person on one street in Manhattan, on any street in Manhattan or anywhere in the borough. A sample of 100 is equally good, regardless of the number of dimensions.

I make a similar point in Chapter 7 on stress testing. An infinite number of things may happen, but a manageably small number of ways they work out. It may take you a lifetime to work through every possible combination of market events likely to occur tomorrow, but if you sample a few thousand of them at random, you can likely identify where you need to concentrate attention and where things are relatively safe.

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**Inventing Monte Carlo**

The mathematician Stanislaw Ulam fell ill while working on the Manhattan Project to develop an atomic bomb during WWII. As he was recovering, he played a lot of Canfield solitaire, and wondered about the probability of winning a game. After working unsuccessfully on exact solutions (the exact problem is still unsolved) he realized he could come up with a reasonably accurate estimate just by dealing 100 games and observing how many were winnable. If you needed a more accurate answer, you could deal 1,000 games or 10,000 or as many games as desired. He further realized that with computers to do the dealing and playing, these kinds of randomized solutions would become much cheaper and easier to do in the future.

Ulam discussed with colleagues John von Neumann and Nicholas Metropolis using the same
idea for performing nuclear calculations. Because their work was top secret, all ideas needed code names. Metropolis’ grandfather was a devotee of gambling at the famous casino in Monte Carlo, so Metropolis suggested this name (by the way, it’s a bad idea to use code names related to the thing you’re trying to disguise, the Manhattan project military administrators found it impossible to enforce good security on the scientists). The name stuck.
Three levels of risk limits

Speed limit: This defines how much risk to take: how big to make positions; how much risk to hedge; how far to deviate from benchmark. Normal risk taking is expected to be near the limit.

Centre line: Normal risk level that doesn’t require extraordinary attention. This is a normal low-risk condition that can be exceeded under specified circumstances if accompanied by heightened alertness on the part of the risk taker.

Guardrail: An actual guardrail physically prevents you from going beyond a limit. A financial guardrail is a limit you should never violate. The main point of a guardrail is to prevent even a reckless, suicidal or unconscious driver from going over a cliff. Risk managers have these kinds of limits as well.

Delve into what a risk manager’s job encompasses at www.dummies.com/extras/financialriskmanagement.
In this part …

✔ Set limits that allow your risk takers enough freedom to succeed, but not enough rope to hang themselves.

✔ Know when to stay the course after losses, and when to pull the plug. You’ve got to know when to hold’em and when to fold’em.

✔ Adjust risk to the right level after drawdowns erode confidence or success breeds euphoria. Don’t let mood dictate your risk management.

✔ Design and execute hedges that filter out unwanted risk, while supporting risk takers in the bets they want to make.
Chapter 10
Setting Limits

In This Chapter
- Understanding limits
- Setting up your system
- Monitoring your limits and your system

Nothing says aggressive financial risk manager better than limits. Limits on everything – leverage, cash levels, stress losses – you name it, a risk manager somewhere has put a limit on it. When limits fail to prevent a disaster, the answer is … more limits!

Of course, limits are one of the key tools of financial risk management. They can prevent build-up of unsustainable levels of risk, and help keep risk distributed according to plan. But mindlessly placing limits can put straitjackets on risk takers, not only impairing their ability to make profits but increasing risk as well. In this chapter, I show you how to design a sensible set of limits to keep the risk taking robust, disciplined and productive.

Describing Basic Limits

Anthropologist Franz Boas famously observed that Eskimos have dozens of words for snow. The idea that the number of words a culture uses for a concept is proportional to the importance of the concept turns out to be a fascinating half-truth and a starting point for useful investigation of anthropological linguistics. I mention the idea here to highlight a strange fact: Financial risk management has a wide variety of concepts all described by the one word limit.

Unfortunately, people use the word limit for different concepts, and the only way to tell the difference is to ask what word they use for
exceeding a limit. People sometimes try to use alternatives such as *threshold* or *warning level* but are rarely successful in enforcing the usage. You see linguistic differences in the names for exceeding a limit, which tells you what kind of a limit is under discussion. Do people talk about *violations, exceptions, overruns, excessions* (a technical risk-management term for a limit breach that hasn’t yet been categorized), *exceedances, overages, alerts, notifications, escalations* or something else?

In normal English the word *limit* has one meaning, at least in relation to numbers – a maximum or minimum. But using the one word, *limit*, to describe a range of ideas can lead to some confusion. For example, you’re allowed to drive at or below the *speed limit*, but going over is a *violation*, which can subject you to being stopped and fined. When people first hear about a risk management limit, they’re inclined to assume that the word is used in this sense, which casts risk managers in the role of traffic cops.

I use automobile driving analogies throughout this chapter because driving is a common activity hemmed in by all sorts of limits, much like financial risk taking. Thinking about speed limits, centre lines and guardrails can help you keep the analogous concepts straight when you see them in finance:

**Speed limits:** These limits inform the risk taker what level of risk to take: how big her positions should be, how much risk to hedge, how far she can deviate from the benchmark her portfolio is compared to and so on. They’re guides as well as limits, normal risk taking is expected to be near the limit. Of course, if conditions are riskier than normal, you’re expected to reduce risk levels to well below limit – like a driver slows down when experiencing fog or ice. Speed limits also communicate to everyone else what kinds of risks (and losses) to prepare for.

If consistent unused limit is apparent in normal times, reduce the limit and reassign the risk somewhere it can support profits.

**Centre lines:** These limits define the normal risk levels that don’t require enhanced attention. In normal driving, you’re required to keep your vehicle entirely to the right or the left of the line, depending on the
country’s laws. You’re expected to observe these limits almost all the time. However, in specified situations you can exceed these limits.

It’s not a violation to cross the centre line if you’re passing a slower vehicle moving in the same direction, assuming that you have a clear line of sight, no traffic is oncoming and passing is permitted. You can also cross the centre line to make a turn, subject to oncoming traffic.

This limit refers to a normal low-risk condition that can be exceeded under specified circumstances if accompanied by heightened alertness on the part of the risk taker and everyone else. These kinds of limits are common in financial risk management. In these cases, the risk manager is acting more like a highway engineer than a traffic cop.

Guardrails: A guardrail physically prevents you from taking your vehicle beyond the limit, usually at the cost of considerable damage to the vehicle and the rail. Crashing into a guardrail isn’t a violation (although police officers will probably take a dim view of it and perhaps bring out the breathalyser or charge you with reckless driving or some other offence); but it’s not like a centre line either, because no exceptions allow you to exceed the limit temporarily. The main point of a guardrail isn’t to inform the driver (the risk taker) of danger, but to prevent even a reckless, suicidal or unconscious driver, or one who has lost control of the car, from going over a cliff. Risk managers have these kinds of limits as well.

Guardrail limits should never be violated. To the extent possible, systems should be in place to enforce these limits even against an incompetent or malicious risk taker.

Drawing the centre lines, in my experience, is the most important job in setting risk limits. In order to be effective as a risk manager, you need to filter out the 99.99 per cent of things that run normally in order to have time and attention for the things that matter. So you can’t draw centre lines that risk takers frequently exceed. On the other hand, if your centre lines allow too much unmonitored discretion, you create the possibility that a major risk will develop with no oversight at all. Unless you’re lucky, you won’t notice it until it causes real pain.

In theory, half the time you notice something’s amiss because it causes an
unexpectedly large gain, but in practice that happens maybe ten per cent of the time – unmonitored risks are preponderantly bad risks. This situation happens to me with reasonable frequency; it will happen to you if it hasn’t already: Something is running along, seemingly entirely inside your comfort zone, when suddenly it causes a loss or other problem that wasn’t supposed to happen. When you investigate, you find all kinds of warning signs that you missed because your attention was elsewhere. The signs were things not measured in limits or things you set ineffective limits for. Setting bad limits is almost always a question of interactions. Measured along any one dimension things look safe enough, but the combination of risks creates synergistic losses.

This is why they call you a risk manager, not a certainty manager or a risk eliminator. You manage the risk of missing potential problems versus the risk of scattering attention so widely that you have no depth about the largest potential problems. You periodically look stupid, which is one of the main reasons that good risk managers are hard to find – most smart people are more afraid of looking stupid than of losing money. You look stupid because something bad happened that you could have easily prevented if you had paid attention to the warning signs. You also look stupid because something bad happened that you could have prevented, but your understanding of the problem was too superficial because you were looking at too many other things. You cannot prevent these things from happening (or if you can, you can take my job and I’ll retire). Your goal should be to make sure that the two problems happen about equally often.

Limiting drinking and driving

Another driving analogy involves limits on blood alcohol levels for drivers. Speaking for myself, I drink and I drive, but I never do both at the same time, so I have no personal stake in this issue. Speaking as a professional risk manager, I dislike this kind of limit. One problem is that the risk takers whose behaviour you want to influence (potential drunk drivers) cannot easily monitor the limit, they have to rely on guesswork. They aren’t given tools to help them comply with the rules such as public breathalysers. People are only told what not to do but aren’t given information about what actions to take in all circumstances.

Another issue with blood-alcohol limits is that it sets a bright-line standard for a continuous risk. From a policy standpoint, the object is to reduce the total amount of alcohol in every
driver’s bloodstream, not bring people from just above to just below an arbitrary level.

Related to this, alcohol isn’t the only factor contributing to accident risk. Being ill or young or old or male, taking prescription or recreational drugs, being angry or depressed or tired or in a hurry, failing to maintain your car – all these and many other factors affect your chances of causing or failing to avoid an accident. Putting strict limits on one factor without effective regulation of others can actually lead to increased risk, for example if a good driver who’s had two drinks cedes the wheel to a sober bad driver, or if police officers are staffing a random alcohol checkpoint instead of patrolling for road hazards.

Then you have the issue of enforcement. You can penalise people after accidents or people stopped for erratic driving, but you don’t need the blood-level alcohol limit to do so – causing accidents and driving erratically or recklessly have always been illegal. You can enforce penalties based on observed behaviour rather than self-incrimination by measurement. The blood alcohol rules are needed only to support random stops of all drivers, but this practice is a highly inefficient way to improve traffic safety. There are far more cost-effective ways to save lives from automobile accidents than enforcing blood alcohol limits. Even more cost-effective ways of reducing drunk driving are possible such as refusing alcohol licenses to establishments with parking lots.

In my opinion, if you want to explain the universal and growing enthusiasm for stricter blood alcohol limits, you have to acknowledge that it has little to do with saving lives. Some people want to discourage all drinking, and hard-to-monitor limits with harsh penalties does just that. Other people are more concerned with punishing drunk drivers than with reducing traffic fatalities. Also, of course, the laws raise a lot of revenue and employ a lot of law enforcement professionals.

Unfortunately, this pattern is common in financial risk management limits as well. Something bad happens (usually not as bad as a fatal accident caused by a drunk driver, but nevertheless bad). Politicians are hugely tempted to slap a limit on the bad thing. Some people support the limit because they want to discourage all risk taking, but doing so is eventually fatal to all organisations. Some supporters want to punish people like the people who caused the bad thing. Some people make their living enforcing or evading limits, and this practice is a profit opportunity. Anyone who opposes the limits is accused of not caring enough about the bad thing. Risk managers are no longer partners helping risk takers manage exposures, they’re adversaries trying to catch violators. Risk managers have to fight against these temptations.

**Going through the Process**

Points to consider in setting limits:

- Limits should be easy for risk takers to monitor and control.
- The limit system should cover all salient risk factors, so that limiting one factor doesn’t result in worse risk elsewhere.
- People should be encouraged to take risk up to the limit, and rewarded
accordingly. Risk takers shouldn’t be forced to stay far from the limit merely to avoid harsh penalties for minor exceptions.

- Limits should not be expensive or burdensome to enforce.
- The goal should be to improve organisational risk taking. Don’t set limits to discourage risk, to punish losing risks, to deflect criticism or to make work for anyone.

**Setting up the framework**

You’re never working with a blank slate when designing a limit system. Organizations tend to build up complex layers of limits over time – it’s much easier to put a limit on than to take one off. Even in a new organization, limits are demanded by regulation, clients, counterparties and business tradition, among others.

The first task is to put everything in a general framework with all the limits in the same system with consistent categories. This task isn’t a one-time exercise; you have to continually update it. So make sure that you put in significant effort to design something flexible enough to encompass all plausible future rules in a unified scheme.

- Some rules aren’t negotiable at all, but others may allow for some tweaking to simplify the overall structure.

It can be helpful to go back and read the actual rules or contracts are the reason for the limit. Often these get lost in translation. I once had a rule in the database that specified that all *over-the-counter (OTC) derivatives* (derivatives not traded on an exchange) were illiquid. The actual rule turned out to say that exchange-traded derivatives were automatically considered liquid but said nothing about OTC derivatives. I called the client and verified that she interpreted that as meaning the risk manager could use her judgement about the liquidity of OTC derivatives. This kind of thing happens all the time. Often no rule exists at all, there’s just something someone put in out of general principles or to reflect industry practice.

One approach to dealing with complex and conflicting requirements is to replace specific rules with the judgment of the risk manager. This tactic may go against the grain for two reasons:
A risk manager usually prefers clarity and specific, objective rules so no disagreement is possible over what does and does not apply.

Risk managers generally emphasise complexity. For example, a risk manager may well say, ‘There’s no single thing called liquidity, we need to consider dimensions and degrees.’

These are important considerations, but you may need to override them in order to build a simple and flexible system.

In working with regulators, clients, counterparties and everyone else, ask them to accept common definitions. For example, I classify securities as liquid or illiquid – ignoring the types and degrees of liquidity – and try to get as many groups as possible to accept this classification based on the risk department’s judgement. If you first build the necessary respect, people often prefer to accept your considered judgement rather than try to craft a specific formal rule.

Relying on the risk department’s definitions can lead to enormous simplification and rationalisation of limits, but it does have a cost. If your company experiences larger-than-anticipated losses, your classifications will be scrutinised. You may face bad feelings or even litigation that could have been avoided with more objective definitions. Moreover, you may find yourself classifying securities one way for one portfolio or business, but a different way for another. Nevertheless, the benefits often outweigh the costs for this tactic.

After you have all the limits in a unified framework, you need an automated tool for determining which ones are redundant. I don’t recommend trying to do this task by hand. Even in only moderately complex situations, you may easily overlook special cases and also easily forget to update the analysis when something changes.

Using your tool, you can design a limit structure that balances simplicity with freedom for the risk taker. Don’t try for perfection; perfection is impossible. Just try for something simple enough to be explained in a conversation without notes or diagrams and that doesn’t impede your ability to take
In practical cases, your simplified rule prohibits certain actions that would be permitted by the full set of rules. For example, a rule may limit accounting leverage to 120 per cent, which means that the total value of all your positions must be less than or equal to 1.2 times the net asset value (NAV) of the fund but allows essentially unlimited derivatives. Another rule from a different group limits total gross notional leverage (this adds the notional amount of derivative contracts, often a large number, instead of their accounting values, which is usually low and often zero) to 200 per cent of NAV. The first rule allows netting of positions (that means, for example, if you’re short some stock you can use that to reduce long exposure in another stock), while the second does not (so a short position adds to leverage, it doesn’t reduce it). The first rule is computed only at the end of the month, the second is computed daily.

You may decide that enforcing a daily limit with no netting allowed is simpler, limiting the gross notional of all derivative positions to 80 per cent of NAV and the market value of all non-derivative positions to 120 per cent of NAV, using one set of definitions. Doing so may cause violations in cases in which both the original rules are satisfied, and in some rare cases it may miss a situation where one of the original rules is violated. You can tolerate these possibilities if you think that the simplified rule encourages good portfolio management and that you can intervene manually in the rare exceptions.

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**Limiting real estate risk**

I was once given the job of setting up a limit structure for a new business that consisted of buying large amounts of commercial real estate assets and related securities. The diversified institution I worked for at the time had long and successful experience advising investors, underwriting securities and working with property managers. It had taken positions in securities from time to time, generally *bridge loans* (loans made for a period typically of a few months, intended to be taken out by permanent financing) or other accommodation financing done to help a deal rather than for pure investment reasons. The bank had decided it could leverage its expertise to make good investments for its own balance sheet; moreover its willingness to commit its own funds would improve its competitive position in the advisory and underwriting businesses.

I've used this story as a case for business school classes for many years, and students are
typically surprised by the assignment. They want to talk about the wisdom of the decision to go into commercial real estate (how they feel about that is highly correlated to whether the market is in boom or bust at the time). Students commonly assume (rather arrogantly) that a couple years of MBA classes qualifies them to second-guess the experienced professionals running the business. If you ever find yourself working for an organisation that entrusts high-stakes risk decisions to people whom you do not respect, quit, don’t try to fix things by clever risk management.

Of course a risk manager did have to approve the business decision as part of the new business approval process. But this approval does not mean that the risk manager had to know more about commercial real estate than the people who were going to run the business for the bank. He had only a general knowledge of the business. He spent his time challenging the assumptions and data used to justify the decision and create the plan. He threw out every risk he could think of to make sure that the business managers were two steps ahead of him in thinking. He checked the planned budgets, staffing levels, capital ratios, profitability and other parameters against comparable operations. What he didn’t do was spend a lot of time wondering if he would have decided to enter the business of buying commercial real estate if he ran the bank. He’s not qualified to make that determination and making it is not his job.

Even students at top business schools who take financial risk management courses often have skewed ideas of what financial risk managers do. My job was to design a limit structure to lead to good, controlled risk taking with as little risk of blow up as possible.

**Considering liquidity**

Having the legal and compliance departments as well as risk involved unfortunately leads to a situation in which you have overlapping limit requirements. In this section I discuss liquidity limits in detail because liquidity is one of the most important things to limit, and also because the detailed examination highlights the issues encountered in setting all limits.

*A liquid position* is one that can be easily and quickly converted to cash at a reasonable price. A US treasury bill is highly liquid, as are actively traded futures contracts and stocks issued by large companies.

Although there is only one kind of liquidity, there are many kinds of illiquidity:

- A position can be closed quickly but at a significant loss.
- A position can be closed at the *mark*, the current closing price, but it takes significant time to find a buyer and arrange the transaction.
- A position can be closed quickly at the mark, but the mark can change rapidly (this is true of futures contracts and equities, which is why although they’re considered liquid, they’re less liquid than US treasury
A position can be closed quickly at the mark, but it requires consent or approval of a third party, which may not be forthcoming, or may be delayed.

A position can normally be closed quickly at the mark, but liquidity can disappear quickly and may not be available when needed.

A normal-size position is liquid, but larger positions take longer to close and result in disadvantageous prices.

A normal-size position is liquid, but small sizes have difficulty finding buyers quickly near the mark.

All these conditions exist in varying degrees. A financial risk manager is constantly balancing all dimensions of illiquidity at the portfolio level.

Meanwhile, external parties may mandate a dozen different liquidity limits. These limits can be based on different concepts and standards of liquidity, and many are vague. Moreover, the limits apply on different levels: some apply to one position, some to a book of positions; some to a legal entity, some to all legal entities under a single manager or group; some apply to transactions on a single exchange or in a single country or with a single counterparty. Limits can apply on different time scales and have different consequences for exceeding limit. It can be an enormous job just figuring out and keeping up with changes, not to mention actually complying with all of them.

The financial risk manager must shield the risk taker from the complexity of determining the degree of liquidity or illiquidity. The risk taker should be focusing on economics and opportunities within simple, meaningful limits. If she has to check each decision in three different systems for a dozen liquidity tests based on different definitions, she wastes time and brainpower and loses her ability to optimise. Moreover, stringent limit checks breed disrespect for limits and encourage tricks for evading the tiresome box-checking. Worse, they can lead to bad financial decisions forced by the interaction of badly designed limits.

The risk manager’s goal is to design a simple, intuitive, meaningful limit
system for liquidity that encourages the right level of productive risk taking and satisfies all compliance and legal liquidity limits. (I should have said dream, not goal. No one ever gets to design such a system perfectly. All I can do is give you a few general tips for doing it reasonably well.)

**Adding risk management**

Financial risk managers never get to design limit systems from scratch. Finance is the most heavily regulated business in the world. Any institution, even so-called unregulated hedge funds, start with many complex limits mandated by governments, intermediaries, counterparties, investors, boards and other groups.

Although the responsibility for maintaining many limits belongs to the compliance and legal departments of an organisation, in practice, the risk department must manage all the limits – those set by the risk managers and those required for other reasons. Otherwise, multiple systems can come into conflict, leading to gridlock or loopholes. (Of course, the other departments monitor the limits they’re responsible for, but the risk manager should arrange things so those limits never get exceeded.)

Moreover, legal and compliance departments are rarely staffed with people with the skills to manage a system designed for risk takers. People who choose to work in compliance or legal departments are usually good at preventing violations, but often less good at optimising behaviour within the limits. Moreover, decision makers in the risk department generally are empowered to act immediately whenever and wherever risk is being taken (or should be, anyway), so they’re in a position to help risk takers manage near-limit situations. People in the legal and compliance departments are more apt to work standard business hours with longer response times than financial decisions demand and also to require hierarchical decision making.

I discuss how to set limits that allow maximum freedom to the risk taker subject to the law, agreements and orders from the top. The risk-management team enters the limit-setting discussion only after that first step is complete. I advise working from the inside out, although you can think about this process in either direction:

1. **Set your centre-line risk limit – the line you don’t cross unless you’re clear that you’re safe to do so.**
Risk takers are allowed to cross this line subject to specific conditions and with added alertness on their part and oversight on yours.

Think about what set of measures would leave you completely unconcerned about the positions. For example, you may set a minimum cash level of five per cent of NAV for the portfolio based on regulatory and contract requirements, but five per cent may still leave you a bit nervous. But if cash were 15 per cent of NAV or above, you wouldn’t even think about the risk of running out and higher cash levels wouldn’t make you feel safer. If 15 per cent cash isn’t enough, then something drastic has happened, and no level of cash would make you confident. Moreover, in normal circumstances, you expect the portfolio to have more than 15 per cent cash.

2. **Set speed limits – the maximum risk levels allowed. If anyone wants to take more risk, she needs to first ask permission.**

   Your limit may be the five per cent cash limit as in Step 1. If a portfolio falls under five per cent cash, you take action to get it above five per cent and investigate how the drop happened.

   **WARNING!**

   Frequent violations of this limit suggest that you’re not running under risk control. You may need to make changes to your systems and procedures, or even to your personnel.

3. **Set your guardrails – the limits that should never be breached in any circumstances.**

   Exceeding these limits sends people to prison, destroys firms and has other catastrophic consequences. These limits don’t appear only on reports for the risk taker and business managers, these limits are built into the structure of your business control processes. No one should be physically able to violate them.

   You probably cannot stop a clever and malicious group of conspirators from getting past the guardrail, but you can do your best to make it as difficult as possible for them.

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**Staffing up is no solution**

Charybdis was a whirlpool off the coast of Sicily. Scylla was a six-headed sea monster (or so
Homer said, probably actually a rock shoal) on the Italian side of the Strait of Messina. (Homer isn’t specific on the geography but this place is probably the one that inspired the story in The Odyssey.) Avoiding Charybdis meant passing too close to Scylla and losing a few sailors. Avoiding Scylla meant passing too close to Charybdis and risking the entire ship. Homer says Odysseus chose the lower-risk option.

When setting centre-line limits, risk managers face an analogous choice. Scylla is the many smaller hits you take because you weren’t paying enough attention to something. Charybdis is the potentially firm-destroying hit from not focusing hard enough on an existential risk. In stressful periods, you can glimpse a six-headed monster roaming the trading floor swallowing money while you feel the powerful but distant pull of the whole business circling down a drain. Do you chase elusive monsters or stay in place to steer the entire ship?

It may sound like I’m joking around, but I’m deadly serious. This tension is a real one you confront every day as a risk manager, and a leading cause of burn out. You cringe a little whenever someone asks you about something you haven’t looked at in a while, and you also cringe when someone asks you a question beyond your depth about a major issue. To turn the screw, the problem is worse the better you are at your job. If you’re incompetent, no one expects you to anticipate anything, so you don’t have to fear disappointing people. Anyway, you don’t care much. You collect a paycheck for walking around looking worried until something really bad happens, then you’ll be fired and find another line of work (or tell the world that you saw it all coming but were ignored). If you’ve earned great respect, people are apt to over-rely on you, and are constantly disappointed in your lack of knowledge.

This pressure leads to excessive staff growth in risk management. It seems like an ideal solution, hire more people to focus on the big risks in depth, and hire even more people to watch the large number of lesser risks. Every time someone asks you a question you don’t know the answer to, you hire a new person to keep up to speed on that issue.

This situation is counterproductive. A large, specialised risk management staff doesn’t feel the tension of Scylla and Charybdis, which means that they’re not really doing risk management. The risk department should be a small team of generalists. There may be a need for more staff: more line risk managers, more compliance, legal or IT staff; and if so, the risk manager has to pound the table for those hires. But headcount growth in the central risk department is not a rational strategy for improving risk management.

You see, you have no way to fix things later if the line risk takers are not making good decisions. The urge for the risk department to increase staff is usually a reaction to loss of faith in the risk takers. If you have so many problematic initial risk decisions in the front office that you need a large department of risk specialists, you have to fix that in the front office. This situation is like a CEO with too many advisors. CEOs should spend time with direct reports who are doing the actual work of running things, not be insulated behind a wall of advisors. Similarly risk managers should spend time with line risk takers, not be cogs in a large department that talks mostly to itself. A big risk department cannot have the external links and broad perspective it needs.

Administering Limits

You need to discuss the limits and what to do in the event of breaches with all
your line risk takers. You also need to build a user-friendly flexible tool for maintaining and monitoring limits. After that, how you administer limits depends in large part on the type of organisation for which you manage risk. Your job may revolve around continuous alerts, a daily cycle or some longer-term cycle. You may be looking at several large screens of continuously changing data, or periodic in-depth reports or anything in between.

Whatever the particulars, every risk manager encounters some common situations:

✔️ **A limit breach:** This touches off predetermined actions, which may or may not require your active participation. However, even if you aren’t immediately involved, you observe processes to make sure that appropriate actions are taken, and think about patterns in the breaches that may point to larger issues.

✔️ **A breach cured:** No, you don’t pop open the champagne and celebrate. This is the time to consider whether the limit worked as it should. Did everyone take the right actions at the right times, the ones you would have wanted if you were considering just this one situation rather than the general rule mandated by the limit? Were risk adjustments made too soon or too late, too big or too small? Don’t just decide on your own, talk to all the people involved. Limit systems get stale quickly without continuous, sceptical monitoring.

✔️ **A risk taker approaching a limit:** The old saying goes that an ounce of prevention is worth a pound of cure. Why is someone approaching a limit, and is she aware of it? I always prefer to have discussions about the philosophy of limits or the proper level of this particular limit before the violation than after. The biggest question in this circumstance, however, isn’t about the limit, but about whether the risk taker is in control of her risk. I’d rather have someone decide to violate a limit than have someone unable to avoid violating a limit.

✔️ **Unanticipated situations and special cases:** These occur in any limit system. Don’t sweep them under the rug in the pressure to check the boxes for the routine and anticipated cases. These situations may require special handling, and they may argue for changes in the limit system. Give them the careful attention they deserve.
In all of this, remember that you’re thinking beyond the administrative task. Managing limits is one of the jobs that keeps the risk manager engaged with the risk takers, and in communication with senior management and stakeholders. Where are the limits active, and where are things quiet? Are breaches caused by risk taker decisions or market events? Are the breaches in the most profitable risks, successful people reaching to increase bet sizes, or in the losing risks, which may be risk increasing out of control or unsuccessful people chasing losses?

**Monitoring limits**

Providing good tools for managing limits is as important as setting wise limits. The first important distinction among limits is how often they’re monitored. The common schemes, starting from the most rigorous are:

- **Continuous:** Most people expect that setting a limit means that it’s continuously monitored and enforced, but people often find it impractical to monitor things continuously.

- **Pre-action:** The limit is checked prior to taking any action that may cause a breach. This check can prevent *active breaches*, in which the action causes things to go over the limit, but it does nothing to prevent a *passive breach*, in which things go over limit due to market movements or other external causes.

- **Periodic:** There is a periodic process, daily or some other frequency, to see whether the limit is satisfied. Exceptions can occur between checks. This ability may be a desired feature of the limit system – for example, traders are often allowed to take more risk during the trading day than they can hold overnight. Or the exception may be a bug in the system – an inability to monitor limits that combine things that trade in different time zones during the day, for example, because reliable portfolio valuations may become available only at end of the New York day, when most markets are closed.

- **Exception based:** Limits are checked after an exception event such as a *futures roll*, in which futures contracts are taken off a near-term delivery date and replaced by longer term contracts, or a change in credit rating. This method works for limits that aren’t expected to fluctuate during the holding term, but only at the end of the process.
After problems: These conditional limits apply only after specified bad events such as portfolio losses beyond some level or a credit default.

Never: Avoid using this category. Better to not have a limit than to have a limit but never check it. However, these kinds of limits are surprisingly common. They exist only so that someone can point a finger afterwards.

These categories are not mutually exclusive. For example, a limit for a portfolio manager on total notional exposure may be checked before every trade (pre-action – don’t do a trade if it puts the portfolio over the notional exposure limit), end-of-day (periodic – notify the manager if the portfolio is over limit at the close) and after corporate actions and large market moves (notify the manager if external events caused a passive breach).

Reacting when you go over a limit
Deciding how to react when you go over limit is key. The common schemes, starting from the most rigorous are:

End of the world: Some limit violations require the firm to shut down (for example, a US broker-dealer cannot do business when its capital falls below a minimum limit). In some cases, exceeding limits can lead to civil or criminal penalties.

Correct the situation as quickly as possible, regardless of cost: Correct active breaches caused by actions like buying and selling as opposed to market movements as quickly as possible. Passive breaches are treated according to the next point.

Correct the situation at prudent speed: Passive breaches caused by market movements or anything other than actions taken by your firm, may not require an immediate response. Prudent speed can mean anything from milliseconds to years.

Escalate: Again, gradations exist. You may bring the issue to the risk manager or the immediate supervisor of the business – or to a higher level such as the risk committee or the board of directors. That group determines whether to order a correction (and if so at what speed), to
suspend the limit temporarily while the situation clarifies or resolves itself or to raise the limit (and, if so, to what level and whether to make the increase temporary or permanent).

**Sign off:** This is like an escalation, without the escalation. In this scenario, the line risk taker acknowledges the over-limit amount formally and records the response she intends to make. She can typically choose from the same menu as in the preceding *escalate* point. The risk manager may be involved in the response, but may attest only that the risk taker provided a response, not that the risk manager agrees with it. (If the risk manager does not agree, the situation is usually escalated.)

**WARNING!**

**Nothing:** Doing nothing is never helpful. It means that the limit isn’t a limit. Sometimes people call these *soft limits*, but I dislike that term. A limit with no response plan attached is like an emergency exit sign with no actual exit. It may make people feel safe, but it makes disasters worse not better.

Combinations and variants of these schemes are possible. For example, an over-limit condition may trigger the need for a sign-off immediately, and then be escalated to be presented to the firm risk committee at its weekly meeting, at which time further action maybe ordered.

**REMEMBER**

Going over a limit may trigger some notification requirements to internal or external parties.

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**Different measuring methods and their results, or how to avoid a speeding ticket**

The great physicist Richard Feynman tells a story about a driver and a police officer in his *Lectures on Physics*. The officer tells the driver she was going 60 miles per hour. She protests because she had only been driving for seven minutes. The officer responds that if she had continued at the same rate for an hour, she would have travelled 60 miles. The driver points out that a wall just ahead would have stopped her.

The officer changes tack and says, ‘Okay, you were going 88 feet per second, which is the same as 60 miles per hour.’ The driver responds, ‘There’s no law against going 88 feet per second.’ Feynman uses this example to motivate a deep discussion on the meaning of
physical quantities.

I have a simpler use for it: It shows that the practical effect of a limit depends on how often it is measured. A law against going 60 miles an hour isn’t the same as a law against going 88 feet a second.

Consider three jurisdictions with the same stated speed limit of 60 miles per hour.

- Jurisdiction A uses speed cameras that typically require about 0.1 second to get a clear reading, so it catches cars going more than 8.8 feet in 0.1 second wherever a camera is pointed.

- Jurisdiction B uses conventional radar guns. In normal traffic conditions, it takes about five seconds to confirm the vehicle being measured, so drivers going 440 feet in five seconds are caught. However, because officers have to apprehend violators, drivers are generally safe unless they’re driving faster than nearby cars.

- Jurisdiction C takes advantage of electronic tolls to compute average speed of drivers on controlled access roads. If a driver takes an exit more than 60 miles away from her entrance less than 60 minutes after entering, she is fined. In this case, a driver can go 120 miles per hour, then stop for half an hour to text and drink coffee before exiting without triggering a violation.

The same stated rule in the three jurisdictions has different effects on driver behaviour. Traffic cameras are cheap and can catch lots of people but only where they’re placed. The evidence they produce is acceptable in some jurisdictions for moderate fines, but in most places can’t support more serious convictions such as licence suspensions or prison. Police officers with radar guns can move around, and their word is accepted in even the most serious court proceedings, but they cost more than cameras and can target only a few of the fastest drivers on the road. The toll road approach is virtually free and can catch every speeder in principle, with little room for argument in court, but it only enforces the limit on the average speed, not the maximum speed.
Chapter 11
Stopping Losses

In This Chapter

- Setting stops
- Sidestepping common mistakes
- Adjusting stops
- Checking the frequency

The American humourist Will Rogers had the best advice about how to make money in the stock market: ‘... Buy some good stock and hold it till it goes up, then sell it. If it don’t go up, don’t buy it.’

For those of us who can’t figure out how to do that, the next best version is: if it don’t go up, sell it. This judgement is called a stop loss, and is perhaps the simplest and most powerful risk management technique. Selling holdings that aren’t increasing their value is an ancient practice borrowed and refined by modern financial risk managers. If you limit your losses to budgeted amounts when you’re wrong, you can survive long enough to collect the profits when you’re right – which is a reasonable definition of managed risk.

Understanding Stops

Unfortunately, most amateurs use stop losses in the precise opposite of the proper manner. They ask how much they can afford to lose or are willing to lose in a trade and set the stop loss at that point. This attitude is letting your risk manage your trading, which is the wrong way around. If your trading decisions are forced by losses or by your risk aversion, you won’t be successful in the long run.

The right question to ask is, ‘What future circumstances would make me doubt my trade thesis (the rationale for doing the trade)?’ For example, a trader comes to you for permission to put on a large long position in gold. He shares his reasons for believing that gold will go up: it’s historically cheap
relative to platinum; hedge funds are short gold (that is, the hedge funds have sold gold they don’t currently own and will have to buy it in the future) and losing money on their trades; central banks are increasing purchases; production is slowing; financial uncertainties are pushing investors toward safe havens.

As a risk manager, it's not your job to evaluate the reasons behind investments, or to ask if they’re already incorporated in the current price or to consider over what time frame they’re likely to play out into increased gold prices. Either you trust the trader, or you fire him. Rather, your job is to help the trader shape the idea into a trade with risk and return characteristics that take maximum advantage of whatever edge he has. So, when he's finished laying out his reasoning, your first question is, ‘How much would the price of gold have to fall to make you admit you were wrong?’ This question is the one that separates traders from the vast majority of people who are bad risk takers. If he has to stop and think about it, he’s no trader.

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**Playing poker with stops**

For years I was a professional poker player at the highest levels, and I've remained a serious player my entire life. An essential skill, in live poker anyway (which was the only form of the game when I was a pro), is to filter the other players' actions and demeanour through your unconscious mind.

Your unconscious mind is far more powerful than any computer, while your conscious mind is inferior to the cheapest calculator. No computer can tell a cat from a dog, but your unconscious mind performs that task instantly and effortlessly while continuously decoding thousands of similar distinctions in a complex visual field, and it doesn't need a programmer to tell it how to do it. Your conscious mind quails at multiplying two three-digit numbers. That's why your unconscious mind controls all the important stuff, like heartbeat and body temperature and when to have sex or a fight; while your conscious brain is relegated to tasks like wondering which celebrity marriages are in trouble and humming the hooks from silly pop songs or advertising jingles.

Your unconscious brain is descended over millions of years from brains that were frequently faced with life-and-death decisions of trust, and its lineage is undefeated in that game a few million to zero. Therefore, in poker, you tap into that brain to ask yourself, ‘Can I imagine the person making that bet as a guy lying in ambush for me more easily than I can imagine him fearfully fending me off with vain shouts because he is weak?’ With thousands of hours of practice, and clear immediate feedback, you get good at that.
Of course, you enlist your conscious brain as well. You track carefully how often both this player and players he reminds you of act in various ways, and how those relate to their hands. You note pupil dilation and voice pitch and whether he's using two hands or one and lots of other stuff with statistical correlations to hand strength and strategy.

Approving trades is exactly the same as playing poker. You're using your entire brain in order to decide whether this person is someone with a sound idea and justified confidence, but also a realistic appreciation of the risks; or if he's bluffing. It helps if you're a good poker player, but any risk manager can learn to do a pretty good job with a little practice, as long as he keeps firmly in mind what he's supposed to be doing.

An analogous point can be found in scientific philosophy. If a statement isn't falsifiable, that is, if no experiment can prove it false, then it has no meaning. If a person tells you, ‘People are basically good,’ you’ll find it hard to know exactly what he means. A good question is, ‘What could happen to convince you that you’re wrong?’ If the answer is, ‘Nothing’, the statement is just an empty slogan. If the person gives a specific answer, then you understand the content intended by the statement.

**Distinguishing traders from normal people**

Most people dislike risk and uncertainty. They make the choices that are forced upon them, mainly in ways that minimise the likelihood of regret, although sometimes in other ways such as maximising excitement. Traders seek out risk in order to make steady profits. It's an entirely different mindset, and it requires an unusual personality and background. I don’t believe it can be taught, at least not in classrooms or to adults.

Normal people assess uncertain situations and make judgements. Some people focus on a single most likely judgement and act as if they’re certain it’s valid. Others maintain a wide range of possibilities, and act in ways that won’t be too disastrous if any of them is true. The first way leads to disasters, the second leads to never getting anything done, so most people form some kind of compromise approach. Unfortunately, this approach is generally based on personality and introspection rather than the empirical calibration that a risk manager insists upon.

Traders, and successful risk takers in general, typically think in binary terms: they’re right or they’re wrong. They know from experience that they’re right
often enough that they’ll profit if they bet aggressively on their judgements. They also know from experience that they’re wrong often enough to require contingency plans before making bets. This experience part is the part that’s hard to teach. It’s not enough to understand intellectually that you’re right more than average but sometimes wrong, you need to feel it deep in your bones, generally from early, intense and frequent reinforcement. Trying to get that experience at adult stakes would be fatal.

**Dividing risk into two**

One way to think about risk management is that it’s an effort to refine this binary view of right or wrong and open up to three or more possibilities. Some traders think this way naturally, but this mindset is rare. It can be hard enough to hold two strong opposing ideas in your mind at once, that you might be right and that you might be wrong. Trying to hold three or more ideas is almost impossible while you’re maintaining the creative, independent thinking and strict discipline necessary to have any useful trading ideas at all. Being too broad-minded can lead to timid or erratic trading decisions.

A risk manager is under less pressure than a trader. A risk manager has less trouble refining views from the outside, letting the trader think in binary terms while integrating the trades into a portfolio that can thrive in a more nuanced world. Experienced traders who act as their own risk managers often set aside discrete times to wear each hat, because they find it so difficult to maintain both mindsets at once.

Therefore, to a trader, an idea isn’t an idea without clear prior delineation of what would prove it wrong. A statement such as, ‘I think gold will go up, and if it falls 2 per cent I’ll know I was wrong’, has an entirely different meaning from, ‘I think gold will go up and if it falls 20 per cent I’ll know I was wrong.’ The two statements lead to different trade types and sizes, and fit differently into your overall strategy. Incidentally, one strategy may well have both ideas in it at once – even from the same trader. And if the trader says, ‘I think gold will go up and no price decline will convince me I’m wrong’, or ‘I think gold will go up and if it doesn’t I’ll think about it later’, he’s no trader.

Notice that the stop-loss point is set without any consideration of risk
aversion or affordability. You set the stop loss at the point where you change your mind. If you bail out of a trade you still think is good because you cannot afford the loss or because you get scared, you sized it wrong in the first place and lost money for nothing. If you stick in a trade you think is bad, because you can afford the loss and hate being wrong, you’re throwing good money after bad.

The job of a financial risk manager is to keep people in the right trades and out of the wrong ones without affordability or psychology entering into the decision.

Avoiding Stop Mistakes

At the risk of repeating myself, let me summarise: you don’t set a stop loss by thinking about how much money you’re willing to lose, but by thinking about what future events would prove your trade thesis wrong. You then construct a trade that allows you to keep your bet on as long as it’s good but no longer. The risk manager’s job isn’t to evaluate the quality of the idea but to arrange things so that the idea makes its maximum contribution to the portfolio.

If you don’t know what the right stop point is, you haven’t thought the idea through deeply enough to risk money on it.

The worst misuse of stop losses is to apply them at a portfolio level rather than a trade level. In other words, you start taking off trades based on whether your overall portfolio is losing money. If you’re doing this, your portfolio risk is too great, and you’re letting it dictate your trading – because you cannot afford losses or because losses are psychologically painful. A stop loss should only be used to take off the trade that lost the money. Portfolio-level loss management is properly done with drawdown control, which I discuss in the Chapter 12.

A common mistake is to use the stop for discipline. For example, you start to lose confidence in a trader or a trader starts losing confidence in
himself, so you continue trading but with tighter stops. This idea is terrible. Perhaps you set stops not based on facts that would change your mind about the trade, but on loss points that would make you unhappy, or scare your investors or lead to criticism. If you do any of these things, you’re letting your risk manage your portfolio. I don’t care how dumb you are, your risk on its best day is a dumber portfolio manager than you are on your worst day.

### Giving orders

If you expected this chapter to be about stop-loss orders, as opposed to stop-loss risk management, this sidebar is for you. A stop-loss order is one way to implement a stop-loss policy. It can make sense for traders who can’t monitor the market constantly and who lack trusted execution agents.

The most common order types, including some intended to stop losses, are:

- **Market order**: In the public equity markets with a third-party broker, the way most individuals and small organisations trade, the simplest kind of order is a market order, which is an instruction to the broker to buy or sell a specified quantity of stock at the best price the broker can arrange. I never recommend giving market orders to a third-party broker as you have absolutely no control over the execution price.

- **Limit order**: Generally more sensible than a market order, a limit order instructs the broker to buy or sell a specified quantity of stock at the best price the broker can arrange, provided that price is equal to or better than the limit price (better means lower for a buy and higher for a sell).

- **Stop order**: Inactive when submitted, a stop order becomes active if the stock reaches the limit price or goes through it. In that case, the stop order becomes a market order (some brokers convert when the stock is quoted at or through the stop price, others wait for actual execution). Therefore, the stop price is always higher than the current price for a buy, and lower for a sell (if that weren’t true, the stop order would convert to a market order when it was submitted).

- **Stop-limit order**: this order is also inactive when submitted. If the stock reaches the stop price, it converts to a limit order rather than a market order. So if you buy a stock at £20 and want to sell if it drops to £16, you can issue a stop-limit-sell order with a stop price of £16 and a limit price of £15.50. That means you sell the stock if the price drops to £16 or below, unless it’s dropping so fast that there’s no chance to execute between £16 and £15.50.

Outside of public equity markets, investment managers use the same terms when instructing brokers or traders. Also, they’re coded into electronic trading algorithms. Order types are important for designing infrastructure to support whatever risk management decisions are made. Stop-limit orders may be the best way the implement a stop-loss strategy, or it may be preferable to have the trader monitoring the market use discretion on the execution (for example, ignoring a small trade through the stop price done at a time of light market activity,
Adding complexity
The answer to the question, ‘What would cause you to change your mind on this trade?’ isn’t always just about losing money. Let me clarify that slightly: there should always be some amount of loss that proves your trading thesis wrong – I don’t believe that conviction trumps evidence to the contrary. However, other factors may undermine your thesis without necessarily causing a loss in your trade:

✔️ **No gain:** A common contraindicator is simply time passing without things moving in your favour.

✔️ **External event:** A central bank action or a peace treaty may change the assumptions that led you to put the trade on in the first place.

✔️ **Significant gain:** There’s usually some amount of gain that signals you were right, and have realised full value, so it’s time to cash in.

The factors in the list are part of your trade strategy, not your stop-loss point. Almost any trade has multiple contingency plans, and the thesis is re-evaluated in light of whatever information comes out. However, some of the occurrences on the list argue not for taking the trade off but for adjusting the stop higher or lower. The most common example is that anything that increases the volatility of the trade usually causes you to take the trade off (or reduce its size) or to make the stop wider. Leaving a tight stop on a volatile trade is letting the market make your trading calls.

Always think of a stop loss as an envelope around the trade strategy. The trade may be taken off at many gain or loss points, for a variety of reasons. The stop should be a simple maximum loss point, not the result of a complex calculation dependent on future events.

**Protecting profits**
Another common practice is using a trailing stop to protect profits, although this kind of stop is closer to the drawdown control I discuss in the next
chapter than to a pure stop loss. With a *trailing stop*, you set the stop point relative to the maximum profit of the trade. With a trailing stop of £10 million, for example, you get out of the trade if it lost £10 million without ever being in positive territory. However, if it made £5 million, then lost £10 million from there to be down £5 million net, you would take it off. Or if it made £100 million, then lost £10 million back to £90 million, you would get out. Doing so makes sense if you believe that any £10 million down move signals the end of the effect you were counting on for profit, but that’s rarely a reasonable thesis.

With a trailing stop, the losses are relative to the maximum profit of the trade, rather than absolute. It doesn’t matter if you’ve lost £10 million, £5 million or made £90 million, only how much you’re down from your maximum.

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**Trailing regret**

One guy who’s sorry he used a trailing stop was profiled in the *Wall Street Journal* after the flash crash of 6 May 2010 when the Dow Jones Industrial Average crashed nearly 1,000 points – the largest single day point decline in its history – then recovered most of the losses, all within 36 minutes with no news. Gary Pinder had much of his retirement savings in the Vanguard Total Stock Market (VTI) exchange traded fund. This fund is one that trades like a stock, but holds investments in a broadly diversified stock market portfolio.

VTI closed at $59.72 per share on 5 May 2010, and Mr Pinder had a stop-sell order with his broker at $49.17. His intention was to limit his losses to about 20 per cent in a stock market crash. After all, VTI had fallen 76 per cent during the 2007–2009 financial crisis. So every time the fund hit a new high point, he put in a stop-sell order at 20 per cent below that peak. In fact, he told the *Wall Street Journal* that the reason he switched from the open-end mutual fund version of VTI to the ETF version was the ability to set trailing stops. Open-end public mutual funds only allow immediate execution sell orders, usually only at the daily close price.

During the flash crash, VTI fell briefly more than 50 per cent, to $29.76. Mr Pinder’s stop-sell order was converted to a market order when the price hit $49.17, but the price was moving so fast at that point that he was actually cashed out at an average price of $41.15. This event cost him 10 per cent of his net worth. VTI, along with the rest of the stock market, rebounded quickly, and closed the day at $57.71.

Take four morals from this sad story:

- Your stop price isn’t the maximum loss you can make from a trade. The stop point is where you decide to get out, but where you actually get out can vary – by a lot. The stop point is where you change your mind; the execution price is what you get.

- Any stop-loss strategy, not just an order with a third-party broker for a public stock, has to consider the trading characteristics used to trigger the stop and precisely what will happen afterwards. If you see a possibility of a stop being triggered by short-term volatility or operational issues, this possibility is important to consider – doubly true in
Markets with less liquidity and transparency. Equally important to consider is the market conditions possible after the stop is triggered. Are you likely to be able to close out the position near the stop price or at all? Will you be selling amid a crowd of sellers with few buyers?

Notice that Mr. Pinder avoided a round number, like $50 or even $49, for his stop. This method is generally a good idea when using formal stops. There's no reason to sell exactly when lots of other people decide to sell. You often want to avoid being just below for a stop sell or above for a stop buy a round number. There's even less reason to sell immediately after the time when lots of other people decide to sell, because you're then in line behind them, and highly likely to get an even worse price.

Notice that the Wall Street Journal could not find the people who bought Mr. Pinder's VTI at $41.15. Perhaps they were hung over from their champagne celebration. More likely is the fact that victims of a financial failure are generally more eager to speak with reporters than people who profit. You should keep that bias in mind when reading the news. Flash crashes are dangers, yes, but they're opportunities as well.

More extreme than a trailing stop is a take-profit order (which is implemented by a limit order). In this, you decide in advance how much money you want to make on a trade, and take the trade off when the target is reached. I am not a fan of these orders in general because few trading theses are undercut by being right. You may, of course, believe that a price will go up to a certain level for reason A, then decline from that level for reason B, but you should think of these trades as two separate trades, and this situation rarely happens in practice.

More common is the idea that a price will go to a certain level and that you have no reason to expect it to continue up. In my experience, that decision should be made at the time of taking off the trade, not when putting it on.

Of course, you should have an expectation for potential profit before you get into a trade (how else would you evaluate the risk/reward ratio?), but few views in the future are clear enough to know exactly when to declare victory. If things move rapidly in your favour, it’s likely that you were more right than you knew and additional profit opportunity is there for the taking. If things move slowly and erratically up, you may have been less right, and should be happy to walk away with a small profit. Alternatively, maybe your trade made money for unrelated reasons (say the stock market in general went up, or foreign currency moved in your favour) and your thesis is as good as when you got into the trade.
Predetermined take-profit levels are usually an excuse to ignore contrary evidence and throw away opportunity rather than good trading discipline. They’re bad risk management because the lost profit from cutting profits too soon won’t be able to make up for the inevitable times you let losses run too long.

**Taking out the stops**

There's an old trader's saying that before the market makes a move, it takes out the stops. Suppose a stock has been trading between £45 and £50 for a few months, never hitting either round figure, without much news. Pretty much anyone who wants to buy or sell at any price above £45 and below £50 has had multiple opportunities to execute those trades. So there probably aren't a lot of stop orders remaining at those prices.

There could, however, be a lot of stop sells at £45 and just below, as well as stop buys at £50 and just above. If the stock had been trading above £50 longer ago, lots of people may be waiting to get their purchase price back. If the stock had been selling below £45 before entering the range, a lot of people may be anxious to sell before giving all their profit back. In addition, you always have people betting that when a stock breaks through a range, it will move a long way, so they want to sell if it drops below its recent support or buy if it trades above its recent barrier.

I'm not just talking about people who enter formal stop orders into trading systems or with their brokers. Holders with *weak hands* always exist, and are forced to sell if the price drops because they cannot afford the loss. Economically, holders with weak hands function like stop sell orders. There are always *chasers* who are forced to buy if the price goes up – say a portfolio manager who had been negative on the stock but cannot afford to miss a big winner or someone who wanted the stock for its long-term potential but had been hoping to pick it up below £45. These people function like stop buys. And you always have momentum investors who buy stocks that are going up and sell stocks that are going down.

Now suppose rumour of some big news, positive or negative, starts dribbling out. Volatility increases, so the stock price drifts to one or the other edge of the range – £50 or £45. As soon as the price hits the edge, a lot of stops trigger and the price quickly jumps, say from £50 to £52 or from £45 to £43. There may be some limit orders to offset some of the stops, and value investors (who tend to sell things whose price has gone up and buy things whose price has gone down) to offset some of the momentum investors, but usually the stops and momentum investors dominate in the short run.

A quick reversal can set in, because there never was net demand for the stock at £52, nor net supply at £43. Volatility induced by trading behaviour can feed on itself until the other edge of the range is hit, and those stops taken out. Only then can the stock make the real move dictated by the fundamental news.

Of course, this is just a highly simplified story. Things don’t always work out this way, and they never work out exactly this way. However, people who watch markets for a living have observed this general phenomenon for many years. After a big move, if you go back and look, the formal and informal stop orders were often hit. Of course, the stops in the direction of the move were hit, that has to be true. But the stops on the other side seem to be hit a lot more
than you would expect by random chance.
This phenomenon is something professional traders have to factor into any stop-loss decision.

**Dividing stops**

I don’t recommend another common practice, placing a *fractional stop*, reducing the size of a trade after losses. People who use them might take off a quarter of the trade if it lost £2 million, another quarter if its cumulative loss got to £4 million, another quarter at a £6 million loss, and the remaining quarter at an £8 million loss. This strategy isn’t necessarily a foolish one, but I consider it four different trades, with different theses and therefore with different points of being proven wrong. It’s hard for me to think of practical examples with more than two or three legs, and even harder to think of ones with equal-sized legs and proportional stops. I think that most use of fractional stops is making suboptimal risk decisions because it’s too unpleasant to think things through and decide whether a trade is a good idea or not. Placing fractional stops can minimise regret, but is not sensible risk management.

Elsewhere in this book, I advise that if you’re unsure about an action, it usually pays to split the difference and take the halfway option. Why doesn’t that apply to stop losses, you wonder? The entire point of a stop loss is to force foresight. If you can make a decision in advance, you do so. That forces you to think things through, and it also helps because you make better decisions when you’re calm than under the pressure of a loss. Splitting the difference is avoiding a decision. It’s often the right thing to do when a choice is forced upon you, but when setting a stop, you don’t have to choose, you can instead not put the trade on in the first place. If a trade might force you to make a choice you don’t want to make, don’t do the trade.

**Overruling Stops**

Almost always when a trade hits its stop, you take it off. After all, the point of a stop is to force foresight. If you treat stops like New Year’s resolutions to be
discarded in February, you’re better off not having them at all.

Nevertheless, it’s always important to consider the situation and to avoid taking automatic actions for their own sakes. There’s no law against overruling a stop, and sometimes that’s the right thing to do.

One reason to be willing to overrule stops has nothing to do with improving trade outcomes. If you carve stops into stone, your discussions about where to set them become impossible. Traders dream up all kinds of low-probability scenarios in which the stop might be a bad idea, and you have to deal with all of them. By leaving the possibility open that a stop can be adjusted, removed or ignored, you can focus the discussion to concentrate on the reasonable possibilities.

**Considering new information**

Obviously you need to react to actual events rather than mindlessly sticking to a script. So, in principle, the risk manager is always willing to reopen a trade discussion and perhaps come up with different size and stop parameters.

In practice, only accede to changes in genuinely exceptional cases. If surprising events change the rationale for a trade, the proper response is almost always to take off the trade and think about a new one, and you’re usually wise to wait rather than putting on the new trade immediately. Surprising events mean you were wrong – not necessarily that your thesis won’t prove out eventually, or that you lost money, but that you didn’t see certain important events coming. When you’re wrong, you’re usually better stopping to reduce risk and to plan calmly and unhurriedly the next step when you’re sure that you’re thinking about future risk and return, not making up for past actions or proving past beliefs correct. You may miss opportunities this way, but most traders should only seize opportunities when they’re thinking at their best.

You enter into a trade for one set of reasons. Things change and you have a new thesis, one that argues for continuing to hold your position, but with a different stop point. However, if transaction costs are high, or trading is slow or you face tax or other penalties for trading, you may decide not to take the trade off. It would be pointlessly expensive to get out of your position and put it back on just for the trading discipline of keeping each trade idea separate.
Although there are legitimate reasons to overrule stops, it happens a lot less than people think it does. Most decisions justified by transaction costs or taxes or similar considerations are bad decisions; that is, they’re more often an excuse for a bad trade than a shrewd calculation of opportunity. Also, even when I reluctantly go along with this argument, I insist on treating it as a new trade and go through the entire trade approval process and account for it as a closing out of the old trade and entry into a new trade.

Two circumstances in which you can cheerfully adjust a stop rather than insist on accounting for a change as a new trade are

- **The trade is resized.** Usually this situation occurs due to a change in market volatility or a partial realisation or refutation of the thesis. It doesn’t necessarily mean the position size is changed; the same position may have resized risk due to outside events.

- **The trading characteristics of the position change.** Perhaps volume goes up or down a lot, or the trade becomes more or less crowded, or intraday volatility changes its relation to longer-term volatility or you think that lots of other people have put on stops near yours – any number of factors can affect the complexion of the trade. These kinds of arguments are the ones you want to hear when a trader wants to change a stop and are the things you look at before seeking out a trader to change his stop.

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**Emotional stop loss**

It’s worth thinking about stop-loss mentality outside of finance as it can help you understand the proper use of stops. Traders have a reputation for wild excess including excessive drinking, drug use, promiscuity and reckless gambling. While individuals vary, of course, considerable truth is present in the stereotype. Yet it also seems to be true that traders are less likely than most people to really screw up their lives, certainly less likely than other people who party and chase excitement as hard.

For one example, I have observed that traders have about the average rate of long-term contented marriages as other professionals of similar education and income levels. But what you rarely see is a trader who is perpetually lonely, or suicidally depressed in love, or bankrupted in a divorce, or slapped with a restraining order, or alienated from his children or any of the other really awful things people do to themselves when their hearts take over.
think that the reason is an instinctive stop-loss mentality that never makes a popular Valentine’s Day card, but is a wiser approach to life than romantic abandon.

Suppose, for example, you grow unhappy because your spouse seems to be devoting too much time and energy to work. A normal person broods on this problem for a while, then looks for a good time to bring it up for discussion – a time when things are not too good to risk spoiling, nor so bad that the discussion just adds pressure – a moderate time. The normal person rehearses a thoughtful, loving speech, which never comes close to what’s actually said.

Sometimes the discussion goes well, the air is cleared and everyone is happier. Sometimes not. The normal person sleeps alone, wondering how the reasonable, thoughtful, loving talk turned into a shouting match airing all sorts of ancient and novel complaints neither spouse really cares much about except during fights. You can trace a similar dynamic in wars, bar fights and political feuds.

A trader thinks differently. No brooding, and therefore no unconscious micro-passive-aggressions, prime the situation for an angry fight. The trader decides to try to get the spouse to direct more time and energy to home versus work. But the trader also has a clear stop loss – if the discussion gets to a certain level of hurt, with correspondingly low probability of successful outcome, the trader instinctively says, ‘You know what, dear? You’re right and I’m wrong. I don’t know what got into me, I must have been a bit lonely for you. Why don’t I get you a glass of wine and rub your feet?’

Maybe this kind of thing isn’t good for true soul-melding romance, but it does seem to limit downsides. Not just short-term downsides – that’s obvious. The secret of stop losses is that limiting your short-term downsides can be a powerful way to reduce long-term disaster.

**Changing the view**

The most common reason a trader asks for an adjusted stop (as opposed to the times when the risk manager raises the issue) is that he changed his view of the trade. If time passes without much movement in either direction, traders have a tendency to want to keep the trade on at a reduced stop. As the risk manager, I generally refuse such requests. For one thing, the trader always has the option to make up his mind to take off the trade at the tighter loss point; risk managers never force any risk taker to take risk. However, and more importantly, I think that asking for a smaller stop is a sign that the trader lost confidence in a trade. The idea might still work, but is not the best allocation of the firm’s risk capital. Kill it and move on to better, fresher ideas.

At the other extreme, sometimes events or moods push the trader into a substantially revised view. In this case, I generally insist on the new
view being treated as a new trade. Tinkering with existing trades undercuts trading discipline.

There’s some room for discussion in the middle, and it’s important room. You want traders continuing to think about existing trades, not running them on autopilot while concentrating on new ideas. The key here is to decide whether to entertain a stop adjustment based on the trader, not the trade.

The most common reason for a risk manager to reopen the stop discussion (as opposed to the trader asking for an adjustment) is concern that the trader has grown used to the trade and is taking it for granted. Making a trader defend his stop is an excellent way to make sure the positions represent current thinking rather than habit. No defence of a position is thorough unless there’s a possibility that the stop can change.

On the other hand, endless rehashing of stops can distract energy and attention from the market and from new ideas. Finding the right balance, for each trader and each trade, is one of the skills a financial risk manager must master.

Adjusting upon approach

Sometimes a stop point is hit, or seems about to be hit, and the trader or the risk manager wants to continue to hold the position. No one should be raising the complicated sort of issues described in the preceding section at that time.

I’m not talking about legitimate discussions about whether a stop was really hit nor about the best way to exit the position. For example, suppose an illiquid distressed bond price is marked down from £60 to £40 based on a model rather than an actual transaction, and your stop point is £45. No one would consider the price change a reason to reflexively sell your position. The price change is merely a nudge to call around dealers to gather information about at what price you could exit your position. (It’s not even much of a nudge because if you trade distressed debt, you monitor the market continuously.)

However, even with liquid securities trading in transparent markets, such as equities and futures, sometimes you ignore trades or quotes based on thin trading or unusual circumstances.
If you’re pretty confident that you couldn’t exit your position at or above the stop loss value, your stop has been triggered, even if no trade has been recorded or no bid received below the stop price. If you’re simply uncertain about where you can exit, the stop has not triggered, even if trades and bids are present below the stop price. A stop loss is designed to get you out when a loss has occurred, not when you’re unsure about how much the loss will be. The point is to get out of bad trades, not to save money on your bad trades (saving money on bad trades is also a good thing, but you don’t use stop losses to do it – that’s the amateur mistake).

When and how to exit a position after a stop has been hit depends on current market conditions. You don’t necessarily dump the entire position into the market at whatever you can get for it; you manage the exit to minimise loss using exactly the same trading tools you use to put positions on.

I’m talking about the decision to widen a stop after it has unquestionably been hit, or is about to be hit, with the intention of keeping the trade on, not just delaying the exit in hopes of getting a better price a little later.

This decision should never be justified by changed market conditions or changed trader views. Those issues have to be raised when the trade is far from its stop point. If the stop-loss point is the signal to start arguing about when to take off the trade, your risk management has broken down completely.

The only admissible argument for keeping a position after a stop has been hit is that the market is taking out your stop. In other words, the only reason the stop point has been reached is that you, and people like you, have stops there. If you hold on after the stops have been taken out, you have high confidence that the price will rebound above the stop point, and you will continue to have a good trade on. If you exit here, you get an artificially low price due to selling pressure, and you’re taken out of a good trade.

Although I believe this situation happens a lot, I seldom go along with the decision to loosen the stop. In situations like this, the people with the weakest hands sell early and lose a little. The people with the strongest hands hang on and make a lot, but endure a lot of pain before that happens. The worst fate
befalls the strongest weak hands – the people who hold until the maximum pain point and are forced to exit there. From a risk management standpoint, the bet that you have the strongest hands is usually a sucker bet and one made out of bravado rather than shrewd calculation. If you sell only when you’re forced to sell, you sell at the worst point, because the price can only recover when the forced selling is over. This advice is close to a central tenet of risk management.

Note that if you find yourself fighting the market in this way, it means that you set your stops incorrectly in the first place. This mistake is a good reason to reassess your stop setting process in the future but a terrible reason to ignore this stop (although someone is sure to raise it – it never fails).

Despite all these dire warnings, sometimes you actually do have strong enough hands to loosen a stop after it’s hit. It is a fateful decision that should be taken rarely. The decision is also a dangerous one, not because it might fail – it’s only money and if you’re doing a good job of risk management the loss is affordable. No, the danger is that it might work and set a precedent for firm-destroying hubris. Risk managers have the power to reset stops after they’re hit. Remember, with great power comes great responsibility.

**Monitoring Stop Frequency**

I am often asked how often trades should be stopped. It’s easy to rule out the extremes. If trades are always stopped, then you never make money. If trades are never stopped, the problem may be that:

- You size the trades too small; you’re not taking full advantage of your edge.
- You stop the trades too large, and you leave too much risk capital sitting in failed trades you keep around for sentimental reasons.
- You pass up too many ideas, which may mean that you eliminate more good ones that bad ones, and also that you don’t learn enough.

So a healthy stop ratio is somewhere in between. But where? This section explores that question in technical detail. Unless you’re actually involved in setting stops for a trading organisation, you don’t need all the formulae.
One parameter important for answering the question is what frequency of stopping will wipe out your profits. If you set a stop at $S$, and you expect to win an average of $W$ if the trade isn’t stopped, a stop frequency of $\frac{W}{S + W}$ means you break even. So clearly you need stops to be less frequent than this.

Risk managers think in terms of the ratio of the frequency with which trades are stopped out to the break-even level. This way of thinking is most useful if the trades are similar in risk characteristics and fairly independent in outcome. If you’re comparing dissimilar trades (say big trades versus small, or short-term versus long-term, or large edge versus small edge) or highly correlated trades, it doesn’t make sense to look for a single stop frequency.

To do this analysis, you divide the stop frequency by the average ratio of win plus stop for completed trades that did not stop out. Suppose that this figure is 0.75, meaning that you got stopped out at 75 per cent of the frequency that would have resulted in zero net profit for all the trades. One minus this number, or 0.25, is the fraction of the trader’s allocated risk capital being used by each of these trades. If the stop is much higher or lower than 25 per cent of the risk capital, it would appear to be out of balance.

This is a rule of thumb, not an iron law of mathematics. Don’t compute the ratio and mindlessly apply it to make things balance. Rather look at the numbers as an entry point to understanding the trading characteristics.

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Suppose that the stop frequency is too high: for example, trades are stopped at 90 per cent of the breakeven frequency but stops for each trade are set at around 25 per cent of the trader’s risk capital. One possibility is that the outcomes have been unlucky, and the trader believes that long-term expected stop frequency is 75 per cent of breakeven. Another is that the trader believes his trades have negative correlation, so that if one fails it increases the likelihood that others are going to succeed. Alternatively, you may be mixing trades with different risk characteristics.

But a risk manager also considers whether the trader is taking too much risk by sizing trades too large or setting stops too loosely. If so, the trader should get more risk capital or cut back on risk. Another possibility is that the trader
is taking profits too quickly, which makes $W$ (the amount you expect to win if the trade is successful) smaller than it should be, which decreases the breakeven ratio, which means that the actual frequency is too large relative to the breakeven ratio. Alternatively, he may be making $W$ smaller by bailing out of trades after small losses, essentially running a mental stop tighter than the agreed stop.

Even if you’re dealing with an automated computer algorithm rather than a human trader, you don’t manage risk by formula. You do the numbers to get insight into possibilities, not to make decisions.

One of the most important things to consider is whether the trader is getting better or worse with experience. If a bad run results in positive learning and new ideas, it can be productive. If it kills confidence or leads to chasing (increasing risk in hope of making back losses from past trades), it can be fatal. Conversely, if a good run leads to overconfidence and chipping up (increasing risk because the trader feels he’s playing with house money and isn’t satisfied with moderate profits), it can be fatal. However, if a trader gets in a groove of sensible confidence, you let him run with it as long as he can.

If the stop frequency is too low, it may be good luck, or that trades are correlated such that if one fails others are more likely to fail or that different types of trades are being mixed. However, also consider whether the trader is avoiding risk or keeping trades on too long.

By the way, the reason to concentrate on the ratio of stop frequency to breakeven frequency is that it gives you a better picture of problems than the raw-stop frequency. If a trader takes profits too early, he has a low-stop frequency, which might suggest that he’s taking too little risk. But taking profits early decreases the breakeven stop frequency by more than the actual stop frequency, so his ratio will be too high, pointing to his taking too much risk. The latter is the correct perspective for a risk manager. Yes, taking profit on one trade reduces the risk of that one trade by locking in a result (the same is true if the trader takes a loss). However, a policy of taking early profits and early losses actually increases the risk of burning through risk capital. Missing opportunities is a risk that leads to more long-term bad outcomes than any short-term risk taking.
Chapter 12

Controlling Drawdowns

In This Chapter

- Distinguishing drawdown control from stop-loss policies
- Calibrating drawdowns
- Thinking about your investors
- Implementing a drawdown control system
- Moving forward after a drawdown

There are two main ways losses are defined in finance – losses from an initial investment and loss in a position relative to its peak value, known as drawdown. Both types of loss are painful, of course, and both can be fatal if not controlled.

Perhaps surprisingly, risk management is entirely different for losses from initial investment, for which you should use stop losses (covered in Chapter 11) and drawdowns, for which you use drawdown control as described in this chapter. One of the most common and dangerous risk management errors is to use a stop-loss technique to control a drawdown – or a drawdown control technique to stop a loss.

Comparing Stopping Loss and Controlling Drawdown

Drawdown is the decline in an investment from its highest value. Drawdown control is reducing risk after a drawdown in order to limit the size of future losses that could create unacceptable levels of drawdown.

You stop losses on individual positions, not on portfolios. You control drawdown on portfolios, not individual positions. The point of a stop
loss is to improve your trading position. The point of drawdown control is to reduce the pain of portfolio losses. Don’t use stop losses for pain management, and don’t use drawdown control for discipline.

Unless you understand why you stop losses but control drawdowns, you will be ineffective as a financial risk manager when you’re needed most – the times when losses stress your organisation.

**Explaining the differences**

To help you understand the difference between a stop loss and a drawdown, I use a driving analogy – a comparison I use extensively throughout this book. A stop loss is your brake; drawdown control is your steering wheel. You use both to avoid collisions, but in most other respects they’re opposites. Braking reduces your ability to steer. In fact, if you brake too hard, you can go into a skid and completely lose your ability to steer. Professional drivers often speed up in order to gain better control over the car when trying to avoid an obstacle. In a similar situation, an amateur may brake, lose control and crash into the obstacle.

✔ A **stop loss** is like slamming on the brakes to come to a stop. You’re not thinking about what happens afterwards or about the destination you were driving to. The situation got bad enough that you decided to call a halt. After you come to a stop, you can plan the next phase of your trip. You may change your destination – say from going home to going to the hospital.

✔ **Drawdown control** is like adjusting your vehicle’s speed and position as you continue on your trip. If another driver cuts you off on the highway, pulls too closely in front of you or goes more slowly than you, you can choose whether to slow down or swerve to avoid her. But you don’t have to slam on your brakes for an emergency stop. Even if you decide to slow down, except in extreme cases, you can do it by removing your foot from the accelerator and letting your speed decline naturally. You don’t need to rethink your route or destination because adjusting to traffic is a routine part of driving.

The previous chapter talks about stopping losses, measured from initial investment, on individual positions as a trading discipline. In this chapter, I show you how to control portfolio drawdowns, measured from prior peak
values, as a way to reduce pain while ending up in pretty much the same place in the end as if you didn’t control drawdowns. *Pretty much the same place* is a theoretical statement only. In practice, the pain of drawdowns very often causes a risk manager to make decisions that turn out to be less than optimal. If you don’t control drawdowns, you may not only suffer the pain of the loss but end up in a worse financial position because of it.

**Controlling and stopping**

One of the reasons people confuse stop losses with drawdown control is that cutting losing positions seems like a way to control drawdowns. This logic leads to drawdown control policies that reduce risk in losing strategies or positions while maintaining risk or even increasing risk in winning strategies or positions. This risk strategy rarely works to control drawdowns. It would only help if losing positions were more likely to continue losing and winning positions were more likely to continue winning. If that were true (and it sometimes is), the effect should be exploited by portfolio managers to increase returns, not by risk managers to manage risk.

The reason stopping position losses rarely controls portfolio drawdowns is that the situations that lead to drawdowns in most portfolios are times when the various assets show high correlation to each other and low correlation from one day’s returns to the next. So, when a portfolio is doing well, it often pays to accentuate the positive and eliminate the negative. That varies from portfolio to portfolio and is a decision for the portfolio manager. When your portfolio is tanking, keep in mind that the anchor that dragged it down yesterday may well be the balloon that lifts it up today – and vice versa.

Abraham Lincoln explained this concept when accepting support for his second term as US president in the midst of the Civil War, ‘I have not permitted myself, gentlemen, to conclude that I am the best man in the country; but I am reminded, in this connection, of a story of an old Dutch farmer, who remarked to a companion once that “it was not best to swap horses when crossing streams”.’ The risk manager’s job is to get across the stream with the horses that started the trip, not to bet on one horse versus another while the water is high.

**Setting the Baseline Risk Level**
The basic idea of drawdown control is pretty simple: when a portfolio has lost a lot of money since a prior peak value, you cut risk. When performance turns around, or when the peaks fade in memory, you assume more risk again. But for this strategy to make sense, you must know the baseline risk level – the average target for the portfolio over the long term. You’re a risk manager, so you must know the long-term average target for all your risk entities. But teasing out what this baseline is can be tricky.

In the simplest case, your baseline risk level is a quantitative portfolio that targets a specified volatility level, say 10 per cent per year. If market volatility goes up, you cut positions to maintain the target volatility. This action isn’t drawdown control but volatility control. If market volatility goes down, you increase your positions (although I hope you have some leverage limits to avoid the trap of holding inflated positions before every crash). If your portfolio defines its baseline risk level as a volatility target, you accomplish drawdown control most naturally by temporarily cutting the volatility target, say from 10 per cent to 8 per cent.

But what if your portfolio has target exposure rather than target volatility? Consider, for example, a portfolio that invests all its assets in large capitalisation global stocks. Such a portfolio has fixed exposure (100 per cent exposure to stocks) but widely varying volatility levels, perhaps under 8 per cent per year in quiet times and over 24 per cent in volatile times. Suppose that a large drawdown occurs when portfolio volatility is at 25 per cent. (Drawdowns in a long equity fund tend to occur at times of increased volatility.) If you cut positions 20 per cent, the portfolio runs at 20 per cent volatility, which is higher-than-average risk and can’t really be described as drawdown control. (I talk more about volatility and exposure in Chapter 2.)

Another issue arises with benchmarked funds, funds whose performance is measured formally or informally against an index such as the MSCI World Index. Both absolute and relative performance of the fund matter, and they matter in different proportions to different stakeholders. For example, a long-term investor using the fund to diversify holdings in a broader equity portfolio is less interested in risk reduction for drawdown control purposes than is a medium-term investor using the equity fund as the core holding. So
what do you do if the fund is down 20 per cent from its peak, but has beaten the benchmark by 5 per cent during that period; or if the fund is at an all-time peak but has fallen 10 per cent behind its benchmark? This question isn’t just one of defining the drawdown amount, it also affects what you do to reduce risk. Do you cut positions or get closer to the benchmark?

There are no universal risk management answers to these questions. They must be discussed thoroughly with portfolio managers, investors and other stakeholders. Decisions on these questions won’t offer a perfect solution for everyone, but any reasonable clear answer is preferable to trying to decide these issues in the midst of a crisis.

After you establish the appropriate expectation and communicate it to all stakeholders, you have the baseline for setting up a drawdown control system. Never do this in the reverse order: Never set up a drawdown control system without first letting all your stakeholders know the expectations you’re working from.

You may want to throw up your hands at this point and decide that you can’t get a universally meaningful definition of drawdown. However, as a risk manager, part of your job is to define it. You need to manage risk according to some standard, and your job is to ensure that everyone has the same understanding about what that standard is.

**Considering Stakeholders**

In a *commingled fund*, one in which multiple investors’ money is combined, you may have many types of investors with different experience and expectations regarding the fund’s drawdown:

- Long-term investors who care about drawdown from a peak two years ago.
- Investors who came in after that peak.
- Investors who care only about quarter-end or month-end results.
- Investors interested in intraperiod peaks, perhaps even intraday peaks.
Each of these investors focuses on drawdowns over different periods. The key concept is performance versus expectation. A stakeholder’s expectation determines whether she thinks things are going well or badly. In answer to the question, ‘How’s the stock market doing?’, one person might say, ‘Pretty well’ because stocks are up 50 per cent over the last three years. Another person might say, ‘Terrible’ because the market fell 2 per cent in the last half-hour. If both of those people are investors in your commingled fund, they each need to be educated about your return horizon – whether the portfolio is being run in consideration of a three-year peak, a half-hour peak or some other time horizon.

The solution is often to use a blended definition, averaging drawdowns from peaks over various periods. But here again, clarity is the goal, not perfection. Come up with a reasonable definition that’s acceptable to all stakeholders. If that’s not possible, the only solution is to separate the stakeholders and run two or more different funds so each can have its own drawdown control.

**Evolving drawdown control**

Of course, investors always dislike drawdowns. But, historically, standard quantitative investment analysis emphasised the probability distribution of returns and losses from initial investment rather than drawdown from peaks. The *high-water mark* fee structure of many hedge funds, in which an investor pays performance fees only when the fund reaches all-time peaks in value, called attention to drawdown as a metric. Investors quickly realised that with limited transparency into portfolio positions and only monthly return information, drawdowns could give more insight into fund risk levels than traditional quantitative measures could. Another advantage of maximum drawdown is that it can be reliable when data issues cause other risk measures to be misleading.

There’s one very important difference between traditional academic drawdown control and the systems practitioners built for investors. To see it, consider a system that cuts exposures by 20 per cent if a portfolio falls 5 per cent from its historical peak and puts the exposure back on when the portfolio gets back to peak. Every round trip on this scheme
imposes a permanent cost of at least 1.25 per cent on the portfolio. This money can only be recouped if the portfolio is liquidated while it’s running at 80 per cent exposures. In other words, this is a stop loss scheme – a way to reduce losses if the portfolio is abandoned – not a rational drawdown control scheme for an investor who cannot exit the market forever.

**Being able to surrender**

Most academic versions of drawdown control lose money as long as the investor remains invested and only pay off if exposure is taken down to zero. Practical drawdown control, on the other hand, generally involves small or zero expected loss, and is intended to reduce the size of the worst drawdowns while resulting in the same long-term return as the portfolio without drawdown control.

A properly designed system can be a free lunch in the sense of reducing risk, and the most painful kind of risk for most institutions, without giving up expected return. This form of drawdown control is the appropriate one for investors who don’t have the option of surrender.

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### Responding to stakeholders in a crisis

A risk manager’s telephone is busy whenever anything bad happens. One common example is when trading counterparties hear about losses. In standard portfolio management agreements, if the assets under management (AUM) decline by more than 10 per cent in a month, the counterparties have the right to terminate all trades. AUM can decline due to investment losses or investor redemptions or both.

Imagine that you’re the risk manager of an asset management company and your phone rings. On the line is the credit officer from one of your major counterparties. ‘I see your fund is down six per cent this month,’ he says ominously, ‘and it’s not even the middle of the month. What are you planning to do?’

You can make several answers:

- **The worst answer:** ‘The market is crazy and this is a gigantic buying opportunity. We’re doubling our bets.’

- **The slightly better bad answer:** ‘We’re shell-shocked. Who knew this could happen? We’re reversing all our positions in a panic.’

Of course no sane risk manager would make either answer, but risk managers have been known to try to find some good answer between those two, or even try to give both at once. This attempt usually leads to getting the worst of both worlds, and the
credit officer hangs up thinking that you’re both reckless and panicked. Another bad answer is, ‘We’re not reacting at all, and we pay attention to our process, not results.’ That’s better than the first two, and is often a sensible attitude for portfolio managers. But risk managers have to care about results. Even if they didn’t, risk managers have to convince credit officers that they care about results.

The great answer: ‘Things are under control. Our systematic drawdown control process kicked in and we’ve cut risk 25 per cent. If we lose another 1 per cent, it will cut risk 10 per cent more. We anticipated this situation and planned for it, and everything is running smoothly. Thank you for your call, I appreciate your concern and I’ll let you know if you can do anything to help.’

This response strategy applies to many situations in which a stakeholder is concerned about losses.

Building a Drawdown Control System

Virtually all investors already have a drawdown control system. It may be called panicking, or firing the chief investment officer, or having a fire sale (in which they sell off all positions at whatever price they can get). Almost no one has infinitely strong hands that can continue to hold a position despite losses. Some degree of losses forces some degree of position reductions.

A well-designed system of drawdown control can give you a great deal of protection against the worst drawdowns without being expensive in terms of expected return. You always incur some transaction costs, of course, and you lose some of the expected return from your portfolio when you’re running at less than full exposure. However, you also lose some risk.

In practice, portfolios with drawdown control tend to have better risk/return ratios than the same portfolios run without drawdown control.

A formal drawdown control system adopted in calm times is superior to an informal drawdown control system driven by institutional weakness, counterparty demands or emotion. You have to plan your drawdown control when things are calm, not when the phone is ringing because the market took a downward turn. Not much middle ground exists in a crisis, and any decision you make in reaction to a problem be criticised as reckless or panicked. In fact, you often get accused of both
at the same time by the same people. The solution is to avoid making decisions during crises.

Designing a drawdown control system from scratch can be daunting, so many factors interact in complicated ways. So the answer is to start with three pieces of good news:

✔ **You find little difference among drawdown control systems in terms of expected long-term results.** After you decide how often you’re willing to let the system trigger and how deeply you’re willing to reduce risk, the specific formulae have about the same expected outcome. One system may cut risk on Tuesday, another cuts risk on Thursday, but a drawdown is a drawdown. After the fact, there can be big differences based on what happens in the market on Wednesday, but you cannot predict that and shouldn’t try.

✔ **The process of designing a drawdown control system engages stakeholders in a useful way.** Discussions about risk have a way of letting everyone think that agreement has been reached, but the first bad surprise often reveals deep disagreements. Drawdown control systems force people to put their opinions in numbers that leave no room for disagreement.

✔ **Drawdown control is always popular.** During the crisis, people find it reassuring to be executing a plan rather than making impromptu decisions. After the crisis, people remember the good it did by trimming the worst of the losses and find it easy to forgive some lost profit in the aftermath. Moreover, in a big crisis, drawdown control makes a lot of money, which is always popular.

## Avoiding bad meetings

I generally dislike meetings and the worst meetings are the ones after large drawdowns or other reverses when no drawdown control policy was in place. Glum people sit around a table, avoiding eye contact. No one wants to be the first one to suggest cutting risk, but no one wants to be remembered as the person who blocked cutting risk. It reminds me of a junior high school dance with all the boys on one wall and all the girls on another and no one willing to be first to cross over and ask someone to dance.

Now imagine you walk into this conclave and announce calmly, ‘The drawdown control policy triggered and calls for a 10 per cent reduction in risk. Does anyone have any reason to overrule that?’
The mood changes instantly. People start thinking clearly and can have a productive discussion about risks and opportunities. Instead of a rehash of tired opinions about the market or unresolvable debates about the philosophy of risk, people have a focused conversation with a clear goal. In the end, the system is almost never overruled, but the airing of views is very useful nonetheless.

A good meeting is one where people enter frowning and tired – due to events, not because they have to attend the meeting – and leave smiling and energetic because they have confidence in a plan, not because the meeting is over. Good drawdown control policies make for good meetings.

**Determining your time range and definitions**

The first choice you have to make is how to define the level of drawdown. You measure from some peak, but the time period you choose may be

✔️ **A trailing period**: A specific and consistent length of time back from the current time – the last three months or the last two years, for example.

✔️ **A fixed calendar period**: You can choose to measure from the peak an hour, a day, a month, a quarter or a year ago – or any amount of time you choose.

You can measure drawdown in absolute terms or relative to a benchmark.

Two pieces of general advice:

✔️ **Average three or more definitions**. For example, drawdown from year-to-date peak, from the trailing 24-month peak and from the trailing 25-day peak.

If you’re averaging, you may often find it appropriate to include some non-drawdown measures such as year-to-date return or draw up from trough. These measures cannot be your sole drawdown measures, or it wouldn’t be a drawdown control system, but they can be averaged in to adjust your measure.

✔️ **Include a short-term measure**. For example, you may choose 20 or 25 days for liquid instruments and 3 months for less liquid ones.

**Setting a floor**
The drawdown measure inevitably is compared to a level universally called a *floor*, a level of drawdown that would cause severe problems.

I don’t like the term *floor* because it suggests that a portfolio can never drop below some value, which is untrue. The appropriate term is *loss-avoidance horizon*. But it’s a losing battle, so you may as well call a floor a floor. Just be sure to explain to people that losses can be worse than the floor amount.

Consider three things when setting a floor:

1. **The level of loss that would cause problems in the fund.** Problems can include
   - Stakeholder concerns
   - Inability to meet cash obligations
   - Regulatory breaches
   - Unaffordable investor redemptions

   The point of drawdown control is to reduce risk when you have the choice, not to wait until you have no choice. So set the floor so that you have a comfortable buffer above critical levels, without making the buffer too big. If the buffer is too small, you can find yourself too close to the floor before drawdown control triggers, and you may be forced to abandon the drawdown control system and revert to seat-of-your-pants risk reductions. If the buffer is too large, the drawdown control system cuts risk after routine losses, which means the drawdown control system is taking too much discretion away from the portfolio manager.

2. **The level of drawdowns the portfolio would expect to realise during normal operation.** Drawdown control becomes portfolio management, not risk management, if it influences positions in normal times. The drawdown number depends on the volatility of the strategy and the time period the drawdown is measured over – drawdowns from trailing 3-year peaks are going to be bigger than drawdowns from trailing 20-day peaks.

What if the level of losses a portfolio can sustain without problems is less than the level of losses a portfolio expects to experience
in normal operation? Then you’re running the portfolio at too high a risk level or you haven’t prepared the portfolio for the level of risk it’s taking on.

You don’t want to err too much on the other side, however. You need a buffer between the losses you expect and the losses you can afford, but too big a buffer isn’t efficient. If you find an excessive buffer, consider returning capital to investors or running the portfolio at higher volatility levels.

**The valuation range of the portfolio positions.** Your drawdown control system must have room for normal trading ranges and bid/ask spreads. (A bid/ask spread is the difference between the highest price anyone is currently willing to pay for an asset and the lowest price anyone is currently willing to sell it for.) Drawdown control systems are supposed to control drawdowns, not get triggered by normal activity.

![Tip]

The trick here is to consider valuation range after large drawdowns, not what they are in happier times.

Although juggling these three considerations is tricky, it forces you to ask the questions you need to ask as a risk manager. These points provide good openings for stakeholder discussions as well.

**Calibrating distance from floor**

Drawdown control means cutting risk before you reach the floor. The question is: How far away do you start cutting? Several considerations come into play:

**Your reaction time:** One consideration is how much you might lose before you have a chance to react. Obviously that depends both on the instruments you trade and your trading capabilities. Some holdings change prices slowly and reasonably smoothly; other investments can make massive jumps without opportunities to trade at intermediate prices. Actually, any holding can experience massive price jumps, but in some instruments this situation is an extraordinary event – in others, just part of routine portfolio management. How quickly you can make trades comes into play.
However, it’s also true that an organisation that runs a large investment department that constantly processes orders or a high-frequency trading outfit with the company’s servers located next to the exchange servers is able to react much faster than an organisation calling trades into third-party execution brokers.

**The complexity of your positions:** Sometimes the trading itself isn’t what takes time, but the preparation and transmission of complex orders, or orders for complex instruments.

**The date and time:** You may be willing to get closer to the floor during the trading day, when you can react instantly to any movement, than you are overnight when less liquidity is evident or your traders are asleep. You may want to be farther from the floor on the Friday afternoon before a holiday weekend or on the last day of a quarter.

A good rule is to cut risk when you’re twice as far away from the floor as you think prices can plausibly move before you can trade. The logic is simple: if you ever find yourself closer to the floor than prices might move before you can trade, you have to trade now or risk being pulled through the floor. You never want to be forced to trade, so you don’t want that to happen. In order to be sure that it doesn’t, you need to be twice as far away from the floor. That way, even if you get the maximum plausible down move, you’re still far enough away from the floor to have a choice about whether or not to trade.

If this all sounds hopelessly complex, take comfort. Considering these points can inspire productive conversations between you and your traders. It can help you discover the things about your trading systems and the markets that a financial risk manager has to know.

**Cutting risk**

Okay, you defined drawdowns and picked a floor, and chose a distance from the floor at which you cut risk. Now, you need to decide how to cut risk.

The simplest risk-cutting scheme is to reduce all positions pro rata. You may have need for more complicated rules. For example, some parts of the portfolio may be liquid, and can be traded cheaply and quickly, while other
parts are more expensive and take longer to trade. Or it may not be practical to trade a certain percentage – you have to sell all or nothing.

**WARNING!**

Drawdowns triggers tend to be hit in fast-moving markets, and the portfolio manager may be rebalancing the portfolio while you’re ordering the drawdown.

If the system is complex, you must agree on an objective criterion to demonstrate that the required drawdown has been taken. A historical simulation Value at Risk (HSIM VaR) is good for this. If positions are cut pro rata, HSIM VaR goes down by the same fraction. If lots of positions are changed, a reasonable, simple, objective way to determine whether risk has been reduced by the required fraction is to compare tail losses of the original and rebalanced portfolios over the recent past. It may not be the perfect measure of risk reduction, but everyone can agree what it is. ([Chapter 6](#) talks about HSIM VaR in more detail, and [Chapter 9](#) covers distributions and tails.)

**WARNING!**

If you neglect to set objective criteria for measuring drawdown, you may find that the portfolio manager, consciously or unconsciously, is offsetting your risk reduction by shifting to positions with less diversity and higher volatility. This shifting not only defeats the purpose of drawdown control, it actually increases risk at the worst possible time.

**Stopping cutting risk**

If you use your drawdown control system to cut risk down to zero, you have a stop-loss system, not a drawdown control system. After you cut risk to zero, you can never make back losses, so you can never take on more risk. Long before you cut risk to zero, return the money to your investors and announce that you failed instead. Don’t feel shame in failure. However, you should feel shame in continuing to collect fees by refusing to admit failure.

**Tip**

A good general rule is to run drawdown control until you cut risk to 50 per cent of your full investment level. If you can’t run a portfolio at 50 per cent risk, you probably shouldn’t be running it at all. I can’t prove
that mathematically, but it accords with my experience. At some point you have to say, ‘My strategy has failed, I’m going home to rethink my life’, or ‘I’m willing to stick with this strategy at reduced risk levels until they pry it out of my cold, dead hands.’ I think 50 per cent risk levels is usually a good time to make that call.

Drawdown control is a way of dynamically altering risk levels to take advantage of opportunities while surviving bad times. A comparison may be a boxer bobbing and weaving, sometimes going in to exchange punches, sometimes covering up to avoid more damage before the bell. But times come when you need to throw in the towel or come out swinging. Risk management is mostly about making calculated adjustments, but sometimes you just have to put up or shut up.

**Regrouping after a Drawdown Event**

Unless you want your drawdown control system to generate only losses, you must create a possibility that risk can be increased at a lower price than it was reduced. For example, a risk-management system may mandate cutting positions 20 per cent when the portfolio falls 5 per cent from its historical peak. But it cannot wait until the portfolio gets back to peak before putting positions back on because that guarantees selling low and buying high.

**Paying attention to peaks**

Some drawdown control systems use a *rolling peak*, in which you raise your risk exposure if time passes without further losses even if the portfolio is below its all-time historical peak. Other systems consider *draw up* from the minimum portfolio value (the increase in value since the trough, as opposed to *draw down* which is the decrease in value since the peak). But in order to get rid of expected losses, any risk management scheme must give up absolute protection against a level of maximum drawdown. For example, with a rolling peak, if losses continue over a long enough period of time, the drawdown control can be ineffective. The market can drop, causing losses and position reductions, then the market can stay flat until the old peak rolls off and positions are restored, and then the market can drop again.
You implement drawdown control to improve results, not to impress people. But it doesn’t hurt that it impresses people.

**Taking on more risk again**

When people design drawdown control systems, they spend 90 per cent of their effort figuring out when to call for risk reductions. But when to start assuming more risk again is both the more difficult and the more important decision.

Most sensibly designed drawdown control systems correspond roughly to what experienced portfolio managers would do naturally. Systems tend to start cutting risk earlier and in smaller increments than individuals do; individuals tend to start later but to cut risk more deeply when they start. Overall, the average levels of risk reduction are similar over the entire downswing. Using a system is better chiefly because it reduces the mental stress of having to make highly emotional decisions under pressure – or perhaps because it avoids the really bad decisions people sometimes make.

Good drawdown control systems differ dramatically from what most portfolio managers are inclined to do after hitting bottom. If they could talk, unemotional numbers might say, ‘The strategy is making money again, market risk has declined, the old peaks are fading in our memories, now it’s time to get risk back up.’ Emotional humans tend to say, ‘I just went through the agony of losing money and cutting risk, and I’m now invested in that decision. There are still huge risks out there in the market. The pain of losing has made me value surviving and not looking like an idiot more than I value taking maximum advantage of opportunities. If things have really turned around, there’s plenty of time to wait and be sure.’

You have to prepare all stakeholders for the human reaction to wait longer than necessary before jumping back into the risk pool. Tell them that they may find the drawdown control system comforting, or at worst a mild irritation, on the way down; but that it will shock them with its recklessness on the way back up. If they’re not ready for that, they should consider
reducing risk now, because they’re investing in or running a portfolio that has more risk than they can manage properly. Most people understand that if you run at too high a risk level, you cut risk too soon and too deeply in bad times. But few people understand that a much bigger cost arises in getting back in too slowly and timidly when good times return.

Reviewing the literature

In 1993, Sandy Grossman and Joe Zhou published ‘Optimal Investment Strategies for Controlling Draw-downs’ in Mathematical Finance. That seminal paper focused on optimal control rather than drawdowns, building on ideas from Robert Merton, Andre Perold and Fischer Black, as well as practical experience from what was (misleadingly) called portfolio insurance in the mid-1980s.

Optimal control is a field in mathematical engineering developed in the former Soviet Union. This control is what you use to write a computer algorithm to fire rockets in order to get a spaceship where you want it to go, but it can be applied to controlling economies or epidemics as well as missiles. I don’t mean with equal effectiveness – people can be harder to control than things, and the Soviet Union did better running a space program than a consumer economy. I just mean the equations don’t care what they’re pushing around. One of the great ironies of history is that the acme of capitalist achievement, the 21st century global derivatives economy, was built largely on mathematical ideas developed for, and often by individuals trained by, the vast failed Communist bureaucracies of the 20th century.

Grossman and Zhou did their mathematical heavy lifting to calculate how to optimise long-term growth of a portfolio in the presence of constraints. It was secondary to the paper that the constraint they chose happened to be on the maximum drawdown – the deepest decline from any peak to subsequent trough. Most theoretical work has continued in that vein and has not gained much traction with investors, although in the last 15 years an academic research thread has emerged that tackles drawdown control with primary emphasis on drawdown and secondary emphasis on control.
Chapter 13
Hedging Bets

In This Chapter

- Knowing when to hedge
- Choosing your exposures
- Monitoring and adjusting hedges
- Taking hedges off at the right time

In financial terms, *to hedge* means to reduce risk by taking on an offsetting risk. A common example is buying insurance. You bet with an insurance company that your house will burn down this year. You pay £2,000 (the premium), and if you’re right, the insurance company pays you £500,000. Considered in isolation, this bet is risky, but it still reduces your risk because the combined value of your house plus insurance policy has less volatility than the value of the house alone.

Although risk managers use hedges all the time, you don’t have to like them. You only consider hedging when you hold a risk you don’t want. In that circumstance, your first instinct should be to get rid of the risk. People buy fire insurance on their houses mainly because they couldn’t afford to replace them if they were to burn down. Considered as a pure risk matter, it makes no sense to buy an asset you cannot afford, and then to buy insurance to cut the risk of holding it. A risk manager would say, ‘Why not rent the house and let someone who can afford it worry about the risk?’ However, people want to buy a house for reasons other than risk management, in which case hedging the risk is probably better than not hedging it. But remember, hedging is a second-best risk management tool or worse.

Think about what the hedge of fire insurance doesn’t do:
It doesn’t make a house fire less likely.

It doesn’t reduce the danger to life and property if a fire does occur.

Insurance only cushions the financial blow if the house burns. In addition, it creates several new dangers:

- The insurance company may go out of business and be unable to pay a claim.
- The homeowner may set a fire for the insurance pay out.
- Disputes about the policy may lead to costly lawsuits.
- The homeowner may cause a fire through carelessness.

Ultimately, the homeowner loses money on average, because the insurance company makes money on average.

Of course, I’m not against fire insurance. I have some myself. I also do a lot of hedging in my job as a risk manager. My message is to hedge when you must, but consider the alternatives carefully before you do.

**Choosing Goals**

You have four reasons to hedge from a risk management standpoint, and you must be absolutely clear about which one is applicable. I cover each in the next sections.

However, most hedging in finance is done for portfolio management rather than risk management purposes. Suppose a trader thinks that the market has over-estimated credit risk, meaning that corporate bonds are cheap (credit risk means fear of default, and if investors think the chance of default is high, they put low prices on corporate bonds). But corporate bonds prices respond to changes in interest rates as well as to changes in perceived credit risk. If the trader has no opinion about the future direction of interest rates, he wants to hedge this risk out of his position.

He can do this by taking short positions in Treasury futures. This position pays him money if interest rates go up. Rising interest rates push all bond prices down – both Treasury bonds issued by the government and corporate bonds issued by companies. The Treasury futures require the trader to pay
money if interest rates go down, which pushes bond prices up. This hedge isn’t done for risk management purposes, but to refine the position so the precise bet is what the trader wants to make, not some extraneous bet. (I don’t cover portfolio management hedges in this chapter or this book; if you’re interested, Nassim Taleb’s *Dynamic Hedging* is the best source.)

**Reducing exposure**

The most straightforward reason to hedge is to offset an unwanted exposure. This reason is common in non-financial businesses. For example, an airline has an exposure to oil prices. When fuel costs more, airline costs go up. Although some of the increase can be passed along to passengers, that increase reduces demand. As a result, the airline is flying fewer passengers at less profit per passenger. Using energy futures contracts to *go long* (essentially to buy) oil can provide gains to offset some of the losses if energy prices go up. Of course, the contracts cost the airline money if energy prices go down, but in that scenario the airline has increased profits to offset those costs.

Risk managers prefer to use other means to get rid of the exposure such as signing long-term jet fuel supply contracts or pre-selling tickets at fixed prices. However, in some cases a company is forced to accept an exposure as a condition of doing business, and a financial hedge is the best way to manage that exposure. Forced exposures are rarer in financial businesses than non-financial, but they do occur.

**Example**

A mortgage originator is exposed to changes in interest rates between the time the originator locks in a rate with a borrower and the time that the mortgage is sold to an investor. If interest rates go up between these events, the originator can lose money because it lent the money out at a lower rate than the current market rate at the time the loan is sold. *Going short* (essentially selling) with interest rate futures contracts can offset this risk.

**Remember**

For the most part, these types of straightforward hedging decisions of unwanted exposures shouldn’t involve the risk manager. They’re
business decisions, not risk decisions. Selecting which exposures to accept and which ones to avoid is precisely what line risk takers do. Other than pushing everyone to try harder to eliminate unwanted exposures rather than hedging them, the risk manager has nothing to add to these decisions.

However, in some situations managers should get involved with hedging to reduce exposures. Here are a few examples:

- Multiple portfolio managers are running components of a fund. Rather than each one hedging his unwanted exposures, it’s more efficient for the risk manager to hedge at the fund level, because individual unwanted exposures in components may offset.

- A line risk manager has trouble with a tail exposure (an unlikely but plausible event). For example, in a merger arbitrage strategy, a manager may buy stock in a company being acquired and short the stock of the acquirer. This strategy has little or no exposure to small ups and downs of the stock market, but may experience large losses in a large equity market decline. Estimating and managing tail exposures is something risk managers have to be good at – portfolio managers may or may not be. But even if the portfolio manager has the skills to do the job, as risk manager you still want to manage this hedge because it must coordinate properly with other tail risk management.

- Multiple hedging schemes are being applied to the same underlying assets. For example, an asset manager offers a fund with different share classes hedged into different currencies, or runs at different risk levels or with different benchmarks or otherwise with different hedges layered on. Alternatively, a hedge may be for the benefit of one set of stakeholders, such as creditors, but not for all stakeholders. In these cases it can make sense for the line risk taker to manage the assets for maximum economic value, and to let the risk manager use hedges to convert the underlying portfolio returns into the desired packages for different investors.

**Reducing risk**

People often confuse the goals of reducing exposure with reducing risk. This confusion may be the single greatest cause of poor hedging decisions. To see the difference, consider life insurance. A young parent uses life insurance as a
hedge against exposure to dying early. His risk is that if he dies young his lost earnings will mean there won’t be enough money to raise his children properly. So reducing the exposure reduces risk. Later, though, when the children are self-supporting and the father is retired, the risk reverses. Now his risk is living too long and running out of money. The same person who bought life insurance at age 30 may buy a life annuity at age 70 (a life annuity pays a fixed, periodic sum as long as an individual lives). So if a life insurance policy is a bet that you’ll die, a life annuity is a bet that you’ll live a long time. The life annuity pays less money if the owner dies young, so it increases his exposure to early death. Nevertheless, it reduces his risk. Sometimes reducing risk requires reducing an exposure; sometimes it requires increasing an exposure.

Again, hedging is a second-best tool for reducing risk. Direct reductions in positions is better for risk management, although that may not be possible or desirable for other reasons.

**Example**

A bank may find that, due to deteriorating credit among its borrowers, the loan book has too much risk. The bank cannot force its borrowers to repay, and even curtailing future loans may do more harm than good by putting more pressure on borrowers. Selling loans can take time, and there may not be a good market. As a result, the bank may choose to hedge either credit exposure or overall risk. A bank may choose to do both (or to do neither, for that matter). But the bank risk manager should distinguish sharply between the two type of hedges.

**Technical Stuff**

To hedge the credit exposure, the simplest method is for the bank to enter into credit default swaps (CDS) on the specific loans on its books. In these contracts, the bank pays a periodic fee to a counterparty (say £1 million per quarter for five years) as long as the loan payments are made on time. If the loan missed a payment or defaulted in some other way, the bank can sell the loan to the counterparty for its notional amount (the face amount of the loan; the amount that the borrower borrowed). The bank no longer has much credit exposure with respect to this loan because it gets the same amount whether the borrower repays (in which
case the borrower pays the notional amount) or not (in which case the CDS counterparty pays the notional amount). In practice, the bank likely buys CDS on a pool of public bonds similar to the bank’s loans. That’s not as good a hedge, but is probably cheaper and more liquid because the product is standardised.

Note, however, that hedging the credit exposure may not reduce the bank’s risk. For one thing, the bank may have offsetting exposures such that it actually makes money if some of its borrowers default (that’s not likely in this specific example, but is often true in general). For another, the market value of the CDS may not track the market value of the bank’s loans closely, and the accounting values may diverge as well. The exposure hedge is justified by an argument about how things turn out in the end when the loan borrower either repays or defaults, not about the ups and downs of value in between.

Hedging an exposure gives up the profit from the exposure (the periodic payment the bank has to make on the CDS is likely to eat up most of the profit from making the loan, and the CDS can cost more than the profit of the loan) as well as the risk. Thus, the decision to hedge an exposure isn’t just about whether the risk is too high in an absolute sense, but about whether the risk is high relative to the expected return.

**Hedging at cross purposes**

One sad-but-true common tale is that senior executives of a financial institution get nervous about an exposure and ask for a hedge. The executives are thinking of a simple hedge closely tied to the exposure. But the managers think the goal is to reduce risk, and come up with a complex and highly levered hedge in which the total gross notional amount of the hedge transactions is much larger than the exposure being hedged.

The managers like it because they think that the hedge will be much cheaper than a simple exposure hedge or even that the hedge will make money. Plus this kind of thing is what they’re good at. The hedge does a great job of reducing day-to-day volatility and making everyone feel safe. Then it blows up – the original exposure loses a lot of money and so does the hedge that was supposed to protect against losses – and everyone is pointing fingers and filing lawsuits.

The reverse isn’t as common, but it does happen. Senior management wants to reduce risk and gives the job to managers who aren’t sophisticated quants. Those managers take the simple approach of hedging the biggest exposures. That proves costly, and it doesn’t do
If what the bank wants to do is reduce risk rather than reduce credit exposure, it should begin by identifying all of its risk, not just its risk from loan defaults. It should consider all financial instruments that have negative correlation to that risk. *(Negative correlation* means that the instrument tends to go up in price when the bank’s net assets go down in price, and down when the bank’s assets go up).* The bank should then select a portfolio of hedge instruments that give the desired degree of negative correlation, ideally at a positive expected return, but if that’s not possible, at the minimum negative expected return for the protection.

**Accounting for performance**

Sometimes what you want to hedge is an accounting number rather than an economic reality. There can be good reasons for this. For example, a company may need to maintain certain accounting values in order to remain in business, or accounting numbers may trigger real economic decisions in other ways. You may find yourself with fiduciary or regulatory duties to use your best efforts to prevent certain accounting outcomes.

Less good reasons to hedge accounting values also exist however. A company’s management may feel that certain accounting values are necessary to maintain market confidence or to allow them to retain control of the company.

There are bad reasons to hedge accounting values, many of them, but they all come down to hiding or misrepresenting risk in one way or another.

Even the good reasons for hedging accounting values are good only when you have some less-than-optimal rule or agreement. In a perfect world, all decisions are based on reality, not on accounting fictions. Note that I’m not saying accounting numbers are bad or unreliable – often they’re the best measure of economic reality you have, or at least the best that can be easily ascertained and communicated. However, risk managers should always focus
on reality. No representation of reality, however accurate it may be, is a good substitute.

Also note that I’m not talking about distorting or gaming accounting values. I’m talking about entering into hedges that produce real economic effects correctly detailed in the accounting numbers. These hedges are likely to accomplish other goals such as reducing risk or eliminating undesirable exposures. However, they’re designed and managed in order to ensure the desired accounting treatment, even when it would be simpler and better on pure economic grounds to do things differently.

So, just as risk managers discourage hedging, when you have to hedge, discourage hedging for accounting purposes. However, you’re unlikely to have a career in financial risk management without doing a few accounting-focused hedges. Even your economic hedges probably have some features dictated by accounting rules rather than reality.

**Sticking to benchmark**

Remember that old joke about two hikers in the woods who see an angry bear rushing at them from a few hundred yards away? One hiker immediately pulls off his hiking boots and starts putting on sneakers from his backpack. The other hiker says, ‘What are you doing? You can’t outrun a bear.’ The first hiker replies, ‘I don’t have to outrun the bear, I just have to outrun you.’

The moral is that sometimes life isn’t about doing well but about doing better than someone else.

In finance, we call that someone else a *benchmark*. For example, an equity portfolio manager may be evaluated by how he does relative to an equity index (such as S&P 500 or Euro Stoxx). If he loses 5 per cent while the index loses 10 per cent, he did a good job, but if he makes 15 per cent while the index makes 20 per cent, he did a bad job. In this case, it can make sense to define his risk as deviation from benchmark rather than absolute risk.

Getting closer to a benchmark requires a sort of reverse hedging. You aren’t hedging the portfolio you own, but the portfolio you don’t own. For example, suppose that a commodity fund manager is benchmarked against the Goldman Sachs Commodity Index (GSCI, one of the most popular
commodity indices). The manager buys most commodities at close to their index weights but thinks that gold is overvalued, so he buys no gold. In order to make this portfolio perform closer to the benchmark, he has to hedge the missing gold, meaning that he has to buy gold (or perhaps a derivative security like a gold future or option).

I offer one caution here: nothing is ever completely benchmarked. A risk manager always has to care about absolute return, at least to some extent.

**Protecting cash**

The final common goal for hedging is to protect cash. As with the other goals, there’s some practical overlap. Hedging exposures or risk or deviation from the benchmark often produces cash when needed, but not always.

The important distinction is among economic value, accounting value and cash. In theory, the three should agree in the long run, but that’s not always true, and in any event you need to consider important timing differences.

Consider a bank that makes a £1 million five-year loan that requires £10,000 interest payments every three months, plus repayment of the £1 million principal amount in five years. The borrower begins to have trouble three years after taking out the loan, stops making the interest payments at the beginning of the fourth year and is unable to repay the principal at the end. The bank seizes collateral and sells it for £800,000 after all costs.

In economic terms, the value of this loan started deteriorating three years after issue. The economic value bounced up and down as good or bad news came out about the borrower. In accounting terms, the bank probably carried the loan at full value until 30 days after the first missed payment. Perhaps the bank took a £100,000 write down at that point, a further £200,000 write down later as more payments were missed and other bad news came out, and then a £100,000 write up when the collateral was actually sold. In cash terms, the bank was out £10,000 per quarter starting at the beginning of the fifth year, plus £200,000 at the end of the fifth year.

The total cash loss was £250,000 (five £10,000 missed interest payments plus £200,000 shortfall at maturity). That should add up to the economic loss and
also the accounting loss, subject to small adjustments for timing and technical factors. If the loan were fully hedged, the hedge should produce a cash profit of £250,000. However, the hedge has its own paths for economic value, accounting value and cash.

For the most part, a good hedge matches the hedged asset in economic value. That is, if you know the hedge will return the proper amount of cash in the end, any economic gains or losses on the asset should be pretty closely offset by corresponding economic losses or gains on the hedge.

Although accounting can be complex, in simple terms if the hedge qualifies for *hedge accounting*, which means that accountants are willing to treat the hedge as a hedge for financial reporting purposes and not as a separate position in its own right, then accounting gains and losses on the loan should be offset by corresponding accounting losses and gains on the hedge. However, if the hedge doesn’t qualify for hedge accounting treatment (usually because it isn’t a specific enough and good enough hedge), there can be large accounting gains and losses in different periods, even from a perfect hedge.

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**Getting the shaft**

Metallgesellschaft used to be one of the largest industrial conglomerates in the world. It decided to enter the US energy market, and in the summer of 1993 it saw a great opportunity. Oil prices were low, and most users of energy were afraid they would increase in the future. Metallgesellschaft offered to supply gasoline and heating oil for fixed prices over ten years. The offer was successful, and the company quickly sold 160 million barrels of oil products. Willingness to sign long-term fixed price deals allowed newcomer Metallgesellschaft to grab significant market share from established energy suppliers.

Of course, the contracts left Metallgesellschaft exposed to increases in oil prices, which would increase the company’s cost of buying oil. Because the price the company sold the oil for was fixed, the increased costs would result in losses – potentially crippling losses. Therefore Metallgesellschaft decided to hedge by entering into futures contracts and swaps to buy 160 million barrels of oil.

Many complex aspects are apparent in this story, but I want to focus on only one: When oil prices moved, it created expected gains or losses on Metallgesellschaft’s supply contracts that would be realised in cash over ten years; but the price moves also created offsetting losses and gains on the hedge that had to be paid in cash immediately.
If oil prices had risen as most people expected, this would have been no problem. Metallgesellschaft’s hedges would have paid cash, which the company could have banked to offset future losses as it had to buy expensive oil and supply it to customers at cheap prices.

But instead, oil prices fell from about £12 ($19) per barrel in the summer of 1993 to £9 ($15) per barrel by December of that year. Now Metallgesellschaft had to come up with immediate cash to pay losses on the hedge. It would make this money back over the next ten years, but it still had to come up with cash today. It was unable to do so, and only a £1.2 billion ($1.9 billion) rescue operation by 150 international banks kept it out of bankruptcy. As a result, the company was broken up and sold.

Unless the hedge is constructed carefully with cash flows in mind, the cash flows from the hedge don’t usually match the timing of the offsetting cash flows from the underlying positions. The graveyards are full of financial entities that were hedged but unable to come up with cash to pay losses on underlying positions because the hedge cash came in later than the cash demand from the underlying position. And financial graveyards are equally full of entities with the reverse problem: the hedge demanded cash but the underlying positions produced the cash later.

**Measuring Exposure**

After identifying a hedging goal, the next step is to measure what you want to hedge. If you approach this problem straightforwardly, you’re likely to underestimate exposure.

In early 2007 almost everyone would have said they had zero exposure to US subprime residential mortgages and in early 2010 that they had zero exposure to Greek sovereign debt. Although some individuals and institutions had direct exposure to these things, nearly all of them thought the exposures were manageably small, and both government officials and private sector analysts were mostly convinced that the aggregate exposure of the economy was small. Yet losses in US subprime residential mortgages and Greek sovereign debt were key contributors to crises that inflicted substantial losses on nearly every
The basic problem is that your exposure today may not be your exposure after bad things happen, so hedging today’s exposure may be inadequate at the time you want your hedge to protect you.

In principle, this effect can work either way, and you may find that in the crisis you have less exposure than you thought. In practice, though, the effect usually hurts you. Think of a town built ten feet above the level of a river. You may think that the town is safe against any rise of the waters less than ten feet. If the river starts to rise, however, things will happen upstream: perhaps a dam fails and people upstream protect themselves by diverting more water downstream. Similarly, as things get bad in finance, institutions may fail and dump their exposures on their creditors. People and institutions take action to deflect losses elsewhere. Positions that were supposed to absorb losses may overflow. These things tend to increase your losses beyond the direct, obvious effects.

A common error is to choose a measure that’s easy to compute rather than one that’s accurate. Remember the old joke about a drunk on his hands and knees under a streetlight? Another man comes by and asks him what he’s doing. ‘Looking for my keys,’ replies the drunk, ‘I dropped them by the corner.’ The passer by asks, ‘Then why aren’t you looking by the corner?’ The drunk answers, ‘Because the light is better here.’ The same error can be made when people choose an accounting measure or easily available proxy for the actual exposure or risk to be hedged.

Finally, you need to consider not just the measure, but how often the measure is computed. If a hedge is adjusted daily, it doesn’t make sense to base it on accounting or government data released only monthly or quarterly – after the information is stale. However, the opposite mistake is to use current market prices of volatile assets (like stocks or oil) for a hedge that’s adjusted annually.

Computing statistics
The simplest way to estimate an exposure is to use statistics. For example, a real estate company is worried about its exposure to interest rates. It can run a linear regression of the value of its portfolio on, say, the interest rate on three-year treasury bonds. That may sound complicated, but it just means that the company uses a mathematical procedure to answer the question, ‘How much does our portfolio value decline for every one per cent increase in the interest rate?’ The linear regression can be thought of as an average of past changes in the portfolio value divided by changes in interest rates. Of course, the company may use more sophisticated statistical procedures instead.

The subject of getting reliable future predictions out of past data using statistics is a vast one – much too vast for me to cover in this book. If you start with an unreliable prediction, of course you end up with an unreliable hedge. So I assume that you have a good statistical fit. I only discuss the complications when using that fit as an exposure measure for hedging.

One common way to go wrong is to do the statistical work on data differently from the goal of the hedge. Statisticians are most likely to work with economic value data, as notional, accounting or cash data have complexities that make additional work in quantitative analysis. Therefore, if you don’t pay attention, you’re likely to get a statistical analysis appropriate for a risk-reduction hedge even if your goal is to hedge exposure, accounting values or cash.

Another important detail is to concentrate on the historical data that represents the most important scenarios for the hedge. For example, it’s usually much more important that hedges work acceptably in the most extreme market moves than that they work perfectly the rest of the time. Hedge measurement depends mainly on correlations (the tendency of different prices to move up and down together) and correlations are different on extreme days versus normal days. A statistical fit that weights all days equally is likely to lead to a hedge that’s mis-calibrated when it counts.

Hedging the US government

One of my lasting memories of the financial turmoil in the summer of 2008 was receiving an axe from a Lehman Brothers trader. No, the trader didn’t send me a tool for chopping down trees, in finance an axe refers to a desired trading direction. Sometimes a trader has a reason
to trade in one direction – say to sell Argentine sovereign bonds. The trader may have a
position he wants to get out of or a customer request.

The trader has a number of ways to execute his desired trade, one of which is to
communicate his desire with people in the market who may be inclined to take the other side.
In finance, the trader is said to have an axe, and is choosing to tell some people in the
market. Disclosing the axe gives the market information that may mean the trader doesn't get
as good a price as he could otherwise, but it's sometimes the best way to execute a large
trade, especially in specialised or niche products. In effect, the trader is offering a good price
to anyone who will help him execute.

This axe was for Lehman Brothers to sell me £100 million five-year credit default protection
on the US government for 17 basis points, which means that I would agree to pay Lehman
Brothers £170,000 per year for the next five years, and Lehman Brothers would pay my
losses on £100 million of US government debt if the US government defaulted on its debt
during that period.

Of course, this situation raises the question of will Lehman Brothers have £100 million to give
me after the US government defaults? The answer is likely 'no'. Things are actually a bit more
complicated than that, but the basic point is that it generally doesn't pay to buy insurance from
an entity that's financially shakier than the thing you're insuring. As it happened, Lehman
Brothers was bankrupt less than two months later, and the US government, despite some
political drama, is still making all its debt payments on time.

Make sure that your statistical analysis takes account of liquidity,
margin payments, timing, counterparty risk and other market conditions.
Some statisticians like to play with numbers in a computer rather than
going their hands dirty with the realities of financial transactions. I’ve
seen hedge analyses in large, sophisticated financial institutions in which
the hedge amount depended on data that would be unavailable at the
time of hedging, or required wildly unrealistic amounts of trading, or
required unacceptable levels of collateral or were otherwise impractical.

**Duplicating models**

When you design a hedge using statistics, you treat the performance of the
portfolio you’re hedging and the performance of your hedge as random
variables. Model-based hedges treat the two performances as outputs of a
system. The distinction isn’t black and white because statistical analyses can
have deterministic components, and models can have *stochastic*, or random,
elements. Nevertheless, you can usually distinguish model-based hedges from
statistical ones. Modelling is more work, but in most applications it results in
a better hedge.
Consider, for example, a large corporation attempting to hedge its exposure to foreign exchange rates. If the US dollar strengthens against the Euro, it will likely have many effects on the company, both positive and negative, both long term and short term, and it will affect economic value, cash flows and accounting statements in different ways.

A modeller begins by measuring as many effects as possible and aggregating the results. The model won’t reflect reality exactly – it won’t be able to accommodate noise from inaccurate data, complex effects left out, reporting lags, model errors, approximations and other factors. Generally modellers attempt to minimise noise, although in some cases they may introduce random elements into the model itself.

The result of the model won’t be a simple exposure hedge, such as the company should buy €100 million with US dollars, for example. Instead, the result is likely to consist of several pieces to hedge different tail scenarios, perhaps with some futures, some options, some swaps and some contractual hedges. It may involve interest rates and other financial variables in addition to foreign exchange rates. Moreover, the model is likely to be dynamic, changing frequently in response to business and financial market events.

One important advantage of model hedges is that the model is a consistent picture of the company’s financial exposures. It may not be completely accurate, but it should be consistent. That allows the company to assign clear responsibilities to line risk takers. For example, a business decision may have positive expected risk-adjusted profit when measured in one currency, but negative when measured in another. One way to run a business is to have managers consider foreign exchange and other financial risk in all decisions; another method is to let the corporate treasury department manage all the risks. Either way can work if the definitions are clear, which requires a model.

**Predicting forecasts**

It may seem contradictory to use forecasts to construct a hedge. A forecast is a guess about what will happen; a hedge is a way to protect yourself because you don’t know what will happen.

The key is that forecasts are used in hedging when you face multiple sources
of uncertainty. You make the choice to guess some and hedge others.

A Bermuda-based reinsurance company that manages in pounds sterling writes a Florida hurricane policy in US dollars. The contract will pay the reinsurer $10 million, but require the reinsurer to pay up to $100 million if there is large damage from hurricanes in Florida during the year. So one risk is how much hurricane damage will occur and the other is how the US dollar payments will translate to pounds sterling. The problem for hedging is that the reinsurer doesn’t know whether it will have $10 million to exchange for sterling (if the hurricane season is benign) or if it will have to buy up to $90 million with sterling (if the hurricane season is bad).

This example is simple in one respect: There isn’t likely to be much correlation between hurricane damage and currency price movements, so there isn’t much loss by considering the risks to be independent. But suppose that instead of a reinsurance company writing hurricane reinsurance, the company was a UK financial company writing mortgage insurance on US mortgages. The UK company expects to make money when the US economy is good because mortgage defaults will be low, and houses will have good resale value and pay money when the US economy is bad for the opposite reasons. The state of the US economy is related to the US dollar/UK sterling exchange rate but not in a simple way.

In general, you forecast the risks that line risk takers are deliberately assuming for profit. That leaves a few residual risks, such as foreign currency exposures in the examples. The three choices are

- To leave responsibility for those risks with the line risk takers
- To hedge the risks on an aggregate basis
- To ignore the residual risks in the hopes than they average out to negligible long-term effect

One important point often overlooked is to consider forecast error when sizing a hedge. You consider this error by putting confidence intervals around
the forecast, meaning that you don’t forecast a single value but a range, and you specify the amount of confidence you have that the true value is in the range.

A robust hedge should help at least a little in almost all the forecast likely outcomes, and not be disastrous in any forecasted plausible outcome. If that isn’t true; if there’s a significant probability that the hedge will lose money when the thing you were hedging also loses money or a non-negligible chance that the hedge will be disastrous, don’t call it a hedge. It may be a good bet, but call it a bet unless you want to look really silly in the media accounts of a debacle. Calling something a hedge dramatically reduces the scrutiny on the associated risk, which is another reason to dislike hedging.

**Changing Exposure**

After you set your goal and measure your exposure, you need to actually hedge, that is, to change your exposure. At the risk of repeating myself, I say again that hedging isn’t the preferred solution to undesired exposures. After going through all the preparatory work to put on a hedge, take time to reflect again on whether you really want to hedge. For one thing, if you’ve done the work carefully, you appreciate that uncertainties and complexities make the hedge more problematic than it appears from superficial consideration. For another, the work to understand the exposures has likely turned up better ways to reduce or mitigate the undesired features, or even to convert undesired exposures to desired ones.

If you pass this second round of scrutiny and want to continue with the hedge, you have two conventional ways, plus one unconventional way, to proceed.

**Reducing positions**

When the need for a hedge is determined, most people’s first instinct is to put on a new position. For example, if the risk manager decides it is desirable to hedge against a decline in the price of oil, he may enter into *short positions* in oil futures contracts – enter into publicly traded contracts that will pay money if oil prices go down, but require payments if oil prices go up.

Often, however, the hedge can be accomplished by identifying and eliminating *long oil exposures* – exposures that make money if oil prices go up and lose money if oil prices go down. This elimination reduces leverage
instead of increasing it, which is sound risk management, and it may save on transaction costs, cash and operational expenses. Even if the long exposure isn’t as good a hedge as the proposed short exposure, eliminating long exposure can be the preferred strategy over taking on new short exposure.

**Adding hedge positions**

In principle, adding hedge positions is straightforward. You identify the exposure you want to hedge and find financial contracts that offset it. If you want to hedge an exposure that will cost the company $10,000 for each point the S&P 500 stock index goes up, go long 200 S&P 500 e-mini contracts. (A *long e-mini contract* pays $50 for each point the S&P 500 goes up, and requires payment of $50 for each point the S&P 500 goes down).

In practice, the decision is more complex. The hedge exposure is probably not precisely to the S&P 500, but perhaps to equity markets in general, or even to something correlated to equity markets. Moreover, the e-mini contracts have limited lives and are available with settlement dates every three months. You may need to make complex decisions in selecting the right contract and adjusting it over time (called *rolling the exposure*). Then you need to consider other equity-related contracts as an alternative to e-minis – ones with different underlying instruments (for example, the Euro Stoxx index instead of the S&P 500), and different forms (for example forwards, swaps or options instead of futures).

The exposure estimate usually has uncertainty attached and changes over time. This fact means that you also need a policy for setting and adjusting the hedge amount. A common practice is to *underhedge* – if you estimate a need for £100 hedge, you hedge £70. The theory is that if the hedge makes money, you’re thanked even if it makes less than the losses it was supposed to hedge, and if the hedge loses money, you’re okay as long as the losses don’t exceed the profits from what you were hedging. However, if you ever have a hedge that loses more money than the exposures make, your job is at risk.

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![Warning](image)

If you’re going to hedge, select the best hedge, and explain the likely outcomes clearly to everyone. One of those likely outcomes is that the hedge will turn out to be an *overhedge*, and will lose more money than the exposures gain. If that outcome is unacceptable, don’t hedge in the
first place.

The main reason people are afraid to overhedge is that they haven’t communicated adequately to everyone the weaknesses of hedging in general. Having oversold the product, the risk manager cannot afford to have it call attention to itself in failure.

Not all underhedges are wrong, however. The not-bad reason to underhedge is that there is legitimate difference of opinion among decision makers about the advisability of hedging. In general in finance, if you can’t make a clear decision between A and B, half A/half B is the best choice, which means that hedging 50 per cent (or some other fraction) can be a reasonable compromise.

Of course, as the risk manager, you should always continue to work for agreement. However, doing so is contingent on there being legitimate disagreement among informed decision makers working for the same goals. You should not half-hedge due to political squabbling or to placate special interests or uninformed constituencies. A half-hedge may be forced upon you due to dysfunctional governance, but that should never be confused with a rational risk-management decision.

A technical statistical technique known as *shrinkage* can be confused with underhedging. I won’t go into the mathematical subtleties here, but it often acts to make the optimal hedge under uncertainty smaller than the hedge you would want under most (or even all) possible resolutions of uncertainty. Sometimes you also have economic reasons to be conservative, which can be equally subtle. Unfortunately this logic can be abused to build multiple levels of conservatism into the hedge calculation, and these assumptions can be hidden. If you have to be conservative, I recommend applying a small number of explicit rules based on either mathematics or economics, and making sure that the rule effects don’t multiply out to produce absurdly small hedge sizes.

Unfortunately, the practical complexities of hedging have a pathological feature: The more complicated hedging gets, the more likely that people will slip in improper elements. The hedge becomes a bet rather than a hedge, or a way to set up heads-I-win-tails-you-lose situations for certain people or departments. Hedging has a way of
getting political, and when it gets political it ceases being a risk management tool. Hedging requires a strong, independent risk manager, and a strong, independent risk manager makes as little use of hedging as possible.

**Uncovering unconventional hedges**

A conventional hedge involves a hedging instrument with a strong *negative correlation* to the underlying exposure so that the hedge will reliably make money if the underlying exposure loses money. These negative correlations should be based on fundamental economic principles, not merely statistical observation. For example, the famous Super Bowl Indicator correctly predicted the direction of the stock market based on the winner of the Super Bowl in 27 of the first 31 Super Bowls, but a bet on the Super Bowl would still not be considered a conventional hedge for equities. Generally speaking, these conventional hedges are the ones that accountants and regulators recognise as hedges. However, financial practitioners make extensive use of unconventional hedges.

**Maxing out a macro hedge**

One popular type of unconventional hedge is a *macro hedge*, which is a hedge based on economics but not statistics. For example, a fund manager acquires a large portfolio of *distressed bonds* (bonds bought cheap because their issuers may not be able to repay them) and used conventional portfolio management hedges to eliminate most of the credit and interest rate risks. Although this portfolio has low volatility most of the time, some scenarios can cause it to have large short-term mark-to-market value changes or high cash demands. One such scenario maybe a rate hike by the Fed.

![](TECHNICAL_STUFF.png)

Distressed bonds are not particularly liquid, so you won’t find it practical to reduce the portfolio size right before the Fed meeting and buy the bonds back immediately after the meeting if there is no rate hike. In this circumstance, you may insist on a position that will make money (and generate cash) if the Fed raises interest rates. This kind of position is highly liquid and can be put on immediately before the meeting in the Eurodollar futures market and taken off afterwards. Fed actions have no statistical relation to the hedged distressed bond strategy,
and there is no direct economic relation between the Fed target discount rate and the value of the distressed bonds. Nevertheless, a reliable economic calculation can predict the likely effect of a rate hike in the immediate circumstances, and a risk management hedge can be put on to mitigate the worst outcomes.

**Trailing a tail hedge**

Tail hedges are designed to pay off only in extreme loss scenarios. They’re usually macro hedges as well because there is seldom enough data about extreme scenarios to form a reliable statistical hedge. A classic example of a macro tail hedge is to go long on VIX futures. The VIX, also known as the fear index, is a measure of how much investors are willing to pay for protection against large stock market moves. The VIX is dominated by fear of down movements because investors are always willing to pay much more for protection against stock market crashes than policies that pay off if the stock market soars.

Going long a VIX future pays you money if fear increases but requires you to pay money if fear declines. This future can be a good general-purpose macro hedge because most bad market events are accompanied by increases in fear. The hedge is a tail hedge because the VIX generally jumps up quickly in a crisis, then drifts down slowly as things settle down. Direct tail hedges, such as put options on your portfolio (if you buy a put option, you pay a premium to the counterparty who agrees to buy the reference assets at a fixed price, which puts a limit on your losses) are usually too expensive to consider; you almost never find it worth holding an exposure and paying for direct tail hedges.

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**Going to Hawaii**

A flamboyant and notorious Chicago Mercantile Exchange (CME) pit trader (pit traders work face-to-face with other traders on physical exchanges, but today this form of trading has faded into near insignificance with the increase in electronic trading), Darrell Zimmerman, was way over his limit selling S&P 500 put options on Monday, 19 October 1987. His wife, who also worked at the CME, insisted that he hedge the positions.

Instead of reducing his positions, Darrell bought more to double up on his risk. When his wife confronted him and asked him about his hedge, he pulled out two first-class tickets from O'Hare airport in Chicago to Hawaii for a vacation the couple had planned. 'Here's my O'Hare hedge,' he is supposed to have replied, 'If the market goes back up, we'll have a great vacation. If it doesn't, we'll be in Hawaii where they can't find us.'
Well, the market didn't go back up. Both Zimmermans were fired from their jobs. Darrell continued to trade with O'Hare hedges for five more years, before finally losing for good and spending two years in prison for fraud (the fraud was basically lies he had to tell in order to put on his gigantic positions); he and his wife were barred from the CME (his wife only for association with Darrell, not for any personal malfeasance). The CME instituted the Zimmerman Rule prohibiting any trader from profiting from overlimit positions. However, you can't keep a reckless risk taker down, and Darrell Zimmerman went on to a successful career as a jazz musician and also to be an active participant in Vancouver's Occupy Wall Street movement, and to run twice (unsuccessfully) for mayor of Vancouver.

The literal O'Hare hedge did not work. US authorities caught up with Darrell after three years (he actually fled to Mexico and Canada rather than Hawaii just prior to his federal indictment). Nevertheless, the phrase lives on, because it describes an idea that long antedates Darrell Zimmerman. After a loss, risk takers may be inclined to increase rather than decrease exposure, on the theory that decreasing exposures leads to a certain bad personal outcome (such as being fired) while increasing exposures holds out at least a faint hope of a good personal outcome (being the hero who didn't panic). The real O'Hare hedge isn't a physical airline ticket, but a psychological fallback plan.

There's a strong regulatory push against O'Hare hedges with financial clawbacks and prosecutions to try to force risk takers to continue to take losses seriously, even when those losses are already so large that the risk taker will be fired or his institution will fail. However, risk managers should focus on the opposite fix – making sure that people are never rewarded for excessive risk taking after losses, even if the additional risks pay off. Increasing psychological pressure in crises is more likely to be counterproductive, although it may be satisfying politically and it may encourage better pre-crisis behaviour. Removing incentives for reckless heroism is much better risk management, but can be difficult politically.

Going to Texas
The final two types of unconventional hedges I discuss share the name Texas hedge. The original Texas hedge came from the observation in the late 1970s that cattle ranchers held the largest long positions in cattle futures – they bet the most money that cattle prices would go up.

Actually, agricultural or commodity producers commonly go long in the futures market and bet that the commodity they produce will go up in price. Going long is certainly more common than for a producer to go short or bet that the commodity price will go down.

Producers who want to hedge against price declines make fixed-price forward agreements with physical buyers; they rarely use the futures markets. When producers use futures markets, they often do so more to adjust hedges or to speculate. Moreover, the factors that push commodity prices down are often factors that push the commodity yield up or production costs down, so producers frequently make more money as a group when prices are low (but
with low costs and high yields) than when prices are high.

Nevertheless, producers are rarely the main long participants in the futures markets. The reason in the 1970s cattle futures case turned out to be the economics of cattle raising. As oil prices increased throughout the 1970s, they pushed up the price of feed, which encouraged ranchers to bring cattle to market younger. That, in turn, pushed current beef prices down, but raised the expectations for future beef prices. Thus, long contracts on the future price of beef were actually hedges for ranchers who owned cattle today.

The original definition of *Texas hedge* was a hedge that seemed to be in the same direction as the underlying exposure but that actually had a negative correlation due to some difference – such as the timing difference between owning cattle today and delivering cattle in the future. The hedge was named after Texas due to the association with cattle ranching, not because of any assumed tendency of people from Texas to engage in counterintuitive hedging.

In the early 1980s, traders started using the term Texas hedge for a different situation. A trader with a large position would put on a hedge that reduced risk if the trader’s fundamental view was correct but could increase risk if the view was wrong. For example, a trader who expected weak economic news may go short the stock market (that is, enter into positions that would make money if the stock market fell, but would lose money if the stock market went up). However, weak economic numbers may induce the central bank to cut interest rates, which would tend to push stocks up.

A Texas hedge is to place a bet that the central bank will cut interest rates. If the trader is correct about the economic news, this bet provides a hedge against an event that may otherwise harm his position. But in other circumstances the hedge can increase risk. For example, strong economic news may push the stock market up and kill any chances for a rate cut.

Again, no actual Texans were involved in this second sense of Texas hedge. The name came from the popular association of Texans with ‘too much ain’t enough’ risk taking. The term is pejorative, albeit with a tinge of admiration. The trader putting on the Texas hedge could claim it was a macro hedge, his buddies on the desk would tease him that it was a Texas hedge, while his risk manager, who insisted he hedge his position, may fume that his instructions had been evaded.
However, a Texas hedge in this second sense isn’t necessarily a bad idea. Both a Texas hedge and a macro hedge are based on economic analyses rather than statistics. The difference is that a Texas hedger actually expects to make money on the hedge as well as on the underlying position. A macro hedger accepts an expected loss on the hedge in order to reduce the risk of holding the underlying position.

Risk managers are understandably suspicious of the idea of a profit-making hedge, but in circumstances it’s possible. The kinds of traders who come up with Texas hedges are usually overconfident wishful thinkers, but that doesn’t mean that they’re wrong, and sometimes you see Texas proposals from cautious traders. Anyway, a risk manager who refuses to listen with an open mind to a hedge proposal with a Texas twang harms his communication with risk takers.

**Monetising Hedges**

A classic hedging sob story goes as follows: The risk manager put on a hedge against a market decline. The market did in fact go down, and the hedge made an accounting profit that offset the losses from the fall. At that point things looked even shakier, so the decision was made to increase the hedge even though the cost of hedging had gone up. The market continued to fall, the hedge continued to make money, and the size of the hedge continued to increase. Then the market turned around, and the hedge started losing money, both because the market was going up, and because the market value of insurance declined.

Because the hedge was larger at the end than on average during the decline, and because the hedge was purchased during times of greater fear than when it was taken off, the hedge lost money even though the market finished lower than where it started. So the firm lost money both from the hedge and the market, even though the hedge did exactly what it was supposed to – providing gains that offset losses all the way down.

There are many variants of this story. In some, the hedge is reduced or taken off at the wrong time instead of increased. One popular way to do this is to put on a big hedge after a bad market event because … well, because you wish you had put one on before the event. Doing so is expensive, of course, because everyone remembers the bad event. As time goes by and the hedge
expense mounts, the decision is made to cut the size of the hedge, because everyone feels safe. When warning signs appear, of course, the plan is to increase the hedge again. Well, warning signs do appear, specifically the cost of hedging starts to rise. But by that time the memory of bad things has faded and people are used to small hedging expenditures. So, as the price of hedging goes up, the hedge is actually cut further to keep the cost constant. After all, everyone has been hearing for years about the obscene amounts of money wasted on the hedge in the early period after the last disaster. So when the next disaster hits, a negligible hedge exists, and the cycle can be repeated.

I’ve seen both of these stories and endless elaborations and variants over the years. The underlying problem is that you don’t have a full lifecycle plan for the hedge. In this chapter I cover why you want to hedge, what you want to hedge and how you want to hedge. But none of it means anything unless you have a plan for taking hedge profits off the table. You need to have a budget for hedging losses that you’re prepared to cheerfully pay forever if the bad event you’re hedging against never happens. If the hedge is dynamic, or goes up or down over time, you need a clear strategy for changing the size of the hedge, and you need to project the cost of that strategy before you place the first hedge.

Most important of all, you need to have a plan for when and how you monetise the hedge, or convert hedge profits to cash. If you never monetise, the hedge is worthless. If you only monetise when you’re sure that the bad event has passed, you never have any profits to monetise.
Part IV
Working in Financial Institutions

Two types of asset management funds

✓ **Public mutual fund** is the best-known type of fund. These funds are commingled vehicles that nearly anyone can buy. Public funds include money market funds, open- and closed-end funds and exchange traded funds (ETFs).

✓ **Hedge funds** are defined by what they are not – they don’t meet the rules for public mutual funds. Hedge funds can restrict liquidity, borrow large amounts of money, use derivatives, short securities and charge a performance fee.

Check out risk management in the front, middle and back office at [www.dummies.com/extras/financialriskmanagement](http://www.dummies.com/extras/financialriskmanagement).
In this part …

✔️ Manage traders to refine their bets into a book that fits into the firm’s risk strategy.

✔️ Manage the complex business, credit, regulatory and market risks of a bank.

✔️ Work with portfolio managers to deliver financial products that meet the needs of investors.

✔️ Partner with actuaries to address the risk issues of an insurance company.

✔️ Set risk frameworks and policies consistent with the business goals and legal responsibilities of any financial institutions, and make them work.
Modern financial risk management started on the trading floor and that remains the simplest place to observe its principles. Trading is primitive: You buy or you sell; you get rich or you go broke. Okay, not all trading is quite that simple, but all trading does retain a direct connection to markets, without as much institutional superstructure as other financial activities.

Managing trader risk is pure risk management, which makes it a good place to explore the basic concepts. Also, because everything in finance eventually depends on trading, a firm understanding of trading risk is essential to all financial risk management. Trading generates the prices used as inputs in all financial decisions, and all those decisions cause trading to occur immediately or somewhere down the line.

Understanding Traders

When I started in financial risk management, all financial risk managers were former traders. A deep appreciation for trading underlies a lot of the concepts built into the risk-management field. As risk management has grown, however, the supply of former traders with the other skills required to be risk managers is nowhere close to sufficient to meet the demand.

If you want to be a financial risk manager but have never traded, I do my best to give you what you need to know. But I strongly recommend that you try trading yourself – ideally professional trading for significant stakes. However, if you can’t go pro, do personal trading, or paper
trading, or sports betting, or Internet prediction markets or anything that causes you to back your opinions with money. Even if you’re no good at it, the attempt shows you a few essentials about risk that are nearly impossible to discover from a book.

The Medieval English philosopher Roger Bacon said it nearly eight centuries ago: ‘For if any man who never saw fire proved by satisfactory arguments that fire burns, his hearer’s mind would never be satisfied, nor would he avoid the fire until he put his hand in it that he might learn by experiment what argument taught.’

**Ignoring the emotion**

One of the characteristics that separates good traders from everyone else is the complete removal of emotion from trading decisions. This statement may seem surprising, because many traders are personally emotional, and make a regular habit of screaming, throwing chairs and acting impulsively. However, that is a release for the emotion they don’t allow themselves to express in their trades.

A story from the 1970s concerns a trader whose wife tried to get him interested in the world beyond securities prices. She took him to a lecture by a famous social reformer on the evils of heroin addiction. The trader resisted going and, when finally dragged to the affair, slumped down in his seat with his eyes half closed. But the speaker’s articulate and powerful presentation seemed to get to him, and his wife was pleasantly surprised to see the trader sit up, lean forward and pay attention.

‘Heroin is a scourge,’ the speaker thundered, ‘with thousands of new victims beginning addictions every day. When addicted, literally nothing stands in the way of a junkie getting a fix – not morality, not love, not danger, not legal consequences, not pride. And even when addicts are forcibly withdrawn from the drug, in the most successful programs, 90 per cent are using again within a year.’

After the lecture, the trader leaped up to join with the rest of the audience in a standing ovation. The speaker called for questions, and the trader’s hand shot up. ‘Can you tell me,’ he asked anxiously, ‘who makes the needles?’

Most information you get in the world comes with emotional attachments that are supposed to shape your thinking. Often the emotional content overwhelms the logical meaning. Traders train themselves to ignore that emotion and to concentrate attention solely on, ‘How can this information be used to make money?’ This attitude can lead them to interpret things in the opposite way to most people.

**Exploring what traders do**

Traders come in many varieties. One important distinction is the amount of discretion the trader has. At one extreme are *prop* (short for *proprietary*)
traders who make decisions for pure profit. Some trade their own capital, some trade the capital of a financial institution (although regulators are trying to push prop trading out of most regulated institutions) and some trade capital from investors. At the other extreme are execution traders, sometimes disparagingly called order takers, who have limited discretion on their trading. A portfolio manager may instruct the execution trader to, say, ‘sell 10,000 shares of Apple’, and the trader is expected to sell the shares quickly, perhaps waiting a bit or choosing a venue to get a slightly better price. Between these two extremes are traders with intermediate degrees of discretion from almost complete freedom to pursue profit to particularly tightly constrained.

Another important distinguishing characteristic is the physical means of trading. Floor traders are physically present on an exchange where they buy and sell via hand signals and voice with other floor traders. This form of trading is the oldest one but is diminishing rapidly in importance in the financial system. In some markets, trading is mainly by telephone – traders call each other up to negotiate trades and also get calls from customers. More and more, however, trading is done by computer, which can mean two traders communicating through some kind of computer system to negotiate a trade, or a trader entering an order into a computer system that tries to match it with offsetting trades in various ways.

Traders work in a variety of institutional settings. Some traders trade solely for their own accounts, that is, with their own money. These traders may work alone or in a trading facility that provides space to many traders – generally in return for commissions on trades or a share of any profits. Some traders raise money from other investors and trade alone or in a company, usually called a hedge fund, with support staff and perhaps other traders. Some traders are employed by asset management companies with lots of support staff and other traders. In these situations, it’s usual for the main economic decisions to be made by portfolio managers who give the traders limited discretion about execution. However, the distinction between hedge fund and asset manager isn’t clear-cut, and some institutions mix the features in varying combinations. In addition to asset-management companies, other financial institutions such as insurance companies, pension funds, endowments and family offices, employ execution traders.

Collectively, all these types of trader are referred to as the buy side. All buy-
side traders have money to invest, and the trader’s job is to put the money to work by using her own judgment or executing the decisions of a portfolio manager.

The other half of trading is the sell side, which consists of banks and brokerage firms whose jobs are to bring new securities to market, to trade for customers (including individual investors and buy-side institutions who don’t have their own traders or who prefer to use the dealer for certain transactions) and to facilitate trades as a broker (lining up buyer and seller), or dealer (transacting at customer request and then trying to find an offsetting trade later) or both. Not all sell-side institutions perform all these functions.

A particularly important type of sell-side trader is a market maker. In some markets this role is a formal designation, in others it’s a role anyone can assume. A true market maker does two things:

- **Quotes a price and stands ready to buy or to sell securities at a spread.** For example, a US treasury market maker may offer to buy the 2 per cent coupon treasury bond maturing on 15 February 2015 for $1,000.14 per $1,000 face, or sell it for $1,000.16. The bid price at which the trader is willing to buy is always lower than the ask price at which the trader is willing to sell; the difference is called the spread, in this case, $0.02 per $1,000 bond).

  A good market maker quotes prices even in chaotic markets. The price may be at a higher than normal spread, but not an unreasonable one. A bad market maker disappears at any sign of uncertainty by refusing to quote or by using a spread so wide that no one will trade.

- **Accepts conditional orders.** A customer may place an order to buy $10 million of the treasury bond, but only if the price falls below $1,000 per bond (or some other condition).

An alternative to market makers is to match orders and conditional orders by a computer system. In some markets all trading is done through these systems; in other markets all trading is done through market makers and in some markets the two are mixed in various ways.

Most traders specialise in a single asset class, such as stocks, futures contracts or currency options. In fact, most specialise more than this, perhaps trading only large US technology stocks, or only oil futures contracts or only options
on the US dollar versus the Euro. Execution traders typically trade broader ranges than proprietary traders because they don’t have to know as much about each thing they trade.

The other important distinction is trading style, any of the trading roles above can be accomplished in a variety of styles. Quantitative traders program computers to make the trading decisions for them. Systematic traders follow a specific set of rules. Some traders rely mostly on momentum, buying assets that are going up in price and selling ones that are going down. Others live primarily by value, buying assets that are cheap and selling ones that are expensive. The other popular style is carry, or buying assets that pay a high cash return and selling ones that pay a low cash return. Some traders make intuitive judgements, some have large research staffs and some traders (called macro traders) make judgements about major economic events and find trades that will be profitable if their judgement is correct.

The basic trading styles can be combined in an infinite number of ways, and other less-common styles can be stirred into the mix.

**Exploring who traders are**

Being a risk manager for traders requires a shrewd knowledge of their characters and thinking patterns. Certain traits are shared by most successful traders, and you must be alert for their presence or absence. Good traders often have above-average, but not exceptional, general intelligence. Intellectually, their strengths tend to be independence, pattern recognition and rapid facility with simple mathematics. Most are comfortable holding conflicting information in their minds and arriving at nuanced judgements with moderate confidence. In similar situations, non-traders are apt to claim to have no idea at all or to put unjustified high confidence in an answer. Traders often express high confidence, but this confidence is likely a trick to provoke disagreement rather than a true expression of their beliefs. Traders tend to seek out disagreement, and unlike many people, are able to benefit from it.

Another common trait among successful traders, but not the general population, is rapid updating. Most people require considerable new evidence to change an opinion (and some never change), and when they do change their minds, they change by a lot even if the new data don’t justify the strong reaction. Most traders move their opinions slightly with every new bit of
information, but are willing to make dramatic U-turns in their thinking when a fact comes along inconsistent with their prior belief.

I describe traders as unemotional in their reasoning, but that’s not precisely the point. When most non-traders think about a question, they often fall into narrow thinking due to the emotional or dramatic aspects of the question, or perhaps just the example of others or habit. Good traders are able to see a range of plausible scenarios and put rough probability rankings on them. Their skill at pattern recognition allows them to construct trades that do well in the most probable scenarios, and have limited downsides in the rest. These trades are often – even usually – unintuitive on first, second or even third consideration.

As a risk manager, you want to encourage all these good traits in your traders. For some traders that requires encouragement, for others the opposite. When you listen to your traders, you want to hear a lot of ‘ors’, ‘buts’ and ‘on the other hands’; not ‘in additions’, ‘moreovers’ and ‘furthermores’. You can tune out all the other words; your job isn’t to offer opinions on the trade itself. Traders should not talk their book, or list all the possible reasons that support their position and ignore contrary factors. They should express moderate confidence and openness to new information. They should be able to answer questions like, ‘How much would the price have to go in the other direction to convince you that you’re wrong?’ easily and reasonably.

The examples here are macro trades, trades based on opinions about major events. These are the easiest to understand. Most traders, however, base their decisions on less dramatic factors. The most common trading input is watching other trades in the market to guess short-term supply and demand. Another common type of trading is based on relations between similar securities. Many other styles are also evident; but the majority of successful traders share the mental traits described here. Even pure execution traders need above-average degrees of independence, flexibility and openness to do their jobs well.

Exploring why traders are traders
One thing that a risk manager shouldn’t have to worry about is the motivation of traders. Right? Traders are clearly in it for the money or the activity would
have no point.

Not right. The biggest single reason for failing at trading, and causing headaches for risk managers, isn’t lack of skill but bad motivation.

Beginning traders may be motivated by dreams of easy wealth or starring in stories to impress others or proving themselves in some way. They wise up or fail pretty quickly. Still, these toxic motivations can slip back sometimes, perhaps after some trading or life reverses. A more difficult problem is a fear of being wrong, or its cousin – a fear of appearing stupid. Even the most experienced professional traders have to guard against these types of problems.

Successful trading requires focus and energy. When you have those things, trading is intense and euphoric, as addicting as any drug. Money is no longer the point. But long-term successful trading requires slogging through the times when focus cannot be achieved and energy is missing. Money helps a lot in that circumstance – the freedom to take time off from trading without worrying about bills, the reassurance that comes from financial security, the patience to scale back and regain your groove. A risk manager must be sensitive to traders’ states of mind, and make sure that pressure and reward are aligned and balanced to get the best performance possible.

**Helping Traders**

Okay, I’m done with the touchy-feely stuff. If you’re a risk manager on the trading floor, you’ll pick up a lot of the subtle stuff naturally. Just being around traders, watching them come and go and succeed and fail, should give you the intuition you need to coach the ones who need it and leave the rest alone. Also, a lot of this stuff is done by other traders, or other experienced people on or around the floor.

The other half of your job as a trading-floor risk manager concerns the trades themselves, not the traders.

**Watching statistics**

Risk managers need to keep exhaustive records of every aspect of trading and analyse them thoroughly. One simple statistic to compute is to restate the
profit and loss by adjusting all bets to the same size. For example, if a trader put on a £100 position and made £20, then a £1,000 position and lost £100, she lost £80 net. But if the £1,000 position had been only £100 (the same as the first position), she would have lost only £10 on the second position, and been up £10 overall.

Even with experienced traders, you often find that constant-bet-size profits are consistently larger than actual profits, which means that the traders are betting more when they’re wrong than when they’re right. This situation is a major source of missed profit opportunity or even a method of converting profits into losses.

Another popular statistical check is to compute the accuracy ratio, the fraction of trades that make money, and the payoff ratio, the ratio of the average amount won when you win to the average amount lost when you lose. For example, suppose a trader makes money on 40 per cent of her trades, wins £2 million on average when she’s right, and loses £1 million on average when she’s wrong. She makes an average of £200,000 per trade; $0.4 \times £2,000,000 – 0.6 \times £1,000,000 = £200,000$.

One thing the risk manager can do is check whether the trader would have done better to cut her losses at £500,000. That would reduce her accuracy ratio, because there may have been some trades that lost more than £500,000 but less than £1,000,000 and went on to make money. So, suppose the accuracy ratio falls to 30 per cent. Now the average profit per trade is £250,000 – 0.3 \times £2,000,000 – 0.7 \times £500,000 = £250,000. Not only is there more profit per trade, but the average profit divided by the amount at stake has gone up from £200,000/£1,000,000 = 20 per cent to £250,000/£500,000 = 50 per cent.

I’m oversimplifying quite a bit here. Real traders usually have complex positions, not simple wins and losses, and may have different types of trades with different sizes. Some trades may be made to execute orders from other people, and those trades have to be benchmarked against the price at the time the order was received. Still, you can use this kind of analysis to shape trading strategies for better profits and better risk-adjusted profits. Moreover, this type of analysis can help you fit the risk that the trader is taking into the overall risk appetite of the organisation.

One more example of the kind of trade monitoring that trading floor risk
managers do: the payoff ratio is usually under the trader’s control – to a large extent anyway. The trader chooses when to cut losses and when to take profits. Given a chosen payoff ratio, the accuracy ratio rises and falls both with market conditions and the luck of the draw.

You generally find it a good idea to maintain a payoff ratio rather than trying to improve a falling accuracy ratio by accepting a lower payout ratio or exploiting a rising accuracy ratio by demanding a higher payout ratio. A few theoretical reasons exist for this, but it’s mainly accumulated trader wisdom. So if you see the payout ratio chasing the accuracy ratio, it’s time for a talk with the trader. It’s not automatically wrong, but it should be your first instinct that it may be.

Rigorous, comprehensive, quantitative analysis of her results can help any trader do better. Just as important, such analysis forms the basis for your view of potential future outcomes, which helps shape your risk-management policies, including things like position limits, risk limits, drawdown points and other risk management tools.

Watching the screen
A trading-floor risk manager cannot focus solely on the rear view mirror, analysing past trading performance. That trading floor is filled with computer screens showing prices, transactions, positions, analytics and other important information. And when I say, ‘watching the screen’, I include all the other stimuli on the floor – voice tones, telephone conversations, general activity, screams, fistfights … whatever.

A trading floor has a mood, and you can sense it the first time you step onto one. However, it takes study and experience to make use of that sense. Most of the time, things should hum along comfortably, with steady profits building amid an acceptable frequency and size of losses. Traders are focused but not tense, there may be light banter and horseplay, but attention is mostly on the markets. Those markets bumble merrily up and down, as they always do, but by normal amounts and in normal patterns.

When that isn’t the case, you must be alert for problems to correct and opportunities to help. That may mean starting a conversation or stopping one, calling to alert higher-ups, forcing position reductions, comforting a troubled
soul or – usually – nothing. However, you absolutely must be aware of the environment. You often don’t get warning for your biggest decisions as a trading-floor risk manager. You don’t have the luxury of studying up before making your call. So you need to stay in the game constantly, every bit as much as traders do.

Watching the world
It can be hard to remember in the midst of a working trading floor, but there is a world outside the floor, and information that’s not on anyone’s screen. The world changes, and the organisation employing the traders changes. Dramatic changes flash across news feeds but not the slow-but-steady evolution that wins the race in the end.

Trading floors tend to be insular and conservative and resistant to change, which is why they’re home to so many scandals. People who spend too much time on the trading floor can lose track of what’s considered acceptable in the real world or they can fail to replace assumptions that may be years out of date.

A trading-floor risk manager has a unique perspective. She’s fully engaged with the floor during trading hours but has responsibilities beyond it the rest of the time.

Watching the trader
With all the quantitative analysis and theory, sometimes trader risk management comes down to simply watching the trader. You don’t have to be a psychiatrist to notice signs of too much pressure, inability to focus, muddled or perverse motivations, emotional overload or other maladies that afflict traders (or anyone in high-stakes, high-stress professions).

Educating speculators
One of the great (and accurate) accounts of trading is Victor Niederhoffer’s book, *The Education of a Speculator*. It opens with this stylised and romanticised account of one of his trading decisions: ‘I am an old trader, and I trade the Yen in the cash market. I once had the best record among all the traders. I was rated number one in my field, and my picture was in all the newspapers. Customers crowded my doors. The attractive currency brokers talked sexy to me, told me where their customers’ stops were, and where the central banks were
buying and selling. The great Soros more than once called to have me trade for his own account.'

As the story goes on, the ‘old trader’ (really Niederhoffer) incurs unaffordable losses during the trading day, but stays up all night to double his bets, and by morning is ahead.

In 1997, Niederhoffer was on top of many worlds. He had been named the number one hedge fund manager in the world as a result of posting an incredible streak of returns averaging 35 per cent per year, which was preceded by a successful career as a finance professor and a squash champion. His book was a bestseller. He had many other accomplishments and honors.

A friend of mine, Nassim Taleb, went to see Niederhoffer soon after *The Education of a Speculator* was published and returned to tell me that Niederhoffer was sure to self-destruct. I had read the book, and said I agreed based on the initial story. Every risk manager of traders should read it; you won’t find a better representation of a brilliant trader on the edge of a blow up.

Niederhoffer did go on to self destruct in 1997, then again in 2007. All of his immense talent was no substitute for competent risk management.

Consider that the traders you manage are likely less talented, less experienced and quite possibly more arrogant than Niederhoffer. Then get to work.

Professional traders have their own methods for dealing with the stresses of the job, and most risk managers aren’t qualified to diagnose and cure them. Sometimes, especially with less experienced traders, a kind or a reproving word can help. Sometimes, suggesting a walk around the block or that the trader go home for the day is the right action. Other times, you have a chat with a trader after the markets close. Mostly, however, you watch and give help only when requested.

When intervention is required – and sometimes it is – the decision is generally made by someone in the trading hierarchy. Risk managers advise, but they generally don’t have authority to cut off an individual trader. Nevertheless, you need to have an informed opinion about every trader’s mental health at all times.
In This Chapter

- Understanding bank-specific financial risk management requirements
- Relating risk to capital requirements
- Staying confident

Modern financial risk management was developed for US commercial banks, banks that take deposits from the public and whose main traditional source of risk is credit risk from making loans. Therefore, even if you don’t work in a bank, you may find that this chapter helps make sense of some risk management terminology and rules. Also, of course, nearly every financial business depends on the banking system, so bank risk management has strong impacts on everyone else’s risk management.

On the other hand, bank risk management is the most complicated and regulated of any financial risk management, which can make it frustrating to study. Most banks are complex institutions with lots of financial businesses and lots of operating and non-operating entities working in many legal jurisdictions. In this chapter, I only cover the core business of banking, but a bank may have asset management subsidiaries, investment banking arms, large trading desks or other businesses. At a certain point, the complexity becomes the main risk management focus, rather than banking or any other business.

Banking Basics

Financial institutions are defined by their balance sheets – their assets and liabilities. All financial institutions gather funds and invest them, using the returns from the investments to repay the people who provided funds. The investments are the institution’s assets and these assets go on the left side of the balance sheet. The funds the institution gathers appear on the right side of
the balance sheet and represent obligations that the institution must fulfil. The key to risk management is understanding the circumstances in which the assets won’t support the obligations imposed by the liabilities.

Okay, I know that sounds hopelessly abstract. In a simple case, a bank raises a little bit of money, called equity, from its owners, and takes in a lot of deposits. It then lends that money out, perhaps in home mortgages. The mortgages are the bank’s assets, and the deposits are the bank’s liabilities. The bank hopes that the monthly payments from its mortgage borrowers are enough to pay off any depositors who want to withdraw their money. The equity goes on the right side of the balance sheet along with the liabilities but, unlike the deposits, the bank is never required to repay the equity, so it creates no cash obligations, which means that it is a secondary concern of the risk manager.

There are many different kinds of banks in different jurisdictions, and I can’t possibly cover all the variants. The most important attribute that they share, to a risk manager anyway, is that they cannot control their balance sheets.

Risk management in most financial institutions relies heavily on controlling the assets or the liabilities and usually both. Banks have limited ability to do either. Banks have to worry about runs, when liability holders race to take their money out first, and they’ve limited ability to suspend withdrawals without closing down the whole bank. On the asset side are credit crunches, when the bank’s assets produce less cash flow and the bank may be forced to extend even more credit.

So how do banks survive? In the modern era, the answer is that they have a government backstop. Most banks have government deposit insurance and a central bank that stands ready to supply liquidity in most circumstances. However, this protection does not remove the need for risk management. For one thing, the government expects banks to have strong risk management in order to protect the government’s interests. For another thing, the government support is there for the benefit of depositors and borrowers, not for the bank’s owners or executives. The government may step in to save things but bank stockholders may lose everything and bank executives may become unemployed – or worse.
**Adding up assets**

The assets on the left side of a bank’s balance sheet can be complicated, so I start with one you’re probably familiar with – a home mortgage. One thing many banks do is lend money to home buyers over long periods of time, often 30 years. The borrower makes monthly payments that combine principal and interest and, if he falls behind on payments, the bank can repossess the house and sell it to pay off the debt.

One obvious thing about this asset is that it’s long term. If the bank wants its money back more quickly, say because depositors are withdrawing their money or the bank needs money for some other reason, it can’t go to the home owner and demand that he repay immediately. The bank may be able to sell the mortgage loan to another bank or another investor, but that can take time, and there may not be willing buyers at the time the bank needs the cash.

Another thing to realise is that the bank may find itself owning a house instead of a mortgage loan. This ownership is one of the ways in which a bank loses control of its balance sheet. In addition, as soon as the bank owns the house, it has to pay for upkeep and insurance, so instead of getting a monthly payment, the bank is spending money. That encourages the bank to sell the house quickly, but that may fetch a low price, which pulls down the value of nearby houses, which makes the bank’s other mortgages less secure. However, holding onto the house isn’t such a great option either, because having a lot of empty, bank-owned houses can kill a neighbourhood.

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**Searching the Earth for assets**

I once had a project with a large bank to quantify the risk around what they informally called their lost assets. One asset was ships the bank had seized legally but had not been able to locate physically. These ships were somewhere in some ocean (probably), possibly sailing under different papers and flags. Other examples were less exotic such as mortgages on houses with addresses that didn’t exist. Large banks accumulate this kind of stuff and hire people to track it down.

One thing I learned in this effort is that it is illegal, in the United States anyway, to repossess an airplane when it is in flight. That doesn’t make a lot of sense – we’re not talking about the bank officer wrestling the controls from the pilot. The bank officer would just hand a piece of paper to any airline employee, which shouldn’t endanger anyone. But that’s the law, so another fun bank job was to chase down stray airplanes and slap on a notice before the plane could get in the air.

My personal favourite was a golf course in Thailand built with a loan from the bank by
developer A. Developer B had promised to build a road to the golf course. Developer A defaulted on his loan, and the bank seized the golf course. Developer A claimed that the course was built, but he couldn't show anyone because Developer B hadn't built the road. Developer B claimed there was no golf course and therefore no place to build the road to. So both developers and a bank officer flew around Thailand in a helicopter looking for the phantom golf course.

An even more dramatic example concerns the shameful episode when the US government forced American citizens of Japanese descent to leave their homes and businesses on the West Coast after the US entered World War II (WWII). There were, unfortunately, many instances when the detainees were forced to take minimal prices for their belongings. The US Treasury made a real effort to avoid this situation by sending federal agents empowered to make loans at the pre-resettlement fair market value of assets – one of the few bright spots in a disgraceful affair.

One Japanese businessman ran a shop selling pro-Japanese war memorabilia, items that had negligible market value in the US after Pearl Harbour. Under the program, however, the Treasury lent at the old market values and ended up repossessing the man's stock. So unless it has been destroyed or resold, somewhere in a forgotten corner of a warehouse, the US government owns a store's worth of souvenirs celebrating Japanese victories in WWII.

You may think that a bank would be slow to foreclose, and perhaps offer to renegotiate – to lower or defer payments – for troubled borrowers. That helps with some of the problems, but it makes other borrowers less willing to pay.

Another potential solution if the bank is having trouble collecting on its current mortgages and needs cash for other reasons, is to stop making new mortgage loans. That will, however, further depress real estate prices and make it harder to sell houses.

Of course all these are known risks of the mortgage lending business, and banks have found ways to deal with them – most banks most of the time, anyway. But the same general issues apply to most of the assets on a bank’s balance sheet to different extents. The assets may be illiquid (difficult to turn into cash on short notice), and the bank may find itself owning collateral instead of a security and that collateral may be difficult to manage. There can be difficult trade-offs between protecting existing assets and maximising cash flow from troubled assets. The bank may even be forced to make new investments that increase its exposure to risk, because cutting off new credit can cause major problems.

Unfortunately, the balance sheets assets are not the only problem. Banks also have off balance sheet obligations to fund. If a bank lends you a million pounds, it becomes a one-million-pound asset on the bank’s balance sheet;
but if a bank promises to lend you one million pounds whenever you need it, that’s known as a contingent commitment. It can’t go on the asset side of the balance sheet because it’s not something the bank can sell for money.

Banks have lots of contingent commitments. For example, one alternative to taking out a bank loan is for a business to sell commercial paper, or short-term bonds, to investors. But in order to sell commercial paper, investors demand that the commercial paper issuer get a letter of credit from a bank that says the bank is willing to lend the business enough money to repay the commercial paper if necessary. So when credit conditions are good and the economy is healthy, the business can raise short-term cash directly from investors. However, when times get bad and loans get risky, that’s when the bank is compelled to extend loans to businesses.

One particular kind of contingent commitment that caused a lot of problems during the 2007–2009 financial crisis was the liquidity put. A put is a promise to buy an asset, usually at a fixed price. The put is like an insurance policy for the asset owner, although this insurance is on the asset’s market value rather than on the asset itself. If the price of the asset stays the same or rises, the owner keeps it. If the price of the asset falls below the put price, the asset owner exercises the put and sells the asset to the bank at the fixed price (which at that point is higher than the market price).

The liquidity puts were different because they did not have a fixed price. The bank instead promised to buy the asset at the market price, which is hard to understand. After all, if it’s the market price, the asset owner can sell it to anyone at that price, he doesn’t need the liquidity put to force the bank to do it. Therefore, some (but by no means all) bank risk managers and regulators accepted that the liquidity puts had no risk.

But when the financial crisis hit, asset owners tried to sell tens of billions of pounds of toxic assets no one else wanted to buy, not at the actual market price (which may have been zero in some cases) but at the pre-crisis price. Eventually, the banks agreed to buy at the above-market prices to maintain their reputations and because the legalities were unclear. This agreement resulted in some of the weakest large banks taking on massive additional toxic asset exposure at the worst possible time.
Another issue that makes bank balance sheets less than straightforward is that some of the assets on there are really owned by other people in the normal English sense of owned. For example, a hedge fund may want to buy £2 billion worth of stock and borrow £1 billion from the bank to help pay for it. Normally, you’d say that the fund owns the stock, and the bank owns a £1 billion loan to the hedge fund. However, this transaction would often be accomplished by the bank putting both the £2 billion of stock and the hedge fund’s £1 billion on its balance sheet, along with a £2 billion liability for the stock it owes the hedge fund.

You can accomplish the same basic transaction in other ways with completely different accounting treatments. The point is that a lot of stuff on a bank’s balance sheet is stuff that it put there for other people (this practice is sometimes called lending its balance sheet). So, another reason that banks have trouble controlling their balance sheet is that they let outsiders use it. None of this is accidental.

Modern banks supply liquidity to all the other entities in the economy. That means that when investors won’t lend enough money to businesses for the economy to run smoothly, banks are supposed to step up and lend. The same is true when housing prices fall, or business inventories climb due to falling demand, or business cash flows fall because customers are unable to pay. In some cases, the same is even true when the government has trouble raising money – the government may expect banks to load up on government debt.

Keeping liquidity flowing can prevent economic dominos from all falling over due to a single shock. But it doesn’t always work that way. Sometimes liquidity just inflates a bubble, and the banks and everyone else get hurt when it pops. Sometimes, liquidity allows the economy to avoid dealing with structural problems or lets the bank double up on bets rather than admitting error. Sometimes, banks are cannon fodder for a government trying to fight the economic tide.
**Balancing the liabilities**

The first liability people think of with respect to a bank is *demand deposits*, which is money deposited by customers that can be demanded back at any time. The great thing about deposits, from a bank’s perspective, is that they’re low cost. Because the accounts are so convenient, customers often accept a zero interest rate or a rate much lower than they demand on other investments. In fact, customers are often willing to pay fees for the privilege of putting their money in demand deposits.

The problem with demand deposits is that they can be withdrawn at any time without notice. Moreover, because all depositors know that the other depositors can do this, there can be a *run on the bank*, when everyone rushes to get their money out first, afraid that the last people in line won’t get their funds. Government deposit insurance has reduced the problem of runs, but it hasn’t eliminated them entirely.

One way to get more stable funding is for the bank to accept *term deposits*, or deposits with fixed terms, anywhere from overnight (which makes it pretty much like a demand deposit), up to five years or longer. These deposits are more predictable for a bank but they’re also more expensive because investors demand higher interest rates for locking their money up.

Another way to get more stable funding is to take deposits from lots of small retail investors. Individuals and businesses that keep a few hundred to a few thousand pounds in accounts for emergencies and general use are not likely to all decide to withdraw one day. Large wholesale deposits, on the other hand, are made by investors who watch the bank’s financial condition closely (generally these deposits are above the limit protected by deposit insurance) and yank their funds immediately if the bank has any problems – or if another bank offers a better rate.

Another major source of bank financing is *repo arrangements*. Repos are one of those ideas that seem crazy to anyone outside of finance. Instead of borrowing money, a bank sells assets (say a billion pounds’ worth of treasury bonds) to someone for slightly less than the assets’ value (say £980 million). The bank promises to buy the assets back the next day (or at some later date) for the £980 million plus, say, £20,000 more. Of course this practice is just like an overnight loan of £999 million with £20,000 interest. The advantage for the lender is that the loan is secured – if the bank doesn’t honour its
agreement to buy the assets back, the lender can sell them on to recoup its loan.

The screwy thing about repos and some other types of short-term financing is that the firms that do them often end up buying and selling similar – or even identical – assets. Banks may sell large chunks of their assets overnight in the repo market, promising to buy the assets back the next morning, then turn around and use the cash to buy lots of other people’s assets, promising to sell those back in the morning. It’s hard to explain why this system makes sense, but easy to see how it leads to instabilities and headaches for risk managers.

Many other types of bank liabilities exist, some quite esoteric and complex. And as with assets, some obligations to make payments do not show up on the balance sheet.

**Regulating Capital**

In accounting, *capital* is the difference between assets and liabilities. Bank capital is defined in a much more complex way, but it carries the same basic meaning. Capital is a buffer in case the cash generated by assets cannot meet the obligations imposed by liabilities. Therefore, one of the basic regulations imposed on a bank is to maintain a minimum capital ratio – requiring that capital must be at least 8 per cent of total assets, for example.

However, regulation isn’t imposed directly on the balance sheet used for financial reporting. All kinds of complex adjustments are possible, with different flavours of capital and assets and different minimum levels for each.

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**Breaking the bank**

Two hundred years ago, banks were much simpler and much better designed. Instead of using government-issued paper money, each bank issued its own banknotes. If a bank’s borrowers had troubles, the value of the banknotes fell. Merchants would only take them at a discount – a percentage of face value. The more the banknotes fell in value, the easier it was for borrowers to buy them up to repay their loans (the bank, of course, had to accept its own banknotes at face value). The discount also served as a high interest rate to attract investors (if you buy a note at 80 per cent of face value, and the bank survives, you make 25 per cent on your investment).

As a result, people said it was impossible for banks to fail. Of course there could be losses – a person might accept a banknote at 90 per cent of face value and find it worth only 80 per cent of face when he tried to spend it. But there was no catastrophic failure to touch off
widespread economic pain, just normal ups and downs of the value of money as the economy prospered or slumped.

Then came Andrew Dexter, the USA's first overleveraged real-estate speculator. Dexter built the Exchange Coffeehouse in 1809 Boston, a luxury office and retail building. To get the money, he gained control of the Farmer's Bank of Gloucester, Rhode Island, (a town with no roads, you had to walk through the woods to get there) and the Detroit Bank (a frontier outpost at the time, 900 miles away that had recently burned to the ground). Dexter printed up lots of Rhode Island money and shipped it to Detroit, and lots of Detroit money to spend in Boston. Although people were suspicious of money from faraway banks, if it came from far enough away and was available in large quantities, people assumed it must be good as how else could it have passed through so many hands and travelled so far? There was always strong demand for money that was accepted over wide areas. Moreover, Dexter knew that it would take years, if ever, for the money to make its way back to the issuing bank, by which time his building would be complete and he would be in a position to make it good.

Of course, it all blew up. Construction cost overruns and delays forced Dexter to print too much currency for his clever scheme to conceal. He proved that banks can fail and started the path to government-issued money and government-backed banks, destroying the sensible risk management principles that made the older banks work. Dexter was bankrupt, but undeterred. He went on to a long career of speculation and development and further bankruptcies, but which included highlights such as founding the city of Montgomery, Alabama.

Don’t confuse the capital requirement with the reserve requirement. They are, in fact, opposites. The capital requirement is a fraction of assets from the left side of the balance sheet, and capital itself is held on the right side. The reserve requirement is a fraction of liabilities (deposits and some others), from the right side of the balance sheet, and the reserve is an asset on the left side (usually deposits at the central bank or cash, but historically often composed of government bonds or gold and silver).

The capital requirement is intended to ensure that the bank is solvent, that is, that its assets are worth enough to cover its liabilities. The reserve requirement is intended to ensure that the bank is liquid, that is, that it has enough access to cash to pay for any withdrawals.

**Managing Bank Risk**

How do you manage risk when you can’t control your balance sheet? If you’re a bank, you begin by facing up to two essential truths:
No bank can survive a loss of confidence, and as soon as confidence starts to erode, people race to take their money out.

No bank is solvent during a credit downturn, that is, no bank can sell its assets for enough cash to pay off its liabilities in that event.

It may not be popular to say these things aloud, but you must keep them in mind to be a good bank risk manager. Don’t place your faith in reputation or tradition or credit ratings; confidence can always disappear in an instant. Nor can you trust in asset quality or liquidity or liability structure, because in a credit crunch or liquidity squeeze, your only hope is that people don’t ask for their money back.

Scary as it is to contemplate that your bank depends on confidence, and that confidence cannot be justified, it’s liberating as well. You don’t have to pretend that the bank can survive any panic or any market turmoil because you know it can’t – it’s impossible. If the dice roll wrong for your bank, either the government will save it or it will fail; no risk manager can hold back the tide.

As a result of this situation, the normal levers you use to adjust bank risk are monopolised by other people. Primary concerns of risk managers in most financial institutions are the safety and liquidity of assets and the stability of liabilities and the amount of equity. However, in banks, these things are controlled tightly by a complex regulatory web. There can be massive unintended consequences from interfering in the process. You may improve the risk management of the product that was your focus, but that may loosen regulatory constraints that result in much worse risk management in another product, and you have no practical way to predict this or even observe it after the fact.

Rather than trying to be one more backseat driver about the balance sheet, when the bank can’t do a lot to control its balance sheet anyway, direct most of your attention to the correlation between the assets and the liabilities. This correlation is a much more productive area for risk-management input.
You know that in a credit crunch the bank’s assets are likely to decline in value, quality and liquidity; and the bank will find it difficult to reduce the size of its assets. Ideally, this event is accompanied by an increase in the bank’s liabilities. How can that happen? In a credit crunch, investors flee risky investments, so if a bank’s deposits are seen as a safe haven, deposits flood in just when the bank needs them to fund its problematic assets. If the bank retains the confidence of long-term investors, it can raise additional capital by issuing debt and equity.

You also know that in a liquidity crunch, investors may pull deposits, and finding investors to buy the bank’s debt or equity at that point is difficult. If the bank tries to raise capital anyway at low prices, that hurts existing investors, which can push debt and equity prices down further and lead to a death spiral. Ideally in this circumstance, the bank’s assets retain or increase their value, quality and liquidity. How can that happen? Mainly if the bank has a diversified pool of customers who don’t all demand liquidity at the same time.

Of course, bank risk management consists of far more than the single insight that you should concentrate more on correlation between the two sides of the balance sheet than on managing the balance sheet itself. But this is an excellent starting point for thinking about bank financial risk management.

Lessons from leveraged loans

A leveraged loan is a loan made to a corporation that already has so much debt that its ability to repay the loan is far from certain. Investors (sometimes) like leveraged loans because they carry high rates of interest that sometimes make up for the credit losses from firms that default.

Many leveraged loans are taken out by private equity investors so that they can buy a public company and take it private, using only a little of their own money. The pitch is often that the discipline of having to make large loan payments will force efficiencies on the borrower and this, along with the management expertise provided by the private equity company and incentive compensation to management, will enhance the corporation’s value to the point that the debt levels are manageable. Sometimes it works; sometimes it doesn’t.

At one point in my career, I was charged with setting risk rules and limits for the leveraged lending business of a large financial institution. Times were good, the business was extremely profitable, and its managers wanted to expand rapidly. Their business risk managers had prepared an impressive analysis arguing that the return-to-risk ratios of the business were extremely attractive. My staff had prepared a more pessimistic assessment, arguing that the business should be cut back slightly rather than expanded dramatically.
As is usually the case, the business focused on relatively short-term, quantitative measures of risk – basically that losses had been few and small since the firm began to make these kinds of loans. My risk people concentrated on longer-term, qualitative measures such as what happens to the weakest borrowers during periodic credit crunches? It's important to realise that both of these analyses were thorough, professional and sober – not window dressing to support reckless expansion nor face-saving objections to avoid criticism if anything went wrong. Moreover, the optimistic business analysis was prepared by top experts in leveraged lending, while the risk analysis was done by generalists with a lot less time and effort to devote to this one project.

There was a lot of pressure on me to accede to the business view, or at least to compromise, and it went up to the firm's executive committee. At a key point, the business head was extolling the growth opportunities and said that companies were borrowing far more money than they could repay out of cash flow generated by their businesses, so they would have to issue more leveraged loans in the future to pay off the old leveraged loans. I said, 'So you're telling us that investor appetite for leveraged loans has to increase constantly, or the old loans will default. That increasing appetite is what has masked weaknesses in the past – troubled borrowers just borrowed more rather than defaulting. At a future point, investor appetite will stop increasing and the losses at that point will dwarf the accumulated profits to date.' Anyway, that's how I remember it, no doubt I was less concise and clear at the time, but I made my point.

I would say the business risk analysis impressed the executive committee more than my risk analysis, but I won due to the way that the business head characterised the opportunity (won means I didn't have to keep defending my rules to the executive committee, and the business head reduced the volume of his complaints. There was never any question of the executive committee overruling the risk manager or the business manager agreeing that the risk manager was right).

However, things don't always work out. The rules I insisted on favoured borrowers with the cash flow to repay loans over borrowers that required continued investor confidence to survive. As it happened, those rules prevented a lot of profits in the good times, and did little to reduce losses when the inevitable credit crunch occurred. It turned out in this case that investor confidence was more robust than cash flows. The rules also damaged the firm's relations with the best private equity investors, and led to deals with second-tier shops that did worse in the bad times. If this kind of thing bothers you, don't go into risk management.
Chapter 16
Managing Assets and Portfolios

In This Chapter

- Looking at types of money managers
- Focusing on funds and their management
- Measuring value for risk and portfolio managers

This chapter covers the financial risks that asset management companies encounter. Asset managers are advisors, issuing buy and sell instructions on other people’s money. The financial risk belongs with the clients, not the asset manager. So you’re probably asking, ‘Why is there a chapter on asset managers in a risk-management book?’ The answer is that asset managers are fiduciaries and must manage the risk (and everything else) for the benefit of the client. The basic idea, although not in legally exact terms, is for the asset manager to treat the clients’ money as carefully as if it belonged to her. In real life, as an asset manager, you treat clients’ money more carefully than that; after all, you’re allowed to be haphazard with your own money.

Surveying Financial Institutions and Their Risks

Financial institutions take money in from customers, invest it, and use the proceeds from the investment to repay their customers. They differ primarily in when and how much money they give back:

- **Banks** promise fixed returns, and often let people take money out any time they choose.

- **Insurance companies** promise to pay when pre-specified events happen, such as a house burns down or a person dies. Much of the risk in these institutions arises because the value of the assets may fall and are insufficient to fund the promised returns to customers.
Asset managers promise to return to customers the value of the assets and no more. If the assets fall in value, the asset management company’s obligations to its customers falls by exactly the same amount.

Asset managers face a number of operational risks: They may lose track of the money entrusted to them or have an employee steal it. They may take money they promised to invest in bonds and buy stocks by mistake. (The general principle is that the customer gets any profit from mistakes, but the fund manager must pay for any losses.) Their computers may add four zeros to a trade order and buy 100,000,000 instead of 10,000; or offer $400,000 per share instead of $40. Cybercriminals could hack in and expose sensitive customer data and holdings. The management company or some of its employees may violate some law or regulation (and a lot of laws and regulations are out there, including many that aren’t obvious and would be easy for an honest operation to break by mistake).

All these are realistic examples of what may happen, and they only scratch the surface of potential bad events. But all financial institutions are subject to these risks, which are mainly the concern of other departments – compliance, legal, regulatory reporting, financial control or IT.

Asset managers pass the main investment risk, called first-order risk, that the assets it buys will decline in value, along to the client. But operational risks, or second-order investment risks, arise from investment characteristics such as illiquidity, leverage, concentration and market structure, among others, remain even if you pass the first-order risk to your customers. Second-order financial risks apply to all financial institutions, not just asset managers, but they’re easiest to analyse when they’re are separated from first-order financial risks. In this chapter, I focus on the investment risks, not the operational risks.

Looking at Asset Management Companies and the Funds They
Manage

When a customer invests with an asset management company, whether that customer is an individual putting aside $500 per month for retirement or an institution such as a public pension plan with billions of pounds to invest, the asset management company doesn’t hold the money. Rather, the money is held by a custodian – usually a bank that specialises in this business.

If the account is invested for the benefit of a single investor, the account is in the investor’s name. If the account is a commingled account and money from different investors is mixed together, the account is in the name of the fund.

BlackRock is the largest asset management company in the world (fact). If the (fictional) Fredonia Sovereign Wealth Fund gives BlackRock £10 billion to invest in stocks, BlackRock would probably open a separate account. If Jane Doe wants to give BlackRock £10,000 to invest in stocks, she selects one of their many stock funds, perhaps BlackRock Capital Appreciation. Her £10,000 won’t be lonely as it goes into an account with an additional £2.5 billion ($4 billion) in it. (That may seem large, but the largest stock mutual fund, Vanguard Index 500, has nearly £100 billion [$160 billion.])

By the way, I am neither endorsing these companies and funds nor saying anything bad about them, I’m just picking some big ones to use as examples for ease of exposition.

Owning the fund

Whether managing assets for an institution or an individual, in neither case does the money belong to the management company. If you put your money in a bank or pay an insurance premium, that money belongs to the financial institution, which in turn incurs a liability (an obligation) to you. But if you give your money to an asset manager, the money belongs to you (if you open a separate account) or to a fund that’s a separate legal entity from the fund management company.

The management company buys stocks with the money in the custodial
accounts. It buys stocks the same way an individual would, through a broker or exchange, but instead of sending the seller a check and taking the stocks in the company’s own name, it instructs the trade to be settled for the benefit of the custodial account. The custodian wires the cash for the stock, and the stock is deposited into the custodial account. The management company never touches the stock or cash.

An institutional client can call up the custodian at any time and tell it to stop taking instructions from the asset management firm, then give the custodian instructions directly or hire another asset management firm to run the account. (Individual clients can theoretically organize to do something similar, although doing so would be nearly impossible in practice.)

Every stock fund that an asset management company may put clients’ money into is overseen by a board of directors elected by the shareholders. (However, virtually no shareholders bother to vote in board elections, and the candidates recommended by the existing board nearly always win.) That board is responsible to investors, not to the management company. An individual investor could try to persuade the directors to remove the asset management company as manager of the stock fund, or even try to get herself or like-minded people elected to the board and fire the management company through board action.

The point is that the fund belongs to the investors, not to the asset management company. The investors, through their elected representatives, control the funds their money is invested in. Those representatives contract the management to the asset management firm, but they monitor the stock funds, vote on certain major issues and have the power to fire the management company.

Totalling the assets

Defining the size of the global asset management industry is not straightforward, mainly because eliminating double counting is hard. For example, one fund may keep its cash assets in a money market fund, and both funds report the investment as part of their assets under management. But £50 trillion ($80 trillion) is a reasonable guess of the amount entrusted to asset managers, about one-third of total global wealth.

Maybe £6 trillion ($10 trillion) of that £50 trillion ($80 trillion) is in passive investments such as
index funds. Another £3 trillion ($5 trillion) is in various kinds of alternative investments and another £3 trillion ($5 trillion) in money market funds and other cash-like vehicles. That leaves £38 trillion ($60 trillion) in traditional funds that buy stocks and bonds with at least some active judgement.

The £3 trillion ($5 trillion) in alternative investments is more significant than the nominal amount. Some of those funds use a lot of leverage, so the £3 trillion ($5 trillion) invested in the funds may control something like £6 trillion ($10 trillion) of assets. Other hedge funds trade a lot, so they may represent 20 per cent of total securities trading even though they hold only 6 per cent of the assets under management.

How much do investors pay for these asset management services? Doing a few back-of-the-envelope calculations and guessing, I'd say it costs about 0.15 per cent of that £50 trillion ($80 trillion), or £75 billion ($120 billion), to manage the money, and another 0.15 per cent to service the investors (including complying with regulations). That's all that the passive investments and money markets charge, but the £38 trillion ($60 trillion) of active investments adds about another 0.70 per cent, or £266 billion ($420 billion) in management fees. The alternatives may average another 2 per cent (this rate will surprise people who think that all hedge funds charge a 2 per cent management fee plus a 20 per cent of profits performance fee, but only some funds charge this rate or more, and the largest alternative funds are ones with lower fees) or £60 billion ($100 billion). So my guess is that investors pay a total of about £400 billion ($640 billion) in fees.

The assets under management numbers may be off by 20 per cent or more either way, and the fees may be half or twice as much. However you adjust it, asset management is a big industry that earns (or at least collects) big money.

Some sophisticated asset management funds are organised as partnerships instead of mutual funds. Exchange-traded funds and closed-end funds are a bit more complicated. But the main point is that the money in the fund is for the benefit of investors; the asset manager chooses the investments but doesn’t own the fund or its assets.

The risk manager is hired by the asset management company and has a responsibility to its owners who may be public shareholders in a company, or an individual or individuals in a private company. But all officers of the fund management company, including the risk manager, have a fiduciary responsibility to investors, meaning they must act in the best interests of fund investors, not in their own interests or that of the fund management company. The risk manager also has extensive dealings with the boards of directors of the funds.

Generally speaking, all parties want the same thing: the fund to have great returns and not have any problems. However, in specific cases, the risk manager has to distinguish carefully among the parties and perform the
appropriate duties to each.

**Explaining types of funds**

An asset management company can offer a single fund or many funds, and can choose from a few types of funds:

- **Public mutual fund**, which is similar to a UCITS (Undertakings for the Collective Investment of Transferable Securities) fund in Europe, is the best-known type of fund. These are commingled vehicles that nearly anyone can buy. Traditionally they had rules to strictly limit or prohibit investments and activities such as leverage, derivatives, short selling, illiquid investments and other practices deemed too complex or too dangerous for retail investors. Those rules have loosened in recent years. Public funds that take advantage of some of the more exotic techniques or investments are called *liquid alternative* – or, more commonly, *liquid alt – funds.

A couple special public mutual funds are

- **Money market funds**: A money market fund is limited to the safest and most liquid investments and is meant to be used as a slightly riskier and slightly higher-yielding alternative to bank accounts.

- **Open- and closed-end funds**: With an *open-end* public mutual fund – the more common type – if you buy shares, your cash goes into the fund, and if you redeem shares, the fund pays you. With a closed-end fund, the fund issues a set number of shares at inception. If you want to buy in, you must buy at inception or buy from another shareholder who wants to sell. If you want to sell your shares, you have to find a buyer.

- **Exchange traded funds (or ETFs)** are a hybrid of open- and close-end funds. Individuals can buy or sell shares with each other, like a closed-end fund (or like a stock or bond). However, dealers who register as sponsors can exchange an ETF share for its pro rata share of the investments or convert a pro rata share of the investments into an EFT share. These give investors the ability to buy and sell at any time during the day. (Most open-end funds can be bought or sold only once per day at 4:00 p.m. New York time;
most UCITS funds can be bought or sold only once per week.) These freedoms also keep the ETF price closely in line with its constituent assets. A closed-end fund stock price can diverge significantly from the underlying asset value, and usually trades at a discount.

**Hedge funds** are defined by what they’re not: They’re funds that don’t meet the rules for public mutual funds. Historically, they had to be organised offshore – that is, in a lightly regulated jurisdiction like the Cayman Islands or Luxembourg, rather than in the United States, Japan or Europe – and could be sold only to a limited number of wealthy investors. Today, the rules have loosened and hedge funds are held by many institutions and non-wealthy individuals. A somewhat broader term is *alternative investments*, which includes hedge funds but also *private equity funds* (funds that buy public companies, take them private and help manage them), *real asset funds* (funds that buy tangible quantities like land or oil) and other funds that go beyond basic investments in public securities.

A fund can do many things to be classified as a hedge fund or alternative investment:

- **Restrict liquidity**, perhaps allowing investors to cash out only once per quarter with two month’s notice, or even locking up the investment for five years or more.
- **Borrow a lot of money**. Public funds are generally permitted only limited leverage.
- **Use derivatives** such as futures or options.
- **Short securities**, or sell borrowed securities in the hopes of buying them later for a lower price. Short selling is perfectly legal and honourable, but is strictly limited or forbidden in public funds.
- **Charge a performance fee** in which the manager gets a share of the profits – a practice forbidden or limited in public funds.

Another way to categorise funds is by what they promise to do:

- **An index fund**, the simplest type of fund, promises to buy the constituent stocks of an index. For example, a Standard & Poor’s 500 (S&P 500)
index fund takes all the cash people send it and buys the 500 stocks in the S&P 500 index. (This isn’t exactly true. For one thing, the S&P 500 has 502 stocks at the moment, and for another, the fund is allowed to vary the purchases slightly, but the overall goal is to match the return of the index.).

In this case, the risk manager is entirely off the hook for the fund’s return. The fund manager’s job is to do what the fund promises, not to guess whether the index is going up or down. The fund is selling a process, not making any predictions about returns. If the S&P 500 index goes down, fund investors know that they are going to lose money. If the manager predicted the decline and avoided the loss, she would not be doing her job.

An absolute return fund is at the other extreme. In this type of fund, the investment manager attempts to make money regardless of the direction of the stock market or of other major market factors. That doesn’t mean the fund always has a positive return, just that it’s as likely to have a positive return when stocks go down as when stocks go up. An absolute return fund doesn’t sell a process but an attempt to produce a result.

Between index funds and absolute return funds are funds that promise some process and some attempted results. For example, a stock mutual fund may pick stocks among the S&P 500 that the manager thinks will do best. Although this fund will go up and down with the S&P 500, the manager hopes to make a little more when the market goes up and lose a little less when the market goes down by holding better-than-average stocks.

Index funds are most suitable for public mutual funds and ETFs, while absolute return funds are usually hedge funds, but in principle any combination is possible.

Risk management is obviously easiest for index funds because the investor is the one who selects the market risk by choosing to buy the index fund. Assessing market risk isn’t the risk manager’s responsibility (or her business, for that matter). As you move along the scale of funds
that attempt to produce certain results, whether beating an index or delivering an absolute return or anything else, more of the market risk of the fund is chosen by the manager and less by the investor and therefore falls more under the purview of the risk manager.

Comparing Portfolio and Risk Management

Portfolio management is a hard job. A manager may have thousands of securities to choose among – or even more. Each of those securities may be individually complex and make predicting future prospects difficult even for the simple securities. The manager must try to combine them to maximise some measure of expected return relative to some measures of risk. The manager must consider a range of likely factors including volatility (how much the portfolio value moves up or down each day), stress loss (how much the portfolio may lose in plausible extreme events) and liquidity risk (how the portfolio may fare if investors want their money back and selling positions is difficult) among others. Even expected return must be considered in the short-term, medium-term and long-term prospects.

Compared to that, risk management is easy. The risk manager doesn’t care about what the portfolio manager might buy, only what’s in the portfolio now. The risk manager doesn’t care why this item is in the portfolio or what the plans are to trade it in the future. The risk manager isn’t worried about long-term prospects, only how the portfolio value might change tomorrow. (Actually, that last statement isn’t completely true. If assets aren’t liquid, the risk manager may use a longer horizon for risk, but the job is still easier than the multiple horizons the portfolio manager has to consider.) The risk manager isn’t concerned about expected return, which is extremely difficult to forecast, only some measures of left-tail risk, the likely amounts the portfolio may lose on, say, the worst 5 per cent of days.

Okay, I exaggerate; the risk manager does care about some about the things that worry the portfolio manager. However, risk management is a much more focused job. Even the best portfolio managers have losing streaks; the job is too hard to avoid those. But risk management can and should be done right every day. That doesn’t mean the fund never loses money, or even that the
fund never has surprisingly large losses. But it does mean that the fund should always be run under risk control.

Portfolio managers generally use a lot of specific data. Depending on the manager’s style, that data may consist of company financial statements, government statistics, news stories, big data aggregations from social media or pretty much anything at all and in any combination. Risk managers are mainly interested in the portfolio positions, the price histories for those positions and some forward-looking estimates of factors such as potential for short-term price movements, relations among positions, liquidity and so forth. The risk manager also looks at portfolio-level parameters like cash levels, counterparty exposure and leverage.

Portfolio managers often have complex analytics both to evaluate individual positions and to combine them into optimal portfolios. Risk managers mainly rely on simple, robust analysis – tools that don’t depend strongly on models or assumptions.

Portfolio managers tend to concentrate on where the big money movements are – what positions or strategies are making or losing the most money. Risk managers tend to focus on the most statistically anomalous results.

These are a few of the reasons why portfolio managers and risk managers have independent views of the same portfolio. To a portfolio manager, risk is something bad to be minimised, just like a cost. For a given level of expected return, a portfolio manager always prefers less risk. To a risk manager, risk is something to be set at the correct level.
In This Chapter

- Understanding risks in buying, selling, and providing insurance
- Insuring insurance companies
- Working with actuaries

Like other financial institutions, insurance companies accept money from individuals and businesses, invest it and return proceeds to their customers. Unlike a bank, which returns the amount deposited plus a fixed amount of interest, or a mutual fund, which returns whatever the investments are worth, an insurance company return variable amounts based on whether the customer had an automobile accident, or a house fire or some other event specified in the policy.

The special risk management issues of an insurance company derive from the fact that insurers cannot control their liabilities. If their customers have bad luck, the insurance company must pay out a large amount of money – potentially much larger than the amount it took in as premiums.

Understanding Insurance

The oldest and simplest form of insurance is risk sharing, in which bands of individuals share resources such as food so that they can survive runs of bad luck. Primitive societies systematised this practice in various ways such as temple granaries, cooperative societies and commons. The great ancient trading societies, including the Phoenicians, Greeks, Babylonians and Chinese, all developed legal frameworks for risk sharing among merchants. These frameworks formed some of the foundations for both modern finance and modern insurance. As economies grew more complex, insurance spread from commercial ventures to personal annuities and pensions to life insurance to property insurance to accident and disability insurance and beyond.
In a fire insurance pool, you collect a yearly premium (perhaps an amount equal to 0.1 per cent of the home value) from homeowners who sign up for the pool. In return, if any covered house burns down, the pool pays for the loss.

Some questions arise immediately. The pool requires premiums from 1,000 homeowners to cover the cost of one house, so what happens if more than one house in 1,000 burns down? Who keeps the extra if fewer than one house in 1,000 burns down? How is the loss amount determined? Also, after a homeowner insures his house, what incentive does he have to be careful about fire? Would a homeowner decide to burn down his house for the insurance money rather than take the trouble of selling it?

These basic questions apply in more complex forms of insurance and others arise as well. If a company sells health insurance, who decides what treatments and other expenses are covered – the patient, the doctor or the insurance company? If two cars insured by different companies crash, which company pays for which expenses?

These types of questions are the responsibility of the people managing the insurance business. All I’m going to say here is that people have figured out solutions, but not perfect solutions, to the questions. The risk manager’s job involves the risks that arise from these solutions.

Speculatively expanding insurance

To an economist, one of the mysteries of insurance is why people buy so little of it. Yale professor Robert Shiller is one of the most outspoken on the subject. He tackled it in a 2006 book, *The New Financial Order: Risk in the 21st Century*. Although people often buy insurance for their life, health and property, many of their biggest risks are economic.

Consider a young person considering going to medical school. One important unknown that relates to this decision is how well paid doctors are going to be over the next 50 years or so. Why should a young person make a massive bet on this question when it could be easily diversified away?

A person can’t buy insurance on his own income of course, because as soon as he bought the policy, he’d stop working. But it should be possible to buy insurance on the average income of a cohort. For example, this aspiring doctor may agree to pay 50 per cent of the median income of all the people who enter medical school in his year in return for a fixed income. (It would probably make sense to refine the cohort by quality of medical school, age, exam scores and so on, in order to be a better match.) If doctors’ incomes are high in the
future, he loses money on the contract, but can afford it. If doctors’ incomes are low, the contract helps make up the difference.

One objection is what happens if he changes in mind or fails medical school? That shouldn’t be a big problem because, unless a big change in doctors’ projected incomes occurs over the next 50 years, he should be able to cancel the contract with a small gain or loss. If a large gain or loss take place, the contract works even better. For example, suppose that a certain invention causes a large decline in demand for doctors, and of course, doctors’ incomes as well. The rational economic response is for many people in medical school to drop out, especially the ones least interested in medicine and with the best alternative opportunities. If people had bought insurance contracts, they could cash them out for large lump-sum payments to help offset the losses from wasted training and the costs of switching professions.

On the other hand, suppose that the country sees an increase in the need for doctors. Now anyone dropping out of medical school would have to pay a large cost. Again, this position pushes people to economically rational decisions.

Another objection is that our doctor doesn’t know what money will buy in the future. Here, another contract could eliminate the risk: the doctor may agree to pay a fixed amount today (perhaps equal to the amount he’s guaranteed under his doctors’ income contract) in return for 50 per cent of the median expenditures of London professionals.

These are just a few examples of things people may do to insure against the large economic risks that dominate most people’s financial life outcomes. The contracts could be written by insurance companies (which makes sense if the main goal is risk sharing among a pool of people) or traded on futures exchanges (which makes sense if the transactions are mainly between people with opposite economic risks, like doctors who lose if medical incomes are low, and health insurance companies who lose if medical incomes are high).

The point is that it is at least possible that the demand for innovative types of insurance, and hence for insurance risk managers, may grow to many times current levels.

**Shopping for insurance products**

People buy insurance for a combination of risk-sharing and financial reasons. Some products, such as automobile insurance, are entirely risk sharing with no investment component. But a product like whole life insurance is a combination of risk sharing (the policy pays a defined benefit if the insured dies young) and retirement savings (the policy has a cash value paid if the insured lives to retirement age).

Another important product that’s mostly financial, with only a small amount of risk sharing, is a *variable annuity*. This product is like a mutual fund in that the return to the insured is determined by the performance of an investment, and almost any kind of investment can be put inside a variable annuity. However, the insurance company makes certain promises, typically that the
investment won’t lose money and will provide some minimum payout in case the annuity buyer dies. A fixed-life annuity is simpler: The insurance company makes a fixed periodic payment as long as the annuity buyer lives, so the annuity is both an investment product (like a bond or savings account) and an insurance product (it pays more if the annuity holder lives longer and needs more money).

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### Pushing the insurance boundaries

You can buy insurance for almost anything (although in most legal jurisdictions you must have an insurable interest – a legitimate economic loss to offset if the event happens – in order to collect). In 1987, when Whitley Strieber had a bestseller with his supposedly non-fiction alien abduction tale *Communion*, the St Lawrence Agency sold over 20,000 alien-abduction insurance policies. London brokerage Goodfellow Rebecca Ingrams Pearson has sold over 4,000 policies for £100 per year that pay £100,000 to anyone who can prove abduction by a being not from Earth with double indemnity (the insured collects double the insurance face amount) if the insured was impregnated during the event.

Movie star Betty Grable got a publicity splash in 1943 by having her legs insured for $1 million by Lloyds of London. Many celebrities have followed her example including singer Bruce Springsteen (voice, $6 million), guitarist Jeff Beck (fingers, $1 million), cricketer Merv Hughes (mustache, £200,000), food critic Egon Ronay (taste buds, £250,000), television star America Ferrera (teeth, $10 million) and American footballer Troy Polamalu (hair, $1 million). Footballer David Beckham thinks his legs are 70 times better than Grable's – he bought a $70 million policy for his.

Insurance companies are usually on the hook for those crazy offers companies like to make to get attention. When Skylab was falling from orbit in 1979, Taco Bell put out a raft and promised if it were hit by any piece of Skylab, everyone in the US got a free taco. Taco Bell paid an insurance company to cover the cost if it lost. Cutty Sark offered £1 million to anyone who captured the Loch Ness monster alive, but the risk was borne by an insurance company.

Afraid that your son or daughter will be left at the altar? Fireman's Fund insurance will sell you a policy to cover the non-refundable financial expenses of a wedding, plus professional counselling for the jilted party. But brides and grooms cannot buy it for themselves, only third parties (usually parents) putting up the costs for weddings. On the other hand, a Hollywood studio routinely took out the opposite policy – it wanted to be paid if one of its star actresses got married while under contract.

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Many insurance companies sell pension products, which are similar to annuities but cover groups of people. For example, an insurance company agrees to pay all the retirement benefits of a defined group of workers for a fixed fee.

Another important group of products are financial insurance contracts.
Companies sell policies against a homeowner defaulting on a mortgage or a municipal government defaulting on a bond or other financial events.

**Looking at buyers**

Most insurance isn’t purchased primarily for risk-management reasons by buyers but as a result of regulation or business practice. For example, automobile liability insurance is required in many jurisdictions, and in order to get a loan secured by physical property, the lender often insists that the property be insured. For another example, health insurance and pension benefits are often purchased by an employer or other entity rather than by the beneficiary directly.

From a risk manager’s standpoint, required insurance is good because it reduces the danger from *adverse selection*, the tendency of people at greater risk to buy insurance, while people with lower risk levels do not. For example, suppose that in a group of 9,000 homeowners most are careful, and only 1 of their houses burns down in an average year. In another group of 1,000 homeowners, 99 of the homes burn down in an average year. That means you expect 100 houses out of 10,000 to burn down, so an insurance company charges a premium of about 1 per cent of home value (plus or minus a little to account for expenses, investment income and profit for the insurance company). At that price, insurance is a great deal for the careless homeowners, but probably not an attractive deal for the careful ones. If only the careless homeowners buy insurance, the company collects enough in premiums to pay for 10 houses burning down but has to pay claims on 99.

To some extent *underwriting* – the analysis of individual insurance policies, among other things, to determine whether the customer is careful or careless – can take care of adverse selection, but it is by no means perfect.

**Accessing agents**

Traditionally, insurance was sold by insurance companies or independent agents. In fact, much of what came to be called *salesmanship* in the 20th century was developed by insurance sellers in the 19th century due to the large commissions offered.

Insurance sellers were expected to do more than just get the customer to sign. They were relied upon to perform preliminary assessments of risk, to collect regular premium payments and to help both the customer and the company
through the process of submitting and adjudicating claims.

Today, insurance is becoming commoditised and insurance sellers are often separate entities from insurance providers, especially on the Internet. Although there are certainly efficiencies to that process, and it may result in better deals for insurance buyers, it removes an important traditional layer of line risk management from the business.

**Seeing how insurance companies operate**

The basic business process of an insurance company is simple: It must assess the risk of policies, price them appropriately, invest the premium income received wisely and pay off the resulting claims carefully. However, the insurance business is usually regulated in such a way that when times are good and claim payouts are low relative to premiums, a combination of regulation and market pressure force premiums down; the same factors do the reverse in bad times.

This situation means – to a greater or lesser extent depending on the company, the type of insurance and the jurisdiction – that insurance premiums can be thought of as paying for past losses as opposed to future losses. However, don’t take this insight too far. For one thing, it generally applies at the industry level, not the firm level. If your insurance firm has excessive losses relative to the industry, don’t count on help from the regulators to let you raise premiums and keep out competition. Only when the industry as a whole takes a hit are regulators likely to agree to increased premiums in order to rebuild reserves. For another thing, regulators also face pressure from insurance buyers who have just suffered disruption and losses (above and beyond the insurance) and who will push against large premium increases.

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**Cheating the insurance company**

The modern form of the insurance industry has been shaped mainly by fraud. One popular business model for insurance is to price it cheap, collect a lot of premiums, hide them and declare bankruptcy when the claims come in. A more sustainable version is to put enough fine print in the contract that nearly all claims can be denied. These problems led to the popularity of mutual insurance – where any profits belong to the beneficiaries, not the managers – as well as professionalization of actuaries, regulation and a legal framework that imposed strict limitations on the insurance relationship, regardless of the words in the contract.

Of course plenty of fraud is in evidence the other way as well. Lots of people have decided that cheating insurance companies is an easy path to wealth. A much larger group of people,
who wouldn’t think of stealing someone’s wallet, have no trouble adding a few fictitious items to an insurance claim or asking their doctors to prescribe double the dose of a medication so they can cut their prescription drug costs in half. Out of these grand and petty criminal schemes, a robust set of countermeasures have evolved, including sceptical professionals, policy provisions and laws.

In most cases, the answer to any why question about the legal, organisational, financial or business practices of an insurance company is, ‘because somebody once tried a scam’.

Every so often cheats come up with even more convoluted or colourful versions worth contemplating. They help train your brain to think beyond the simplest versions of risks and appreciate some of the astounding variety of human behaviour and how it affects risk.

❖ A Texas couple, Clayton and Molly Daniels, decided that the solution to their financial problems was to collect on Clayton’s £70,000 ($110,000) life insurance policy. This solution is not original in itself, but the couple went the extra mile by digging up a corpse from a local cemetery, dressing it in Clayton’s clothes, putting it in his car, lighting the car on fire and pushing it over a cliff. Clayton then dyed his hair, shaved off his moustache and reappeared as Molly’s new boyfriend, calling himself Jake Gregg. The insurance investigator had little trouble seeing through all this, and a Texas jury had no trouble imposing the maximum 20-year sentence for insurance fraud on both Danielses. (Clayton received additional years for arson, desecration of a cemetery and some earlier charges he had run out on.)

❖ John and Anne Darwin, from Seaton Carew in the UK, had the same basic idea as the Danielses. John set to sea in a homemade canoe and disappeared. This idea was a lot less trouble than the Daniels’ scheme, but it had the disadvantage that Anne had to wait a year and only collected half the benefits because no body was found. However, the big money was not in the life insurance but in a policy that paid the mortgage on her house if John died. The deception was successful for five years, despite the fact that John lived in a house the couple owned next door to their primary home, was recognised by several people and engaged in a lot of public behaviour. Eventually, John had the idea of showing up at a police station and claiming amnesia. The police had already been investigating and were sceptical, and both John and Anne were sentenced to over six years in prison.

❖ Simple is usually better, and Nicholas Di Puma of New York tried another common gimmick. He put pans of oil on his stove and ignited them. While investigators are obviously suspicious of major fires that start this way, they often find it hard to prove that the fire was intentional. Nick claimed that he threw one pan out the back door, where it landed in the backseat of his car and destroyed it. That made his story harder to credit. It became impossible to believe when he said he then picked up a second pan, tried to throw it out the back door, tripped and threw it on his couch, where it started a fire that destroyed his house. He was fortunate enough to avoid prison, but he received five years probation. He did not collect on his policies.

❖ Ted Lilly was a good pitcher for six major league baseball teams over 15 years. When his uninsured vehicle sustained £2,900 ($4,600) worth of damage in a 19 March collision, he got the bright idea of buying insurance on 24 March, then claiming that the accident occurred on 28 March. This type of fraud is garden-variety and made the news only due to Lilly’s fame and the fact that a guy who was paid over £50 million ($80 million) to throw baseballs ought to be above cheating an insurance company
Insurance companies differ on their core competencies. Some are sales organisations focused on selling profitable products, or customer service shops who distinguish themselves with customers after the sale is made. Other companies rely mainly on their underwriting and risk assessment for good returns or succeed by monitoring and reducing dangers of their insured clients. Still others are best at investment. These competencies may be combined in various permutations, especially in the large companies, although companies that claim to be good at everything usually have low standards rather than exceptionally broad excellence. You need to understand the source of a company’s advantages (if any) – not all insurance companies are alike.

**Reinsuring**

*Reinsurance* is nothing more than insurance sold to insurance companies. For example, suppose that a UK insurer writes a lot of homeowner policies. Many of the claims under these policies will be idiosyncratic, perhaps a homeowner gets sued when his dog bites someone or a house is infested with mould. These claims are easy for the insurance company to handle, because they affect only one home at a time and are reasonably predictable in frequency. Moreover, they tend to be small, and often the homeowner’s premiums can be raised to recoup the payout.

However, suppose that an area is hit with a massive thunderstorm that causes severe damage to thousands of insured homes at once. Because these systemic events are rare, estimating frequency is hard and the total claims may be large enough to damage the insurance company’s earnings or even to push it into bankruptcy.

The sensible thing for this company to do is to turn to the reinsurance market and purchase a policy that can help pay the losses if a major event occurs. Many types of policies are available, some based on the individual company’s loss, others based on industry-wide losses, some covering only highly specific losses and others general in their coverage.
Captive reinsurance means that an insurer sets up a company it controls to sell it reinsurance. Doing so is generally done for tax or regulatory reasons as, obviously, you can’t reduce risk by insuring yourself. Catastrophe bonds are the same idea as reinsurance except that they’re sold directly to investors instead of executed through a reinsurance company. The investors buy the bonds, earn a high rate of interest and get their money back at the end of the term (usually five years) – unless a specified type of catastrophe occurs (say an earthquake in Japan that causes more than ¥100 billion in insured losses) in which case the investors’ money is used to pay the excess losses, and investors likely end up with nothing.

There can be tax advantages to running a reinsurance company. For one reason, they’re usually not taxed on gains in their investment portfolio as long as that money is held in reserve to pay potential claims. For this reason, some reinsurance companies (and even a few insurance companies) engage in aggressive investments designed to maximise the value of the tax deferral. In particular, some reinsurance companies are set up by hedge funds and invest much of their capital in those hedge funds. If taxing authorities feel this investment is abusive – that the reinsurance company is taking primarily investment risk rather than insurance risk – it may seek to disallow the tax deferral.

Accusations, sometimes but not always well founded, of using reinsurance for tax avoidance or regulatory arbitrage (getting around minimum capital regulations by playing a shell game with capital) are as old as reinsurance. However, you must understand that the large companies, and also most companies, are entirely reputable and fill an important economic need. In fact, the world would be a better place if the reinsurance business, or an alternative like catastrophe bonds or an insurance exchange, were at least ten times larger. The potential for global risk sharing is much greater than the current supply.

A key concept in reinsurance is that the reinsurer must follow the fortunes of the insurance company. If the insurance company pays a
claim that’s collectable under the reinsurance contract, the reinsurer must pay unless it can demonstrate bad faith, collusion with the insured, fraud or gross negligence. In other words, the reinsurer isn’t allowed to contest the payout on the grounds that it was not justified or that the insurer could have challenged it in court. Insurance companies pay disputable claims for a variety of reasons: to maintain a good reputation, to save money on legal expenses, to keep agents satisfied and so on. This fact makes a reinsurance contract more of a business partnership than standard contacts are.

**Crunching the Numbers with Actuaries**

A key element to the modern insurance industry is an *actuarial approach* to risk. This approach means collecting as much data as possible on historical losses and using past frequencies to project likely future outcomes. Although actuarial science has developed far beyond its simple roots into a sophisticated quantitative field, careful collection and categorisation of data for the precise estimation of frequencies remains at its heart.

The core of actuarial science is prediction based on careful collection and categorisation of historical data. Modern financial risk management isn’t about prediction. An example of the difference is the question of setting the appropriate premium and reserve levels for an insurance product. An actuary tries to predict the probability distribution of the future claims and to set premiums and reserves high enough to cover the payments at some level of confidence. A financial risk manager has nothing to add to this process. Instead, his expertise is in determining what level of confidence should be required. If you set the premiums and reserves so high that you’re completely certain of being able to pay all claims, no one will buy such costly insurance, and it won’t generate profits for the company or be any benefit for customers. If you set the premiums and reserves too low, you have enough probability of being unable to cover claims that you’re not really selling insurance at all.

The actuarial problem is focused on the particular product being analysed. The risk management problem must be done at the enterprise level as, to a risk manager, all risks are one risk. History and frequencies, the bedrock of
actuarial science, are not useful to risk managers.

Insurance companies employ actuaries to compute premium levels and reserves (how much a company should set aside for future claims on existing policies), among other functions. This role is a formally recognised profession, and both regulation and tradition (not to mention common sense) require qualified actuaries to sign off on key insurance metrics.

Financial risk managers at insurance companies must form productive working relations with actuaries. One impediment to this relationship is that some actuaries think that they’re the risk managers, or at least that they should have been entrusted with that job. In this attitude, they’re no different from certain portfolio managers, traders, loan officers and other line risk takers, who don’t appreciate the benefit of the independent view of risk taken in modern financial risk management or who appreciate it but think that they can apply it better on their own than via independent oversight.

One easy bit of advice here is to stay scrupulously away from kibitzing on any actuarial decisions. Don’t offer opinions on appropriate product pricing or reserve levels. Likewise, you don’t tell a portfolio manager what securities to buy, a trader how to trade or a loan officer what loans to approve. Actuaries pass a rigorous series of exams, and their profession has evolved techniques that incorporate centuries of practical insurance wisdom. Outsiders should respect that expertise.

On the other hand, be completely open to risk management advice from actuaries. Also be open to advice from other line risk takers, of course, but actuarial advice can be even more valuable because it reflects not only experience in insurance but mathematical expertise and risk training. In addition, many actuaries, out of personal interest or for career reasons, have studied quite a bit of financial risk management.

Many actuaries are knowledgeable about the problems addressed by risk managers, having come up with their own approaches or having studied financial risk management. Some of them may be better at analysing them than their financial risk managers. However, a core principle of modern financial risk management is that you need a layer of risk management independent of the line risk decisions (in this case the underwriting and
However wise and talented line risk managers are, experience shows that you’ll find it extremely difficult to be effective both managing risk and exploiting uncertainty for profit at the same time. The separation of those functions is a cornerstone of modern financial risk management. Of course, independence doesn’t mean that the two risk professionals shouldn’t communicate, it just means that each has a job to do and should respect the other’s sphere of responsibility. Risk managers and actuaries view a few things quite differently:

**Information gathering:** Consider the question of how much information should be collected for insurance. A traditional actuarial answer is that more information is always better. After all, if your goal is prediction, more information gives you more to work with. However, to a financial risk manager, any collection of information reduces the risk sharing that is the entire point of insurance. If you collected enough information to predict exactly when each person would die, you wouldn’t have perfect life insurance – you wouldn’t have any life insurance at all.

Of course actuaries think about this issue in the context of individual versus group versus government-mandated insurance; or in evolving issues such as collection of genetic information, sharing of health information and research on life and health prediction. But setting optimal information levels is at the heart of modern financial risk management.

**The financial and legal organisation of insurance companies:** What kinds of insurance should be combined, for example? Larger and more diverse companies are less exposed to idiosyncratic risk because profits on some products in some markets can be used to offset losses on other products in other markets, but at the same time, integration and scale can lead to contagion risk and too-big-to-fail companies with all the evils those entail. Financial risk management studies ways to use financial and legal arrangements to get the advantages of scale while minimising the disadvantages.

**Treatment of investors and customers:** Financial risk managers treat insurance company investors symmetrically with insurance company
customers. Both investors and customers send money to the company and expect to get money back in certain future circumstances. A successful company makes both groups happy. Although actuaries also care about both groups, they’ve distinct legal responsibilities (which vary according to the insurance product and jurisdictions) to each. Moreover, actuaries obviously get far more training in insurance concepts and law, but financial risk managers are taught more corporate law and finance.

None of these general statements should be taken as applying to all actuaries or all financial risk managers. Some actuaries know more about business and finance than most financial risk managers, and some financial risk managers know quite a lot about insurance. Rather, the statements apply to job functions. A sound insurance company needs solid actuarial talent to make line risk decisions and an independent risk management group to monitor and set optimal risk levels.

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**Evolving actuaries**

Although the single word, *actuary*, has described quantitative insurance professionals since 1849 and the profession can be traced back another 150 years, what actuaries actually do has changed considerably over the years. Until the 1930s, the job consisted mainly of compiling data and computing approximations accurate enough for pricing and reserving. Although the job involved some statistical theory, meticulous calculating and a good practical sense of data were more important requirements than any advanced mathematics. Also, insurance business judgement was prized at least as much as numerical skills.

From the 1930s to the 1970s, as information storage and processing improved, the job shifted. There was less need for doing rapid and accurate arithmetic and more for conceptualising systematic representations of information. The ability to see patterns on the fly – while ignoring patterns that weren’t real – became less important than design of algorithms and formulae for computerised computation. The old subjective and intuitive skills were still essential, of course, but they were now applied to much larger sets of much larger data.

Over the last 40 or 50 years, a new trend has emerged. As science improves, historical frequencies are less useful for prediction than models. *Catastrophe insurance*, insurance against damage from major events such as windstorms and earthquakes, is priced almost entirely from models today. Even in life and health insurance, predicting mortality trends, the effect of behavioural changes and medical advances now consumes more actuarial effort than compiling historical frequencies.

Some actuaries embrace this change, and devote themselves to adding actuarial value to the outputs of models designed and run by subject-matter experts such as weather forecasters, quantitative sociologists and medical scientists. Other actuaries prefer to fight by improving traditional actuarial tools to compete with models. This situation parallels the love/hate
relationship that financial risk managers have had with derivative pricing and risk models since the mid-1980s.
Part V

Communicating Risk

Four statements to be sure you can say

✔ You didn’t miss problems because you were lazy, unqualified or blinded by prejudice.

✔ You didn’t spin communications in deference to powerful stakeholders, no matter how intimidating or impassioned.

✔ You didn’t allow different stakeholders to have different ideas of your risk views, however much easier that would have made everyone's lives.

✔ You never downplayed the risks of a plan because you couldn't think of an alternative one.

Find a free article about knowing risk and communicating risk at www.dummies.com/extras/financialriskmanagement.
In this part …

✔️ Describe the risk that you mention in clear terms all stakeholders can understand.

✔️ Pick the right phrases and metrics that communicate risk accurately to everyone to avoid disclosure that different stakeholders will interpret in different ways.

✔️ Write the risk disclosures section of financial reports.

✔️ Work productively with regulators so everyone is comfortable with the risk decisions.

✔️ Design risk measures that work both to manage risk and to report risk, so that you actually use the numbers that you show to regulators and investors.
Chapter 18
Reporting Risk

In This Chapter

- Understanding risk management goals
- Working with professionals on reports
- Reporting to the board
- Making use of feedback

Financial risk management is all about reporting and communicating. I discuss these responsibilities in nearly every chapter, but in this chapter, I deal with the formal, top-level reporting financial risk managers must do to boards of directors and in annual reports and similar circumstances.

Appreciating the Role of Risk Management

The modern field of financial risk management is less than a quarter century old, but the subject of this chapter – reporting on risk – is an ancient and essential part of finance. Textbook definitions of finance often centre on money, or markets or securities; but these are limited views. Finance is a way of organising human activity. Money, markets and securities are merely useful tools in this endeavour. You can do good finance without any of them, and you can most certainly use all those tools without doing good finance. On the other hand, you cannot do good finance without honest and accurate top-level reporting of risk.

Small-scale projects are often accomplished by people who agree on goals and how to accomplish them. Painting a house, for example, or sailing a boat, work best when everyone involved sees things the same way. Sometimes people just work together naturally and, if not, disagreements have to be settled before work can continue. The simplest way is to put one person in
charge of all decisions.

**Agreeing not to disagree**

A key feature of finance is the constructive embrace of differing opinions and tastes.

Organising activities to require consensus has three problems:

1. The set of things people agree on is pretty small, mostly limited to activities necessary for survival. Put a dozen shipwreck survivors on a deserted island, and there's hope they can cooperate effectively. I mean, they might not, but they might; ditto for an extended family, a couple of hundred people in a religious cult or on a kibbutz or in a long-established, traditional village.

However, after people have their basic necessities assured, they start wanting different things, and they have different ideas about how to get them. To progress beyond subsistence, to develop economically, requires a flexible system of organising work.

2. For large-scale projects, enforcing agreement among all participants requires unpleasant tools – rigid indoctrination, blasphemy prosecutions, slavery, thought police and an infinite variety of other horrors. From ancient monarchs building monuments to 20th-century totalitarian socialist states – and most of the wars in between – getting big things done using organisational methods that assume universal agreement requires nightmarish repression and violence.

3. Suppressing dissent kills innovation and diversification – two essentials for progress. The wisdom of crowds is needed to navigate the future successfully.

**Agreeing to disagree**

The beautiful, magical idea underlying finance is to turn disagreement into a positive force. Instead of trying to force two people to agree on the value of an item, the one who values it more trades for it with the one who values it less. The more disagreement about value, as a result of disagreement about facts or tastes, the more trading, the more economic activity, the more
Large-scale projects are organised by complex arrangements among people who disagree. Optimists provide resources to the project in return for equity, a share in the residual profits after everyone else has been repaid. Pessimists, or people with relatively high preferences for certainty, provide resources in return for first crack at repayment before anyone else. (They get a lower average repayment than equity holders get.) Employees, customers, suppliers, the government – they all strike deals for portions of the fruit of the project; deals they consider advantageous given their beliefs and preferences. The more disagreement among stakeholders, the higher the total value of the project, so the more resources can be gathered, so the more economic growth.

Unfortunately, presenting the same project in different ways to different contributors makes the job of financial management pretty similar to fraud, which is why honest and accurate risk reporting isn’t a nice-to-have embellishment of finance, but a core discipline that keeps finance from becoming toxic exploitation. This is why financial risk managers need steely resolve in the face of opposition from powerful and knowledgeable – and well-intentioned – stakeholders who legitimately disagree with the risk manager’s view.

**Avoiding fraud**

Honest financial professionals scour the earth for people with resources and genuine disagreements. They help those people refine genuine disagreements about beliefs or tastes into mutually profitable trades with others, taking a fair fee along the way in one form or another. This activity is what turns idle resources or consumption into economic growth. The technical term is *capital formation*. Con artists create artificial disagreements, or mislead people into exaggerating disagreement, in order to encourage rigged trades, taking everything along the way. The technical term is *fraud*. Both activities require similar skill sets – a fact that diminishes popular appreciation for financial salespeople.

In a pure fraud, the instigator knows for certain that the project is going to fail. No legitimate disagreements about facts and tastes exist, the con artist deliberately creates false beliefs to separate stakeholders from their resources.
However, the damage from pure frauds is tiny compared to the gigantic failures, blow-ups and scandals when initially honest projects degenerate into frauds. The common denominator of these disasters isn’t greed or personal dishonesty or bad regulation or any of the other usual suspects. From Hegestratos in 300 BCE (and no doubt many unrecorded before him) to Enron in the 21st century (and many afterwards), a breakdown in communication of accurate, transparent, independent risk assessments is what turns legitimate finance into gigantic debacles.

For financial risk reporting, giving in a little here and a little there isn’t the grease that keeps things running smoothly, but the oil on the slippery slide to disaster.

**Distinguishing fraud from finance**

I have known a few confidence criminals in my life, as well as a number of honest but foolish people who caused financial disasters. One characteristic shared by both types is the ability to convince themselves of the truth of their schemes. The main difference is that the criminals know they’re doing it.

You can see it in movies like *Boiler Room* or *The Wolf of Wall Street*, which are mixes of fiction and fact, but which capture well the energetic persuasive charm of people pushing investments that are strongly rigged against the victim, and who are half-persuaded of their schemes even while duping others. These people don’t deal in complete fabrications, but in a hazy netherworld of slippery partial truths.

One consequence of this fact is that confidence criminals nearly always seem to fall victims to other people’s frauds, or invest heavily in dubious financial schemes. Philip Stoller is the father of a good friend of mine, and is perhaps the most famous securities fraudster of the 20th century (since eclipsed by Bernie Madoff in the 21st century). Phil is the central character in Murray Teigh Bloom’s bestseller *From Rogues to Riches* published by Putnam.

I met Phil after he was released from prison, and he taught me a lot about both fraud and financial salesmanship. One of his most memorable stories concerned a mining penny stock fraud he organised with the financial backing of a bunch of Canadian mobsters. Granted, *Canadian mobster* does not have the same connotation of ruthless brutality as certain other nationalities, but these guys were ruthless and brutal enough to scare Phil pretty thoroughly, and he was not a timid man.

The fraud was a classic pump-and-dump: Phil bought a defunct public mining company for $300 Canadian (about £150 or $240 US) and found a genuine, if slightly cracked and extremely naïve, mining engineer to do some work for $1,500 (also Canadian, about £750 or $1,200 US). The point of the engineer was to have just enough of a real business to argue that the scheme was a highly optimistic mining venture, not a fraud. Also, the engineer had a decent résumé and a convincing manner if you didn’t speak to him for too long.
Working through a network of dishonest brokerage firms and illegal boiler rooms, Phil started selling shares, first at ten cents a share, and slowly moving the price up to $5 (about £3). If any investor wanted to sell, there were registration delays or other issues to prevent it. However, with the steadily rising price and manufactured good news, there were always more buyers than sellers. In Canada at the time, it was easy to disguise the number of outstanding shares in a company, so investors who thought they were buying one-tenthousandth of the company were actually getting one-ten-billionth, although that didn't really matter because the company was worthless.

The plan was to sell about a $1,000,000 (£600,000) worth of stock, with the profits split equally between the brokers and Phil's backers. The plan, however, exceeded expectations with seeming insatiable investor demand and ever higher prices. By the time the take had exceeded $5,000,000 (£3,000,000), Phil discovered that the enthusiastic buyers were none other than his organised crime partners who had somehow managed to convince themselves of the value of the fraudulent company they were supposed to be trying to sell. After hearing the sales pitch, though, and seeing the price move inexorably upward, they were unable to resist jumping on the bandwagon, despite being the scammers. This kind of thing is remarkably common in the murky underworld of securities fraud – it's sometimes hard to tell the wise guys from the marks.

Phil elected to take a long vacation with no forwarding address rather than explain the situation to his backers.

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**Owning up to your role as risk manager**

If you choose a career in risk management, you will be involved in some financial disasters. If that weren't true, they wouldn't call it risk. I hope none are Enron-sized, but even little ones are hugely painful and scary. They threaten your equilibrium and judgement and confidence. Champion heavyweight boxer Mike Tyson may not be known for his wise life choices, but he could have been speaking for any risk manager when he said, ‘Everyone has a plan until they get punched in the mouth.’

Of course, you'd love to be the hero who prevented the disaster, but that's an unrealistic goal and also not your job. Failing that, you'd like to be able to say that you envisioned the possibility of the events that caused the problem, and informed all the stakeholders, and generated consensus contingency plans. That is a realistic goal, and it is your job, but you won't always succeed. What you have to resolve to be able to say is that you always took an honest and independent view of the risk, communicated it clearly and took reasonable precautionary steps given your view. You may have been wrong, but you were honestly wrong.
Plan so that you can always honestly say:

- You did not miss problems because you were lazy or unqualified or blinded by prejudice.
- You did not spin communications in deference to powerful stakeholders, no matter how intimidating or impassioned.
- You did not allow different stakeholders to have different ideas of your risk views, however much easier that would have made everyone’s lives. To be clear, stakeholders should disagree, that’s the whole point of finance, but you cannot allow them to disagree about what you think.
- You never downplayed the risks of a plan because you couldn't think of an alternative one.

Unfortunately, following these precepts won’t win you respect outside of the financial risk management profession. I know of many cases in which risk managers adhered rigorously to strict professional standards yet were blamed for failing to predict or prevent disaster after the fact. I know of even more cases in which risk managers who ignored these guidelines were lauded after the fact because they could point to warnings that had been delivered only to stakeholders unlikely to act on them. Insisting on good financial risk reporting can make you unpopular in good times and offers slim protection from criticism in bad times. Only your peers will appreciate your performance. If that bothers you, find another profession. Please don’t take a risk management title and then tell everyone what they want to hear.

Review the preceding bullet points before you write any important top-level risk reports. Write as if this communication is going to be your last as a risk manager – the one that gets endlessly rehashed and debated as you wander dazed through the smouldering ruins of the organisation whose risk you used to manage. You won't always be right and you won't always be lucky, but you have it entirely in your own hands whether you face being wrong and unlucky with professional pride and dignity.
One of the attractions of finance as a field is that unlike jobs like surgeon, military officer or air traffic controller, when you make mistakes, nobody dies. It's only money. But financial risk managers have a larger responsibility than most other financial professionals. A trader makes money when she’s right and loses money when she’s wrong. It’s symmetrical. She can make up for a mistake with a good call. But when financial risk managers screw up, an honest financial business becomes the economic equivalent of a fraud. It may not fit the definition of an illegal fraud, there may be no nefarious individual to blame, but the effect on people’s lives and fortunes is the same as if the entire enterprise had been dishonest. In fact, the effect is likely greater than a deliberate scam because a real financial business with faulty risk management can grow much larger than most overt frauds.

The reason you need so much resolution in top-level reporting is that you’re writing for multiple stakeholders who have strong and diverging beliefs and tastes. You want to make all of them happy – after all, you work for them. Also they’re individually knowledgeable and many are experienced. Collectively, they’ve far more knowledge and experience than you and your staff. Nevertheless, an honest independent risk assessment often makes all of them unhappy and always makes at least some of them unhappy. However, to close with a second Mike Tyson quote, ‘If you're a friend of everyone, you're an enemy to yourself.’ Risk managers can say it even more strongly: if you're a friend of everyone, you're an enemy to everyone, including yourself.

Writing Reports

In January 1997, the US Securities and Exchange Commission (SEC) introduced extensive new rules requiring public companies to include more specific and thorough risk information in quarterly and annual reports to investors. Prior to that time, risk was part of general management discussion, and was written by the financial reporting staff and approved by the chief financial officer (CFO). Risk managers may be consulted on some technical items or asked to supply footnote information, or they may not.

Practically overnight, risk managers took an active role in drafting some of the most complex and useful information in financial reports.
The SEC rule was not the only cause of the change, and it extended beyond US public companies. After about 15 years of sudden disasters emerging from off the balance sheets, and therefore invisible to most financial reporting and management discussion, financial practitioners and regulators awoke to the need for sophisticated and honest risk reporting. The primary investor concern at the time was market risk of derivatives, but the rules covered all kinds of risk, and in the ensuing years the quality and scope of risk disclosure increased dramatically.

Today, financial risk managers are expected to draft regular detailed discussions of risk, which are then made available to all stakeholders. These discussions may be included with quarterly and annual financial statements, quarterly reports from an asset manager, investment updates for private ventures or other documents. Although this inclusion is undoubtedly a good thing in general, integrating technical risk information with legal requirements is a significant challenge, the hardest of which may be making it all readable.

**Writing with lawyers**

Your job is complicated by the facts that you’re not handed a blank sheet of paper and that everything you write goes through layers of painstaking review. Much of this collaborative effort is with lawyers.

On the good side, the law has been honed by centuries of experience with contracts and disclosure. A simplified way of thinking about it is that lawyers try to write the words that minimise the chance of lawsuits if unexpected events occur. That’s not exactly what they do, and not all lawyers try for that, but the simplification is a useful approximation to keep in mind when discussing risk reporting with them.

A lot of overlap exists between the legal goal of reducing lawsuits after the fact and the risk manager’s goal of making all stakeholders understand the range of potential events before the fact. However, important differences are evident as well. A risk manager can benefit from constructive engagement with lawyers when writing the risk section of a disclosure, but she also has to maintain defences against excessive legalisation.

Be aware of the differences between what you, as a risk manager, want to
You want your reports to be read and understood by decision makers among all stakeholders. That rules out using jargon, fine print, over qualification, boilerplate. You won’t win the battle to eliminate all these things, but you must fight to keep them to a minimum.

Inexperienced risk managers often begin with a plain English, forthright, simple text, which then gets edited into mush. You’re better to start with the best example you can find of disclosure – from your own organisation or a similar one – and adapt it for the information you want to report. If you start with a draft that everyone, including the lawyers, can live with, you’re likely to end up with a better final product than if your first proposal is in a completely unfamiliar format. You also save a lot of time and energy.

Your concern is with the decisions people make after reading the disclosure, not the lawsuits they may file after something bad happens. This distinction means avoiding disclaimers too extreme to affect anyone (such as the ‘not to be used in any situation where human life or property is at risk’ in the ‘Roping lawyers’ sidebar). Instead, you need to include the objective and quantitative information that supports rational decisions (such as the total amounts of life and property protected by ropes, and the main reasons that ropes fail, with frequencies).

Lawyers care a lot about assigning fault. Many disclaimers aren’t statements about degree of risk, but assessments of blame if something bad happens. Risk managers care about outcomes, not culpability for them.

Lawyers are usually at great pains to avoid predictions of any sort. The overarching message of many legal disclosures is that anything is possible; nothing should be relied upon. Risk management is based on constant, explicit, objective prediction with rigorous validation.

If you understand these differences, you can work in creative tension with lawyers to produce risk disclosures that satisfy both of your professional...
standards. I don’t say this task is easy to do – it requires both assertiveness and flexibility. You must be a clear thinker, a good writer, a fair negotiator, and you must really understand the risk. You need the respect of the organisation, and it helps a lot if they’ve hired good lawyers. However, whatever your strengths and weaknesses, you have to try your best because this task is among the most important tasks of a risk manager.

Roping lawyers

I recently bought a rope that had a fine-print warning on the package: 'Not to be used in any situation where human life or property is at risk.' That pretty much rules out any non-ornamental use. This rope was not brightly coloured ribbon or decorative thread, it was a nylon diamond braid kern mantle rope with parallel core – the rope of choice when your life depends on it not breaking.

This story illustrates one of the problems with lawyers gone wild, protecting one stakeholder (the manufacturer) rather than giving useful information to anyone. I also suspect that the warning would have little weight in any actual suit over harm from a defective rope – the warning is too extreme to be taken seriously.

In finance, lawyer-like tendencies sometimes lead to long lists of generic risks without any effort to rank or explain nuances or do anything else that may help someone.

The rope came with a paper insert that had tons of useful information about choosing and using ropes. Yet it was also a poor model for risk disclosure, because it treated only likely outcomes. It was useful, but it was not about risk. Also, it was aimed solely at the rope purchaser/user, it was much too detailed to be useful to a third party stakeholder to any project involving the rope.

So how would a financial risk manager report on a rope? Well, she would do two things:

✔ Establish quantitative estimates of the range of outcomes, focusing particularly on the left tail – plausible but unlikely bad events. Project stakeholders would have some idea of the distribution of losses from routine rope failures, and would be alerted if actual losses were too high, suggesting an underlying problem.

✔ Describe total exposure to rope issues. It's not likely that the total exposure would be affected much by idiosyncratic rope failures. Instead, large potential losses would likely result from systemic problems such as a poor choice of rope type, or buying from a manufacturer with poor quality control, or using the rope inappropriately.

What a risk manager wouldn't do is try to list every bad thing that might happen with any relation to any rope. She would not provide stakeholders with information to support cost-benefit analyses. Instead, she would describe fully and clearly her view about the rope-related risks to the project.
Because risk disclosure is quantitative, it involves considerable interaction with accountants. Within the company, internal auditors, controllers and accountants supply much of the information you use to make risk judgements, and all three groups contribute directly to risk disclosure. Moreover, the external auditors have a lot to say about risk disclosure and outside consulting firms with accounting risk experts may be involved as well.

As with lawyers, useful overlap between risk managers’ and accountants’ professional standards and goals is evident, but important differences as well:

- Both are dedicated to gathering accurate quantitative information and organising it in a meaningful fashion.
- Both respect rigorous validation.
- Both have deserved reputations for near-obsessive focus on accurate detail and immunity to hype.

The essential difference between accounting and risk management is the accounting insistence on consistency, which necessarily entails accounting fictions. For example, the balance sheet has to balance. In order to accomplish that, numbers with no basis in reality have to be plugged in, side-by-side with objective, measurable values. Although no one likes doing that, the alternative is to allow inconsistency, which in turn would destroy the discipline that a complex business needs, both in order to run efficiently and to maintain honesty.

Risk management has no need for consistency, and it abhors all fictions. Risk management is ‘just the facts, ma’am,’ and if the numbers don’t add up, they don’t add up. Accountants sometimes push risk managers to use accounting reporting units as subtotals in risk tables, even when risks cut across reporting units and another breakdown is more informative. In the accounting world, the same risk can be reported entirely differently depending on administrative categorisations (this situation is also often true in the legal world).

Consistency also results in some of the most important risks being invisible, or at least relegated to supplementary disclosure without links to other information. Risk has to care about all risks, whether they’re on
or off the balance sheet. In fact, risk on balance sheets tends to be the simplest and best understood. The profession of financial risk management exists mainly due to the other stuff.

Another aspect of consistency that conflicts with risk is that consistency can be achieved only at a specific as-of date, which usually must be some time in the past in order to collect all relevant information and fix errors. Thus, accounting not only concentrates on the past, it describes a past that never actually existed in the sense that by the time all the information became available, it was out of date. This retouched snapshot can give clarity for understanding the business model and its past results, but it misses the dynamic features that define the risk.

Fortunately, working constructively with accountants is usually easier than working with lawyers. I seldom have trouble getting accountants to understand why I want to deviate from accounting conventions in my risk disclosure. They may fight me, but we both understand the issue the same way, we just disagree on the relative importance of consistency. With lawyers, on the other hand, difficulties usually stem from differing worldviews than from substantive disagreement.

**Talking with disclosure specialists**

The other main group of people that gets involved with top-level risk disclosure is the *disclosure specialists*, people who know the rules about disclosures and specialize in writing them but who rely on others for the specific factual information. These people may work for the chief financial officer in a public company or form a group that reports to the head of business development. Alternatively, they can be scattered among other groups including legal, compliance, marketing, accounting and public relations. Top decision makers, including business heads and CEOs, often inject themselves into discussions. To all these people, risk disclosure is one small part of a vast disclosure project.

![Technical Stuff](image)

In my experience, disclosure specialists rarely bring useful input to the table. Unlike lawyers and accountants, no long-standing profession of financial disclosure specialist evolved and developed important knowledge. (By the way, many disclosure professionals are lawyers – by
training if not by practice – but even the ones who are lawyers seldom think in lawyerly terms.) Financial disclosure was basically imposed upon unwilling public company executives by regulation and owes more to political battles than sensible communication standards or transparent honesty. When in place, it developed some good standards as investors became more assertive and sophisticated. Subsequently, disclosure departments spread beyond companies that issue public securities. However, it has never matured into a field with useful foundational principles. Nor is it a profession with the discipline to resist bad ideas or build wisdom from accumulated mistakes. Moreover, the top-down rules change too frequently and dramatically – and without sufficient input from practitioners – for evolution to improve things.

The good news is that disclosure professionals seldom have substantive information to challenge your views. Their focus is the effect of your words, not on their accuracy or relevance. Only the most timid risk manager fears pressure from people armed only with opinions about effects. That’s not to say that you never give in to their requests, but you never give in on anything important. Even if the CEO of the company directly orders you to make a statement you consider misleading in formal disclosure, you should have no problem refusing (and the CEO isn’t going to directly order you – she’s too smart for that).

The bad news is that disclosure professionals control all sorts of aspects of disclosure you cannot easily fight on grounds of accuracy or relevance. They generally have unfettered control over placement, length, fonts, colour, presentation, headings and other aspects of disclosure. Worse, they’re good at using these things to get their way. Information that is starkly obvious in a table can be buried in an obscure footnote; while information with little relevance can be presented to seem important. No one disputes the risk managers’ unfettered right to disclose risk information, but few people support their right to dictate presentation. Even if you’re willing and able to fight, disclosure professionals may concede a point today, then quietly reverse things tomorrow, then rinse and repeat as necessary. Moreover, you may not even see the final version of the report until it’s already printed.

When you read risk disclosures, look carefully at what information is
exaggerated in the presentation and what is minimised. This activity can tell you more about the attitudes of company management than the words themselves.

**Disclosing Citigroup’s risk**

In the book *Resisting Corporate Corruption* (published by Scrivener Publishing), author Stephen V Arbogast offers a case study of Citigroup CFO Gary Crittenden writing the press release for the bank's second quarter 2007 earnings. If you weren't paying attention at the time, Citigroup was experiencing various financial problems. A little more than a year later, the bank would require a massive federal bailout due to these problems and others.

Crittenden's job was to distil a single number (earnings) and two or three paragraphs of narrative that summarise everything important in Citigroup's financial prospects ... and that also comply with about a million pages of principles, regulations and policies – clearly an impossible job. Even the 150 pages of formal disclosure with thousands of numbers only scratches the surface.

The case study suggests that the ethical thing was to describe the situation in more pessimistic terms. The unstated reason is that things got worse in the second half of 2007 and then in 2008. However, Crittenden didn't know this would happen. He couldn't be completely accurate, that was impossible given the constraints (probably impossible even if unconstrained – think about what two paragraphs you would write today with all the benefit of hindsight to tell the entire story to July 2007 investors). In addition, if he had told the unvarnished truth – that every bank is insolvent in every credit downturn – the share price would have dropped to zero before he finished the sentence.

His choice was to be optimistic or pessimistic. Errors on either side cause harm, but clearly more is to be lost by being pessimistic. Optimism causes new buyers to overpay for the stock, but Crittenden's fiduciary duty was to existing shareholders who lose if pessimism costs them money when selling their stock. Optimism causes too much capital to be allocated to the bank, which is wasteful, but pessimism can destroy all the capital currently invested in the bank, not to mention the jobs of employees, the profits of suppliers and the business of customers. Everyone expects a public company CFO to be optimistic in public, so they discount optimism and overreact to pessimism.

You can't find much ethical dilemma here, other than perhaps agreeing to be an officer of an opaque public corporation with all the inherent conflicts. The question is one of calibration, not truth. Crittenden didn't know the truth and couldn't tell it if he had. There was no set of rules to follow for a safe harbour. Only a lawyer incapable of following the financial statements of a lemonade stand would treat this situation as a simple case of honesty.

**Presenting to Boards of Directors**

Aside from public written disclosures, the other major form of top-level risk reporting is to boards of directors. Many financial businesses have multiple
layers of boards. A public asset manager, for example, has a board of directors for the management entity as well as boards for each of its funds. A diversified financial institution has a board for the holding company as well as for many of its financial subsidiaries. Risk managers are often called on to meet with boards of other companies for various reasons.

The way this usually works is that the risk manager submits written material for the board, which gets extensively edited by lawyers and reporting professionals, and integrated into a board packet. The material is sometimes so complex and extensive that opportunities for review are limited. Moreover, little of the material actually gets discussed at the board meeting.

Therefore, the important aspect of the risk manager’s job is the actual discussion in the board meeting, with both the risk committee of the board (assuming there is one, as is common these days) and the full board. The topics generally are controlled mainly by the lead independent director and secondarily by the risk manager. Occasionally questions from other outside directors determine the direction of discussion. Rarely do non-independent directors take an active role, and a wise risk manager discourages that type of involvement. Non-independent directors should get their risk questions answered in other venues and participate in board risk discussions mainly to answer questions from independent directors. (Of course, after the risk manager leaves, open season on all topics of major strategic concern, including risk, starts).

One important rule is never to use a board presentation, written or oral, as a way to protect yourself from future criticism. Don’t slip in cryptic or low-key warnings that you can point to if anything bad happens. This kind of thing completely undermines the governance of a board. If a risk rises to a board level of concern, say so clearly and forcefully. If it doesn’t, leave it out. Similarly, don’t present the board with non-actionable warnings. Don’t tell them what to worry about, tell them what the risks are and how those risks are being managed.

The most generally useful information the risk manager can give the board concerns the goals and day-to-day functions of the risk
department. What are you watching, and what do you do about what you see? Give a lot of specific detail and examples. Emphasise when decisions change due to your actions, and when they do not change. Explain what you really worry about, and what you don’t – not what you think people think you should worry about. Give sober and honest assessments of what you can do, and what you cannot do. Remember that the board is at least as interested in the quality and attitude of the risk department than it is in the department’s specific opinions about risks.

Another common approach among risk managers I do not endorse is when the risk manager picks a small number of risks that really matter, and spends her board time quantifying them. This approach leads to an impressive technical presentation, and it may help the board understand the business. I don’t like it because I think that the important thing for the board to understand is how the organisation manages risk, not exactly what those risks are or precisely how big they are. Of course, if any risk is so large that the risk manager feels it rises to the level of board concern, then it has to be raised; but in a healthy organisation the CEO leads that discussion.

Treat board meetings as a continuing educational process not a periodic reporting of facts. Use the events of the quarter (or whatever period the board meeting covers) as case studies in specific risk management tools and techniques. Emphasise the weaknesses as well as the strengths of the risk management strategy. Don’t let the board develop unrealistic confidence in your power to predict or prevent disaster. You have limited face time with the board, and your contribution to the board packet won’t have much influence. Don’t try to cover too much ground in each meeting. Rather, go into enough depth on a few big topics to teach important risk management principles.

**Incorporating Feedback**

This final topic is the one most often neglected. Communication should be two way. Don’t spend all your effort writing the material and then ignore what happens afterwards. One of the best ways for a risk manager to find out
about stakeholders is to observe how they react to risk disclosure.

One fruitful source of information is equity analysis and news reports of the risk. If they distort your information or focus on the wrong aspects, see whether you can revise your presentations so people hear the message you want to give. Also, don’t neglect to consider that the problem may be with your message, rather than how you crafted it. Maybe you’re the one who misunderstands the risk.

Another important exercise is to read past risk disclosures, written by both you and others, in light of subsequent events. How would you want to rewrite them in hindsight? This review can be an excellent way to sharpen your risk disclosure skills.

The best source of feedback is face-to-face meetings with stakeholders. Of course such meetings happen naturally with board presentations. With written disclosures, you have to make an effort to find feedback. When you meet with stakeholders, ask whether they read the risk disclosures. If they did, find out whether they understood it the way you meant it, and whether it was useful to them. Encourage them to air disagreements and make suggestions for improvement. If they didn’t read your opus, find out how to make it useful enough to them so they do read it.
At my last count, national governments had established 206 major financial regulatory organisations, from the Afghanistan Bank to the Zambia Securities and Exchange Commission. No doubt others have sprung up by the time you read this book. This total does not count supranational entities like the Bank for International Settlements, subnational entities like the New York State Insurance Commission, quasi-governmental organisations like the UK Panel on Takeovers and Mergers, self-regulatory organisations like the US Financial Industry Regulatory Authority and private regulatory groups like the UK British Bankers Association.

I can’t cover everything a financial organisation has to do to satisfy all of these regulators because

» I only know a tiny fraction of that answer.
» It would take many, many books of this size.
» It would be out of date before the ink was dry.
» This job falls to the legal and compliance departments, not risk.

I explain some general principles about risk management of regulators and cover the important areas of overlap between risk and regulation.

Looking at Regulators and What They
Before dealing with a regulator, you must establish two things:

- Whom does he work for?
- What is he trying to do?

The answer to the first question may seem obvious, ‘He works for the government.’ But that’s often not entirely true. In the simplest case, the regulator is a government employee, working for a government agency, established to administer and enforce statutes enacted by the legislature.

Often the most powerful regulator in a country is its central bank. Although legal forms vary, usually a strong degree of independence is evident between the central bank and political institutions.

Financial regulation is often delegated to quasi-government organisations that can be called panels, or commissions or something similar. Typically these organisations are created by the government, but have no direct legal authority and are funded by user fees assessed on the regulated institutions. If regulated entities challenge their decisions, the regulator may have to go to court to force compliance.

Powers are sometimes delegated even farther to private entities known as self-regulatory organisations. These organisations are financed, organised and run by the institutions being regulated under a degree of government supervision.

Finally, private organisations without specific government supervision regulate markets. Although compliance is theoretically voluntary, it’s nearly impossible to do business in many areas of finance without following the rules set down by these regulators.

In answer to what a regulator tries to do, most regulatory organisations work to accomplish one or more of the following goals:

- Maintain bank stability, such as the Bank for International Settlements
- Protect consumers, which the South African National Credit Regulator
does

- Regulate economic factors, primarily with respect to inflation and economic growth, for example the US Federal Reserve System
- Prevent losses to government insurance programs, such as the Canada Deposit Insurance Corporation
- Protect pensions, for example the European Insurance and Occupational Pensions Authority
- Raise money to fund the government, such as the US Treasury
- Ensure smooth and honest market functioning, such as the European Securities and Market Authority
- Attain non-financial goals, such as fighting terrorism and organised crime, like the International Criminal Police Organisation (Interpol)

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**Creeping regulation**

Working as the risk manager of a hedge fund, I had a routine audit in 2007 that consisted of three lawyers asking me basically two questions: 'Are you defrauding your investors?' and 'Are you cheating in the markets?' They satisfied themselves that both answers were 'No', and they went away.

Fast forward three years, during which there was a financial crisis and a massive expansion of financial regulation. In the 2010 routine audit there were more lawyers, but also other types of professionals and experts. They had a much wider range of questions.

Afterwards I was chatting with the head of the group and I said, 'You guys asked the same questions that our investors do when they come in to do due diligence. It's as if you're not asking if our funds are legal investments, you're asking if they're good investments.'

He laughed and said he sometimes thought the same thing. 'We used to care about whether or not you were breaking the law. Now we have pressures to look for anything that anyone may object to at any time in the future.'

I don't know if this change in permanent. If it is, regulatory dealings will become more complex and overlapping.

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**Forging Relationships with Regulators**

As I write in almost every chapter, good risk management is mostly avoiding bad risk management. As a risk manager, you need to worry more about rooting out bad attitudes toward regulation than having a proactive regulatory
Regulators are stakeholders, no different from customers, equity investors, creditors and other people with interests in your financial institution. Sometimes they represent your customers, as with investor protection agencies; other times they represent the broad social interest in fair and efficient financial markets. Alternatively, they can represent the government’s interest in raising money to cover deficits or avoiding losses on deposit insurance. Sometimes regulators have specific policy goals like affordable housing or secure retirement accounts. Any of the above make a regulator the officially appointed agent of a stakeholder.

**Checking your attitude**

Your job as risk manager is to present all stakeholders with the same accurate view of risk, and to encourage consensus about the type and level of risk the institution should take and the contingency plans to put in place. Your job isn’t to lecture stakeholders about what they should want.

You’re free to like or dislike the stakeholder group represented by the regulators you have to deal with, and you’re free to have opinions about how the group’s interests should be represented. But keep your likes and opinions to yourself when dealing with regulators as they’re irrelevant to the issues at hand.

Avoid these four common bad attitudes toward regulators:

- ‘**What’s the fine?**’ This attitude is how many drivers treat a speeding ticket: they drive the way they want and treat the police officer who pulls them over for speeding as a nuisance to be paid off, not as a stakeholder in highway safety. Similarly, some financial professionals want to run their business as if it were unregulated and pay lawyers and compliance people to make it legal, or at least to keep the penalties at a manageable expense level. This attitude may or may not be the most profitable way to run a business in good times, but it leads to staggering disasters in bad times.
‘I’m not hurting anyone.’ It can be frustrating when you have a nice, profitable financial business that satisfies your customers, and a regulator either forbids it or tells you to run it differently, or even just asks for a million pages of information about it. As a political argument, I have sympathy for this attitude as I believe that most governments are too quick to interfere with voluntary transactions among consenting adults. But as a risk manager, you have to recognise the legitimate stake the government has in both the financial system in general and your business in particular. If you don’t like the government’s attitude, change it at the ballot box, don’t take it out on regulators.

‘You’re not smart enough to get a real job, you can’t understand my business.’ People become regulators for a variety of reasons, some good, some not so much. Some regulators are really smart, some not so much. Neither issue should concern you. Your job is to help regulators understand the risks of your business and to find out from regulators how these risks fit into the bigger picture from the regulatory perspective. Some regulators make this job easy because they’re cooperative, hard-working and smart. Other regulators make it hard because they’re antagonistic, inattentive or less smart. But hard or easy, your job as the risk manager is to establish productive bilateral communication, not to blame the regulator.

‘Just follow the rules.’ This attitude is the lazy way to do business and it can lead to disasters as bad as ignoring the rules. Regulators are only one stakeholder and the institution has obligations to customers, investors, employees and others as well. Everyone has to work together for success. Sometimes the rules are wrong. Even when the rules are right in general, they can lead to a dangerous monoculture where everything fails at once. Risk managers should fight to preserve diversity and innovation, even when that’s disreputable (and the most valuable diversity and innovation generally is disreputable). Even the best-defined rules create grey areas. Sometimes the interests of your customers or investors require you to navigate the grey areas rather than erring on the side of caution. If you avoid risks for fear of being criticised afterwards, you should find another profession.
If you can steer your organisation away from these bad attitudes and nourish a culture of constructive, transparent, bilateral engagement with regulators, with tolerance for principled disagreements, you’ve done 80 per cent of your job.

**Being prepared and positive**

Anticipating what regulators want to discuss usually isn’t difficult. If there have been dramatic events either at your firm or in a similar firm, it’s likely regulators will want information about related matters. If you follow regulatory press releases and speeches of senior people, they can provide useful clues. Speaking to risk managers at other firms is another good source, along with simple common sense. Finally, regulators often tell you the purpose of a call or visit, and if they don’t, you can always ask.

Making the effort to anticipate the questions and gather the appropriate material can do a lot to foster good relations. And don’t limit yourself to what you think the regulators are going to ask. If you have useful thoughts about what they should ask, most regulators will be grateful to hear that as well. It’s just smart salesmanship to tell your story your way rather than forcing regulators to drag it out of you with repeated cross-examination. You may be able to delay giving regulators bad news by being unprepared and stalling, but the damage you’ll do to your relationship is costly. Unless the news is so bad that you should hire a lawyer and shut up, you’re always better off being prepared and proactive.

Also strive to be positive. You’ll never have a perfect story, but that’s no reason to be defensive. If you or your firm has made mistakes, say so clearly, and explain what you’re doing to fix the damage and make sure they won’t happen again. If there are problems with your processes, point them out along with your plans for improvement.

Of course, you don’t have to carry this to extremes. You don’t have to bring up anything that might possibly concern a regulator; the meetings would last forever and create lots of future work. My personal general rule is that if something is going to come to a regulator’s attention sooner or later, better to
bring it up sooner and frame it the way that makes sense to you. You get points for honesty and sparing the regulators from unpleasant surprises, and it’s easier to deal with things before they get too big. But until you’re confident that an issue will rise to the level of regulatory attention, bringing it up can be just opening a can of worms, causing both you and the regulators trouble, without benefit to anyone.

Although anticipating is good, don’t let it get in the way of listening. Listen carefully for nuance, and pay attention to what the regulators don’t say. Regulators aren’t always able to say things outright, and their hints can be valuable. Also you don’t always understand exactly what they’re looking for; careful listening today can prevent major misunderstandings tomorrow.

Some regulators will make your life easy by being prepared and positive themselves and by listening to you; others present bigger challenges. But even if a regulator is completely unprepared and out to get you, you can’t win by responding in kind. You still should be prepared, positive, honest and attentive. Doing so may not make things good, but anything else will make things worse.

### Managing disaster

I was walking into a meeting with federal bank regulators, being briefed frantically by a guy at my elbow, whom I didn't know. 'The bank president will handle all the questions,' he told me, ‘but as chief executive of the holding company that owns the bank, the regulators will want to meet you and be sure you’re honest and competent.'

Technically I wasn’t the CEO, I was running this mid-sized diversified financial services company as a representative of the board of directors, and I had held that position for less than an hour. In a brutal day-long meeting, the board had fired the company founder and kicked him and his allies off the board. For complicated governance and legal reasons, they couldn’t hire a replacement CEO for three weeks, their only alternative was to run the company directly. They brought me in as a special consultant to do that.

The guy at my elbow continued as we walked, 'The bank got a rating of four last quarter, meaning generally unsafe and unsound. The only lower rating is a five, extremely unsafe and unsound, which means they shut the bank down. We promised we would clean up all the toxic assets and pay down debt, instead we borrowed more money and doubled the toxic assets. The bank is losing money but there’s one good thing that you have to emphasise. It’s our only hope of keeping the bank open.'

I really didn't need this. I was juggling multiple potential disasters. The holding company had been missing margin calls from half a dozen Wall Street banks for weeks; any one of them could pull the plug without notice and the entire company would collapse. Losing the bank would be also be fatal. The founder and his buddies were in the corner offices strategising
with lawyers about how to get the company back, while investigators from four different federal agencies were in the building looking at documents to try to put the founder and his buddies in prison. I was camping out at a cubicle trying to persuade the employees to ignore the founder, who had been their boss for over a decade, in favour of a guy they had never met, appointed by a board of directors the employees were only theoretically and vaguely aware existed.

‘What's the good news?’ I asked, without much hope.

‘The bank is the leading provider of credit card services to phone sex companies in the region, and that division will make a million dollars profit this year… . Hold on a second… . I just got an email from the bank president. He has suddenly discovered the phone sex business is an accounting fraud and the business actually lost a million dollars. He's resigning and leaving town immediately.’

This was the worst set of facts I ever had to present to regulators. I had to tell them the bank would probably fail, either on its own or brought down by the holding company, or both. I told them I had no idea of its true financial condition, only that the numbers in front of them were almost certainly wrong. The only question was whether they would let me try to clean up the bank and sell it to someone solvent and honest or whether they would take over that job themselves.

In the end, they let us keep the four rating on the bank. I held the company together for three weeks, and delivered it to the new CEO who turned everything around over the next seven years. The moral? Good facts are nice to have, but honesty goes a long way with regulators. I hope you always have a better story than this one to tell when you meet with regulators, but even if you don’t, there’s always hope.

Note: This story was compressed and simplified to make a point, but it really happened.

**Banking on Basel**

The practice of finance was comprehensively re-engineered from the mid-1980s to the mid-1990s. Part of this process was an entirely new concept of financial regulation that came to be called *Basel* after the city in Switzerland that’s one of the headquarters for the Bank for International Settlements. The framework was codified in three successive accords, known unimaginatively as *Basel I*, *Basel II* and *Basel III*, as well a huge number of long and complex related documents.

I can’t take you through all the ins and outs of this massive body of work, but you need to understand a few key principles, both because they underlie a lot of modern financial risk regulation and because they’re important ideas in their own rights.
Cheering for the unsung heroes of Basel

I did a lot of Basel work, mainly in the early period from 1986 to 1995, but I kept a hand in later and know many of the key workers. Although the accords have a mixed – at best – reputation outside the financial risk management profession, I consider them to be an incredibly inspiring story. An awful lot of the good things in the world are done by altruistic and cooperative groups of technical experts operating below the radar screen of politics, ideology and punditry.

No heroes of Basel stand out. Hundreds of academics, practitioners and regulators gave many years of their professional lives to forge the accords, not one of them is famous for it. Their efforts did not lead to career advancement, pretty much all of them would have higher rank and more money today had they passed up the Basel project. They did it because they believed in it, because it was the right way to regulate risk.

The energy for Basel was middle up; it came from working technical experts, not heads of institutions, politicians or grand theorists. The extent of the work is staggering. It required a thorough re-examination of all kinds of financial risk with all the messy details of real institutions, real people, real laws, real data (and real data errors). This kind of hard work is what lots of smart people avoid, but it also required the deep thinking that many hard workers avoid. And, most of all, it required ability to communicate and to reach consensus with all types of people all over the world, things a lot of quantitative experts find difficult.

Using the Use Test

A key principle enshrined early in the Basel process became known as the Basel Use Test. The test is simple: any risk number reported to regulators or other external parties should be one that the institution actually uses in its risk management decisions. You can’t, however, just say, ‘Sure, we use that.’ You should be able to document when and how you use it and demonstrate that real decisions were made on the basis of the number.

This may seem obvious, but non-risk information isn’t conveyed in this way. A company makes internal decisions using cost-accounting numbers, reports to investors using financial-accounting numbers and pays taxes using tax-accounting numbers. Also, there can be multiple instances of all of these systems, plus other forms of quantitative reporting. It’s perfectly possible for a company to have a good year by its internal systems designed to capture economic reality, but report poor accounting earnings to investors and report an entirely different number to tax authorities.

Why is risk different? The main reason is that a primary goal of risk management is to achieve consensus from all stakeholders. The primary goal of accounting is to report truth, according to accepted rules, and let each
stakeholder interpret that truth. But risk is essentially an opinion – no objective truth ever exists except in certain narrow circumstances. Everyone exposed to a risk must know how it is to be managed, which in turn means that everyone exposed to a risk should know the risk manager’s opinion about it.

An important side advantage of the Use Test is that you make sure that the numbers you use in risk management are right, and that when they change, you know why.

An annoying part of a risk manager’s job is when a regulator or investor calls up to ask why some number he doesn’t use is whatever value it is or why it changed. Because he doesn’t use that number, he generally doesn’t know the answer. It’s a mechanical exercise to answer such a question and not something that adds to your understanding of risk. And the answer is sometimes that it’s a data error that no one caught because it’s a number no one cares about. That’s embarrassing, but nowhere near as embarrassing as if there were an error in a number you used for a risk decision.

The Use Test is an ideal, not a law. No institution lives up to it completely. Regulators, customers, investors and other parties constantly demand specific risk numbers that you have no intention of using in your determination of risk. Resist demands for these irrelevant numbers to the extent that you can but, in the end, if a stakeholder wants information, he has the right to get it, even if you don’t think that the information is relevant for decisions. Also, clearly disclose when you’re providing numbers that do not factor into risk decisions.

**Taming risk IT**

A few months back I was speaking at a risk management convention, and was followed by a panel discussion by the heads of risk information technology (Risk IT) at three major financial institutions. I listened with dismay as all three panellists said in one way or another, ‘When someone asks for a risk number, you have to find out who they are and why they want it before you give it to them.’ Of course, this response is a direct contradiction of the Use Test.

Risk IT departments in global financial institutions can be huge, and the people who head them up have to be exceptional managers and highly skilled at information systems development and the financial and mathematical underpinnings of financial risk management. They do not, however, necessarily have expertise in managing financial risk.
The ethos of corporate IT is service: find out what users want, and give it to them. A lot of IT is devoted to storing information in one form and letting multiple users maintain different views of it. This attitude is great for allowing diverse use of data while keeping core information consistent. But it’s terrible for building informed consensus about reality.

This approach to information has nothing to do with technology. Most of the innovative and exciting stuff done with computers is decentralised and open. The model of a central fully consistent truth that ordinary mortals are only allowed to glimpse portions of comes from hierarchical organisations (and an oppressive Roman/medieval ideology that’s only slowly losing its grip on society), and actually runs counter to the science of information. This model is a gigantic source of risk.

The ethos of risk management is disruptive: force everyone to deal with the range of possible outcomes that appear from any stakeholder’s perspective. If you give everyone what they want, you’re facing disaster. Everyone wants comfort, and everyone wants to work within their own perspective. No one wants to be told worrying things and forced out of their comfort zone. Also, be aware that no hidden absolute consistent truth exists.

As a risk manager, this culture conflict is something you have to deal with. My preferred solution, after many years of trying many different arrangements in different institutions, is for risk IT to be part of firm-wide IT, but to be directed day to day by the risk manager. The risk manager isn’t one user among many, but the single user.

I don’t like having IT professionals report to the risk manager as it limits career development of risk IT staff and hurts cooperation with firm-wide IT efforts. Technical experts generally dislike reporting to a boss who is a technical expert in a different field – and for good reason. But I also don’t like having risk write detailed specifications for its projects and have them managed in a general IT queue. Risk IT really is a specialty that needs dedicated resources that own the risk systems.

**Adjusting for risk**

Another early decision that underpins Basel is reliance on risk-adjusted numbers. Consider a simple rule, such as one that states that for each one pound in deposits a bank is allowed to make six pounds of loans. The obvious problem with this rule is that it makes no distinction between a diversified portfolio of high-quality loans and a single, low-quality loan. In fact, it encourages perverse risk-taking behaviour because if the bank is constrained by the amount of loans it makes, it has an incentive to search for the highest-yielding loans, which generally are among the riskiest.

Of course, you run into problems with risk adjustment as well as it may not be done properly due to either honest error or deliberate mischaracterisation. In particular, three common errors made in risk adjustments are

- Looking backward: You don’t adjust for the risk a portfolio evidenced in
the past, you adjust for the risk you foresee in the future.

**Adjusting to everyday risk:** People sometimes adjust based on the common, everyday moves in market value of the portfolio. These are irrelevant. What you care about is risk during times when the institution is stressed. There’s a saying in finance, ‘In a crisis, all correlations go to one.’ That’s an exaggeration, but one with a grain of truth. If you estimate the risk reduction from diversification looking at normal times, you’re likely to place too much faith in how much it helps you in bad times. Similarly, complexity is seldom a problem on normal days, when everything works seamlessly, and no one at a high pay grade minds glitches. On the bad days, complexity can kill.

**Focusing on volatility:** The ups and downs in market value of a portfolio is only one aspect of risk, albeit an important one. Other characteristics, such as liquidity and legal certainty, must factor into risk adjustments.

However, even if you avoid errors, risk adjustment is still a matter of opinion. Two intelligent, experienced, careful analysts can come up with significantly different adjustments. Much of the work in developing the Basel accords consisted of coming up with systematic standards for risk adjustments across all product types and businesses. It used to be quite common to find that different firms differed by more than two to one in their assessments of the same positions.

These differences bother people who think that an ideal risk number can be found and that the purpose of regulation is to come up with a magic set of rules that can prevent bad things from happening. Grown-ups look at it differently. Risk is a judgement about the future, not a fact about the past, so there will never be complete agreement about it. Risk adjustments lead to productive conversations focusing on real economic risk, and stimulate the development of consensus around risk decisions. These conversations don’t prevent bad things from happening; they just make it more likely that any bad outcomes are the result of careful decisions, communicated to and approved by all stakeholders.
For example, in a risk-adjusted world, a regulator may challenge the benefit a risk manager assigns for diversification. The risk manager may say that in a crisis the risk of the institution’s portfolio is 20 per cent of the sum of the risks of the individual positions; the regulator may push for 50 per cent of the sum of the risks of the individual positions. This discussion can be useful and may lead to gathering more data and a compromise adjustment. The board and senior management will be interested in the issue. Perhaps most important, real business decisions may change as a result of the discussion, perhaps improving portfolio diversification or raising yield demands.

Without risk adjustments, regulator challenges involve words, not reality. A regulator may claim that a transaction the institution categorises as a lease is actually a loan, or that some offshore entity the firm excludes from consolidated risk computations should be included. This discussion isn’t useful concerning judgements about the future, but a deep dive into words written about the past. Neither the board nor management will have any interest in the dispute, they’ll just ask for expert opinions and not from experts in finance or risk. Any change that results from this discussion affects only reporting, not reality.

Although everyone agrees that notional regulations lead to reporting games, some people think that risk-adjusted reporting just leads to more complicated games. That’s not entirely false – no regulation ever written is completely immune from being gamed. But the scope for creative accounting is much smaller with a rigorous system of risk adjustment.

The Basel process generated a huge volume of highly specific research and forged broad consensus about the proper tools and approaches to use. Moreover, this area of research is active and evolves constantly. That last is important, it means that regulation stays up-to-date with respect to new products and market developments without the regulations themselves having to change. Of course, you get surprises with risk-adjusted rules, just as you do with traditional rules, but the difference is that risk-adjusted rules adjust. No system is always right, but a system that learns beats a fixed system.
As with the Use Test, risk-adjusted numbers are an ideal risk managers strive for, not a complete description of regulatory reporting. Plenty of non-risk-adjusted numbers are still reported to regulators, which of course means that lots of paper transactions are done with no economic substance, purely to comply with rigid rules. A lot of people waste their days arguing about words.

**Validating risk**

Rigorous validation is an essential partner to risk-adjusted reporting. A risk estimate is a prediction about the future, and predictions can be checked. For example, if a firm uses one-day 95 per cent Value at Risk (VaR) on a portfolio, the positions should lose the VaR amount or more one day in 20 – no more, no less – and the days that it loses more than VaR should be scattered randomly in time and be unrelated to the level of the VaR (this is the definition of VaR, which is discussed fully in Chapter 6). Moreover, the VaR should be computed every day before trading begins, even on days when systems are down or markets are disrupted.

When regulators agreed to let firms use internal models to adjust for risk, they properly insisted on validation of those models. Yes, a foolish or dishonest firm may understate the risk of its positions. Even the most careful regulatory review would have difficulty preventing that, given the complexity of large financial institutions. But that understatement would quickly show up in validation, triggering sanctions and also forcing the firm to improve.

One large flaw is evident in this system, however. Validation occurs in the past, that is, the firm demonstrates that its risk estimates were accurate in the past. Disasters happen in the future.

For example, from 2004 to 2009, almost everyone treated Euros issued by different European countries as identical. A risk model that made that assumption would have performed well on validation tests. But starting at the end of 2009 and accelerating in 2010, people began to take the idea of a Euro break-up seriously. This change led to portfolios of European sovereign debt and related instruments to move in ways that many risk models did not take into account.
Things happen that no one thought of, that aren’t in any risk model, that aren’t revealed by any validation exercise. But the key premise of risk management is that the discipline of preparing for what you can foresee helps you survive what actually happens. One kind of fool waits for a perfect crystal ball before taking action, another kind doesn’t bother to think ahead because they can’t possibly foresee everything. Risk management requires working hard to anticipate what you can foresee, and also working just as hard to deal with what you can’t foresee.

Having validated risk models does not guarantee surviving crises, but it does prove that you understand your everyday risk and that you’ve incorporated lessons from historical events. Institutions that cannot produce validated risk estimates, or don’t think that such things are worthwhile, in my experience do not understand their everyday risk and have not paid sufficient attention to history.

**Stressing Regulation**

Rigorous stress testing (discussed in [Chapter 7](#)) was a major part of the early design of Basel Accords, but from the mid-1990s to 2009 it was downplayed in favour of other tools. This downplaying wasn’t a decision someone made for a reason, stress testing just fell out of fashion as more exciting progress was being made in other areas. Institutions continued to do it, and everyone said good things about it, but efforts were often pro forma and more energy was put into generating the reports than to studying them. I don’t recall anyone ever arguing that stress testing should be neglected, and I think that most risk managers passively assumed that it would get attention again at some point in the future.

In late 2008, during some particularly dark days of financial crisis, the US Federal Reserve decided to make stress tests a cornerstone of its campaign to restore trust in US banks. Despite a lot of criticism at the time, the tests were a resounding success. Some of that may have been the luck of coming out in the Spring of 2009 just as markets were bottoming out and preparing for a tremendous run-up, but we’ll never know for sure. Did stress tests help stop
the slide toward a Great Depression and save the global economy? Or did they just happen to be standing around when the wind changed? Probably some of each, but even if the answer is the latter, risk managers of the period still feel a warm glow remembering a solid piece of major good news at a time when good news was rare and precious.

European regulators tried to emulate the US success, but with less determination and only mixed results. Nevertheless, stress testing was the chorus dancer brought centre stage to become a star. By 2011, it had evolved to what the United States called *Comprehensive Capital Analysis and Review* (CCAR). Europe and other jurisdictions are adopting many of the CCAR principles, although so far they’re still using the older stress test name.

I don’t go into all the technical details of a CCAR. The basic idea is that the regulator creates a few stress scenarios and asks regulated institutions to show how they would navigate them while remaining in compliance with capital rules. These scenarios are detailed and powerful tests that stress every item on the balance sheet, income statement and statement of cash flows of financial holding companies.

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**Crediting stress**

At one point in my career, I had the job of designing the stress tests for a financial institution. There were the old, pre-CCAR stress tests. I selected five stress events and singled one out for special attention. Whenever I presented the results, I would tell regulators, senior executives, board members, counterparties, rating agencies and investors, ‘Four of these stress events might occur, but the fifth one, our credit stress event, will happen. Every five or six years a credit downturn occurs, and when the next one happens, we will have significant losses as a result. In fact, every large modern bank is insolvent in every credit downturn, in the sense that it could not liquidate and pay all its creditors in full.’

We decided to calibrate our stress tests to a 1-in-25-year event; that is, we asked, how much does the bank expect to lose if we have the worst credit downturn in 25 years? We then prepared for losses that were twice as large as that number.

In the 2007–2009 financial crisis, the bank actually lost about 2.5 times as much as our pre-crisis stress estimate. I am familiar with the credit stress tests at other institutions and that was a pretty typical result. Does that mean we were wrong? I’m not sure. Maybe the 2007–2009 financial crisis was 2.5 times worse than the average worst credit downturn in 25 years. Or maybe not. Should we have calibrated to a rarer event, 1-in-50 years or 1-in-100 years? Should we have prepared for more than twice the loss of the stress event? Again, I don’t know. The stress loss assumed an overnight hit, the actual event played out over 18 months or longer, giving the firm time to cut positions and hedge (its biggest problem turned out not to be the direct credit losses, but that some of the hedges unexpectedly backfired).
My main point is that the exercise was useful. On the basis of the stress test, we made a number of changes that helped quite a bit when the crisis hit. Working through the scenario was informative and led to productive discussions with regulators and others. By the time we were through, we had a pretty decent consensus on what the firm’s credit risk was, and how it should be managed.

My secondary point is that the stress test was not perfect. I had a lot of resources to work on this, a lot of help. I talked to as wide a variety of people as I could, including people like Robert Shiller and Nassim Taleb who were predicting major credit disasters. I incorporated their ideas, but mixed in other opinions, plus statistical data, plus internal firm models. I’m willing to claim today that the stress event represented the best available consensus expert judgement at the time, or something close to it. Nevertheless, things were 2.5 times as bad, and might have been much worse.

And the problem isn’t just the size of the loss. Some things happened more or less as envisioned in the credit stress test, but other things diverged. For example, we did predict bankruptcies of some major institutions, but instead of some being rescued by governments with no creditor losses and Lehman failing with over 70 per cent creditor losses, we expected 10 per cent to 30 per cent creditor losses at all failed institutions. We predicted mortgage-backed securities rated BBB and lower would lose most or all of their value, but did not predict losses in super-senior corporate credit instruments. I’m not embarrassed by those predictions today, but the bank obviously could have prepared for the crisis better if we had got all that stuff right.

Dealing with Unintended Consequences

I argue that risk managers must treat regulators as legitimate stakeholders. You may think they’re wrong sometimes, but if so they should be educated out of their error, not fought (and you should listen hard to make sure that the regulators are the ones in error, not you). Regulator interests may diverge from other stakeholders. Don’t try to be the arbitrator in these cases; your role is to try to make sure that both sides have the same accurate view of risk so that whatever settlement they negotiate is based on reality, not divergent assumptions.

However, I also warn against accepting regulations as ethical principles. Following the rules in some cases may violate fiduciary duties, or require you to do things you think are wrong or stifle necessary innovation. It obviously requires courage and skill to resolve such situations. All I do to help you is to remind you that regulators are sometimes catastrophically wrong, and disaster is only averted because some brave souls are willing to risk disgrace by
exploiting loopholes and doing regulatory end runs. My examples are all from the United States, but similar stories occurred in most developed country financial markets.

**Regulation Q:** This 1933 US regulation placed a tight limit on the amount of interest that banks could pay on deposits (0 per cent in most cases and a maximum of 2 per cent). The intention was to prevent banks from competing to pay more on deposits, which might encourage them to take risks to earn higher yields on their investments. It wasn’t a terrible idea in gold-standard days when it was adopted, but it had horrific consequences when inflation soared in the 1970s and early 1980s. It destroyed about half of the net wealth of the US middle class.

Most bankers watched this effect happen without doing much for their depositors. But a few brave souls looked for alternatives. The most successful idea was the money market mutual fund, which exploited regulations intended for an entirely different purpose. The important point is that these innovators were fought by regulators, and most were put out of business. All of them risked severe penalties. Eventually, the regulatory consensus shifted (after inflation had broken, however, and the need for the product had lessened) and money market funds were taken under the legitimate regulatory umbrella.

**ERISA:** The Employee Retirement Income Security Act (ERISA) was enacted in 1974 to protect beneficiaries of defined benefit pension plans. Unfortunately, it set the protection levels so high that the plans became uneconomic, and almost all private sector workers lost their plans.

Again, a few people started looking for solutions. A guy named Ted Benna found an obscure provision of the tax code, 401(k), intended for entirely different purposes, that could be used to create a defined contribution pension plan. This development is what saved retirement plans for the private sector.

The reason this example is more complicated is that the original ERISA law was not obviously flawed. It set in motion a dynamic that led to a disastrous outcome, but you can’t find many specific decisions or actions that were clearly wrong. Lots of legislators, regulators and
practitioners worked on this problem – most with talent and good intentions – but in the end it was the maverick willing to exploit a technicality who saved the day.

It’s entirely possible that pension funds would have ended up in a worse place if ERISA had not been passed. So my point isn’t that ERISA was a horrible mistake, but that even sensible and well-intentioned pieces of legislation don’t always work as anticipated (in fact, never work as anticipated). Therefore, preserving diverse experimentation is a must. If regulatory scofflaws are treated as disreputable near-criminals – or worse, as actual criminals – the safety valve that has proved so useful in the past is lost.

The 40 Act: The Investment Company Act of 1940 (the 40 Act) and related legislation created the modern public mutual fund. The 40 Act had a lot of good features, but it effectively outlawed the best investment alternatives for individuals. It enshrined high-fee actively managed stock and bond mutual funds that consistently underperform random selections of instruments and that carry sales loads. Jack Bogle and others had to fight regulators to be allowed to offer low-fee, diversified index funds. Strategies that could beat the indexes were forced to register offshore and allowed only rich people to invest.

Here the complexity isn’t with the original legislation. Despite some good provisions, the 40 Act clearly promoted a narrow – and bad – idea of investment vehicles for individuals. It rewarded sales efforts, not performance, and was based on a statistically incoherent model. It was a great benefit to traditional providers, and it discouraged any competition or innovation.

The reason this case is complicated is that regulation of retail investment vehicles is fiendishly difficult. Products that help sophisticated investors can be traps for everyone else. No one has ever written a law that can distinguish useful financial innovation from fraud – at least not before the fact. Retail investors can often be their own worst enemies, so laws that empower them are double-edged swords. And retail investors have plenty of external enemies in the form of sharks, idiots and well-meaning friends, so they may need shields more than swords.

Therefore, while I can criticise the 40 Act for disadvantaging index funds
and hedge funds, I couldn’t write a better law. All I can say is that finance needs diversity and innovation, so whatever the law is, it should allow for robust experimentation.

The bottom line? Respect regulators, whether you agree with them or not, but always be willing to think outside the regulatory box.

### Changing minds

In 1997, I partnered with Kellogg Business School Rhetoric Professor Martin Stoller to found [eRaider.com](http://www.eraider.com). We were a public mutual fund (the Allied Owners’ Action Fund) with the plan of acquiring 5 per cent stakes in badly managed public corporations then rallying both fund shareholders and other stockholders on the Internet to effect change. Our research indicated that we could reach about 40 per cent of the float in targeted companies that did not have large insider or institutional ownership.

If you don’t know US corporate governance law, this idea might seem like a Mom-and-apple-pie idea; investors taking an active interest in their companies and communicating with management to enhance return. But it set loud alarm bells ringing at the Securities and Exchange Commission (SEC) for a dozen reasons. At the time, the SEC was struggling with traditional scams and frauds – such as insider trading and pump-and-dump schemes – that had found vast fertile fields on the Internet. The SEC has always been ambivalent about activist investors, as in the past many of them have been more interested in gaining unfair advantage over other shareholders than in improving corporate management.

Therefore, a key part of our strategy was to lobby hard. We got a former SEC chairman involved with our company, as well as some of the top academic experts in corporate governance. I met with lots of SEC members from the commissioners on down. We had a simple, transparent business plan. We enlisted allies like the Council for Institutional Investors, which represents the large public and private pension plans and endowments in the United States. We worked with journalists to get extensive coverage.

Midway through this process, I realised that I had made a strategic error. I had approached the problem single-mindedly as an attempt to get the SEC to stay out of our way, as an obstacle to be surmounted or avoided. Instead I realised that the SEC, despite causing some frustrating delays and complexities, was moving in our direction. We got tons of free legal and business advice from staff members, and the SEC protected us from what could have been ruinous lawsuits. The idea could never have succeeded to the extent it did without the active assistance of SEC staffers (eRaider won a pyrrhic victory – the fund succeeded after several years by forging productive relations with corporate management in all target companies, and getting changes that significantly improved shareholder value, but was never able to attract enough investors to cover expenses. eRaider eventually morphed into a traditional private activist hedge fund and closed its Internet operation. A lot of people like shareholder activists, but no one wants to pay for activism.).

Why did we get so much help? eRaider was forcing questions in important areas of financial regulation and SEC staffers were interested in the answers. For some, it was the interest that led them to join the SEC in the first place. For others, it was the desire to learn cutting edge
areas of law for future employment prospects. Not all staffers agreed with eRaider’s business model, but most of them wanted to see how it would develop. The alternative was to have the same questions play out in the shadows.

The moral isn’t to reflexively assume that regulators are rigid obstructionists. That certainly is the case sometimes (and sometimes rigid obstructionism is what protects us against disaster). But regulators change and if you can get on the right side of that change, you can benefit. Don’t automatically blame regulators if you don’t like something. Try to change it and see whether they help.
Part VI
For ten tips on how to master the art of risk management, head to a free article on www.dummies.com/extras/customerexperience.
In this part …

✓ Figure out how to manage risk in ten minutes – not ten minutes to learn, ten minutes to do.

✓ Study dramatic historical examples of risk management and discover how they can apply today.

✓ Start a ten-book reading list to round out your education as a risk manager.

✓ Unlearn ten popular lessons about historical financial disaster, and then focus the right lesson so you can do a better job of risk management in the future.
Chapter 20
Ten One-Minute Risk Management Tips

In This Chapter

- Setting up for success with planning, patience and knowledge
- Paying attention to the right things

As much as I try to simplify financial risk management in this book, I realise that parts of it require a lot of work, including long thought, careful communication and extensive analysis. However, you can do a lot of good in risk management just by taking a minute and doing something simple. Here are ten examples.

Fear the Market

This directive may seem a strange one because to work in finance is to rely on the market for your living. But a sailor relies on the sea for her living, yet she still fears it. If you ever feel like you’ve beaten the market, or that it’s your friend or that you know what it’s going to do stop immediately and gin up some fear! Think over your market failures, or historic disasters or anything else that puts you in the right frame of mind to make financial decisions.

You do not understand the market. You do not own the market.
You’re not important to the market. But the market often understands you, and it owns all your assets and liabilities, and it is important to you.
In those circumstances, a healthy fear of the market is just common sense.

Now you’re not wrong to be courageous. In the 19th-century classic book,
Speculation as a Fine Art, Dickson Watts wrote, ‘Speculation requires prudence and courage; prudence in contemplation, courage in execution.’ Too many people reverse this order and make bold armchair plans, which they carry out timidly.

Plan for Success

When you act, act on the assumption that you’re going to succeed. A common flawed strategy is to wait too long to take a risk and then get into it too slowly. When your strategy seems to be working, you ramp it up quickly to catch up with earlier and more aggressive risk takers. When the inevitable downturn occurs, you find you have much larger exposure than you had during the good times and forfeit all your accumulated profits and more.

Rather than doing that, better not to take the risk at all. If you’re going to take a risk, limit yourself to a prudent amount of study, then plunge in. You don’t really start learning until you start doing. Do the things you need to do if this risk is going to be a long-term success: make the investments in people and systems and reputation and everything else. Pick a reasonable level of exposure, get up to it quickly, and stick to it.

People who plan for success may succeed or may fail, but they exploit their successes for full value. People who plan to avoid failure also may succeed or fail, but they give up much or all the value of their successes without saving much on their losses.

Hire Honest People

This statement sounds obvious, but is often ignored. Of course, everyone knows you shouldn’t hire people who will steal from you, or who will steal from others and leave you to take the blame or who will do other criminal acts. However, those aren’t the people I’m talking about here. I’m talking about people who refuse to face up squarely to reality.

Success in finance, or in any sort of risk taking, requires ruthless self-knowledge and unquestioning acceptance of reality. The human brain is layered with defences against both these things. We find all kinds of ways to explain our actions in rational terms and show us to be good people. Even the
craziest and worst people have no trouble doing this. We also filter and rearrange reality to make ourselves comfortable.

These tendencies are fatal to long-term success in risk taking. Hire people who are unflinchingly honest about themselves and about reality; and who share that honesty. That advice doesn’t just go for hires; it goes for people you work for and partners as well.

On top of that, I once did a study to find common denominators among rogue traders (traders who violated the rules in their financial institutions and caused great damage as a result up to and including failure of the entire institution) and other employees whose dishonest actions crippled their firms. The most obvious correlation I could find is that they all lied on their resumes. The lies were often trivial, but they were there. Of course, lots of people lie on their resumes and don’t commit huge crimes. My belief, though, is that the dishonesty is the fundamental problem. It may not cause a huge disaster, but I think hiring dishonest people for any role involving any kind of risk is a bad gamble.

**Listen Another Second**

As a risk manager, you spend a lot more time listening than talking, but you don’t take much of what you hear at face value. Mostly what people say is information about what they want you to believe – or sometimes what they want to believe – rather than direct information about reality. After they finish what they planned to say, if you keep silent another second, they may blurt out a valuable truth. Even if they don’t, you get points for listening to them closely and perhaps even a reputation for deep wisdom.

This advice doesn’t apply just to people. When a market event hits, you may be tempted to make a quick reaction. This temptation leads to knee-jerk responses – reactions determined by the nervous system without engaging the brain. Most financial institutions already have oversupplies of hair-trigger responders. Risk managers add value by watching the market a second longer, or reading down to the end of the news release, or thinking one level deeper about the meaning.

The composer Claude Debussy said, ‘Music is the silence between the notes.’ I have no idea what that means, but in my experience, a big chunk of risk
management is the extra seconds of silence in between actions.

**Split the Difference**

This one usually works for finance, but not for all fields. If you can’t easily decide between two options, go for half-and-half. If you’re not sure whether or not to get out of a position, sell half. If hedging something is tempting but expensive, hedge half. If two different investments seem attractive, split your money and buy both.

Sometimes it may be hard to see how to split the difference. If your institution is considering entering a new business, and you can’t decide whether to grant risk-management approval, think about entering the business with a partner or investing in a stand-alone company to do the new business. These options aren’t always available or practical, and they may not address the risk issues that concern you, but you can always look for this kind of third way.

Bear in mind that when I say half, I mean half. It rarely helps to agonise over whether to do 30 per cent of one and 70 per cent of the other. If you have the data and model to make decisions like that, you’re not making a risk-management decision in the first place. Also, as soon as you go down the road of careful blending, you’re likely to mash things up so you make no clear decision at all. ‘Do half’ is a decision, ‘Let’s mix and match parts of everyone’s ideas’ isn’t. Of course, you have no magic to half as opposed to any other fraction; my point is to focus on the decision to split the difference rather than the detail of what proportion to use.

**Don’t Ignore Idiots**

Just because someone’s a genius doesn’t mean she’s right and just because someone’s an idiot doesn’t mean she’s wrong. If you stop reading something any time the author writes something idiotic or stop listening when you hear the first bit of nonsense, you can miss out on a lot of important wisdom.

See, no one has everything figured out, but everyone knows something. Idiots are not random; they say what they say for reasons. Sometimes they say true things for bad reasons, other times what they say is false, but if you think
about why they said it, it points to a valid reason.

The stuff the smart people think is probably already embedded in your institution’s planning. The risk manager’s role is to broaden the range of possibilities to consider. You won’t broaden it much talking to smart people; you have to get some input from idiots. After you filter out the idiocy, you can be left with valuable insights missing from the expert analysis.

Of course, you’re not always right about who are the geniuses and who are the idiots. Listening to idiots is the only way to find out if you’re an idiot; if you only listen to people you think are smart, you only listen to people who agree with you, which isn’t the way to learn or to find out if you’re smart. If you’re just sure that you’re smart from first principles, then you’re no risk manager.

**Respect the Past**

Yes, things change. How do we know that? Because they’ve changed in the past. So even that bit of wisdom relies on the fact that things usually don’t change.

Now I don’t say ‘worship the past’, nor ‘assume there will never be change’ – but respect the past. Think about whether your proposed risks would have succeeded in the past. If the answer is ‘yes’, it’s no guarantee they’ll work in the future; but if the answer is ‘no’, you should think long and hard about why this time is different. It usually isn’t. And although people have made great bets on change, they’ve usually done so not because they ignored history, but because they thought about it deeply.

Another aspect of this issue is to avoid the mindless prejudice that everyone in the past was unenlightened, while believing that current knowledge is free of superstition and error. There were smart people in the past, and deep wisdom is embedded in old cultures and institutions. Foolish people still exist today, and so do shiny new ideas that have not yet been tested by time.

**Do the Asymptotics**

This one is a bit technical, but it’s important. When someone does a probability calculation and shows that a statement is true if the sample size is
large enough, that’s called an asymptotic result. Some probability ideas can be reliably demonstrated in small samples – for example, ‘the stock market goes up and down’. Using the S&P 500 back to 1928, the market has never gone up more than 14 days in a row, nor down more than 12 days in a row. So if you watch for, say, 30 days, it’s extremely likely that you can confirm that statement.

Other probability statements take much more data to confirm. For example, in the casino game of craps, the Pass bet (the bet that the shooter will win) is slightly inferior than the Don’t Pass bet. But after a million plays of craps, you still have a 40 per cent chance that the Pass bet will do better. You would have to live in a casino 24 hours per day watching a craps table for many years to reliably confirm from observation that the Don’t Pass bet is better (you could figure it out in less time by doing calculations, or by simulating on a computer).

A lot of cookbook statistics taught in elementary courses rely extensively on asymptotic results without making that clear to students. Some of these results are reliable in some practical situations, because the asymptotics kick in at reasonable sample sizes while other results in other situations are worthless. For example, saying that the Don’t Pass bet in craps is better than the Pass bet has marginal value given than the average difference is less than one bet per year even for a heavy craps player. That particular example is obvious, but much more subtle ones are buried in common statistical calculations.

This fact becomes important because risk management begins when you ask people not to judge decisions by their results but by what would happen in the long run if the same decision were repeated. Some mathematically minded people have a habit of accepting any amount of time for the long run, and recommending actions that can only be justified over billions of years. Less sophisticated analysts do the same thing unconsciously by applying some standard statistical method.

Whenever you ask that long-run question – and as a risk manager you ask it frequently – make sure that you know what amount of time you have in mind. You don’t need to do any maths, just ask yourself how long it would be before you’re confident that your advice would pay off on average. If this period is longer than your expected career, you should probably hold off
giving the advice.

**Check the Data**

As a risk manager, you’re constantly asked to approve things. The people seeking approval love to explain their ideas, logic, aspirations, inspirations and everything else … except their data. Sometimes they disguise their data with fancy graphics or generalities as in, ‘We looked at that effect and it’s not significant’ or ‘The data show overwhelmingly that …’

If people are bringing you bad ideas, find new people to work with; don’t shoot down ideas all day. If you can see flaws in ten minutes that they missed all the way to the final approval stage, they’re not likely to be the kind of team that achieves success. Moreover, a convincing presentation is as likely to be the result of wishful thinking as solid analysis. There are plenty of hopeful dreamers in the world, and many of them know how to sell. Anyway, your job as risk manager isn’t to second-guess the risk takers, but to help them in their endeavours.

So while they’re blathering on about their grand schemes, look hard at their data. Is it grounded solidly in reality or was it downloaded in a casual Internet search? Does it add up? Has it been massaged to present support for an idea rather than show messy reality or mined (selected from among a large set of possible data as the part that provides the most support)?

Bet on the people with good data – real, hard evidence; not opinions, guesses and indirect indicators. Bet on the teams that understand their data, and that subject it to rigorous, sceptical scrutiny. Trust their analysis, because the kind of teams that start from good data, develop good strategies.

**Encourage Fast Failure**

People hate to fail fast. Why? Well for one thing, it makes the decision to take the risk seem foolish. For another, it opens the risk-taker up to criticism that she didn’t try hard enough. And in big organisations, leading up an effort confers prestige, power and money, and who wants to give that up just because that effort won’t lead to success?

Whenever I hear people say approvingly that ‘he gave it his all’, I think ‘and
most of his all was likely wasted’. On the other hand, I get impatient when risk takers engage in lengthy preparations before acting. Often it’s better to try it, see what happens and improve or move on. Obviously this decision depends on the risk in question. I’m not against prudence and forethought. But people have a tendency to plan far beyond the point of diminishing returns, where the reduction in probability of failure is dwarfed by the cost of the delay. The old commando adages ‘plunge, don’t plan’ and ‘reconnaissance pull’ are better general guides to risk-taking than the conventional wisdom ‘look before you leap’.

Success requires learning. Learning requires failure. The faster you fail, the faster you succeed.
History is written by the victors.’ So said Winston Churchill. Er, not quite. Churchill actually said in a debate with Prime Minister Stanley Baldwin that he was confident history would find Baldwin in the wrong, ‘because I shall write that history’. So, what’s the point? The point is: don’t believe everything you read. Survivors write accounts of financial disasters; financial risk managers have more need to understand the decisions taken by the losers. Here are ten, mostly one-day financial disasters whose popular accounts misstate the financial risk management lesson.

If you have a serious interest in financial risk management, I urge you to do in-depth research on all these episodes. The capsule summaries in this chapter have been simplified to a high degree. Mulling over the complex ins-and-outs, the might-have-beens and the variety of people and motivations involved can help you gain the nuanced perspective necessary to make forward-looking risk judgements.

**3 February 1637: Tulipmania**

**Conventional wisdom:** Holland went crazy in a frenzy of speculative trading and bid the price of tulip bulbs to unsustainable levels.

The popular account of Tulipmania was written by a thoroughly unreliable researcher by the name of Charles Mackay in his 1841 *Extraordinary Popular Delusions and the Madness of Crowds* (he did have a flair for titles). Mackay confused two distinct events:
The high prices paid for individual tulip bulbs around 1610. The key misunderstanding here is that people were not paying for single flowers but for control of the breeding stock of popular new varieties, which could generate sales of tens of thousands of flowers and bulbs over decades. The people who paid these prices made money, and people continue to pay inflation-adjusted prices as high or higher for valuable bulbs.

Trading prices of partial interests in low-priced tulip bulbs went up nearly ten times from November 1636 to February 1637, then fell 95 per cent by the end of April 1637, never to rise again. High-priced bulbs fell about 20 per cent, and quickly recovered.

Mackay’s source for his claims of widespread financial ruin and social turmoil is pamphlets put out by government authorities inveighing against financial speculation. None of the claims is true. Not many people were involved in trading partial interests and most had offsetting long and short positions. There was no rise in bankruptcies or financial distress, no disruption of the real economy.

**Actual moral:** People love morality tales in which crazed greed is punished dramatically. Because that rarely happens, people make up stories.

1 December 1825: South American Bond Crisis

**Conventional wisdom:** Small, unsophisticated banking institutions imperiled the British economy by chasing high-risk returns in foreign countries.

During the Napoleonic Wars from 1803 to 1815, the British government had a tremendous need for cash, and it paid a healthy five per cent interest to get it. Wealthy people used to living off interest were pinched when peace reduced the need for funds and pared the interest down to three per cent. Foreign countries stepped up eagerly with bonds that paid up to six per cent. In fact, you didn’t even need to be a country – adventurer and serial conman Gregor MacGregor sold £200,000 worth of Republic of Poyais bonds in 1822, issued by a country he invented for the purpose.
By 1825, defaults in Spain and South America had caused large investor losses and led to a run on the banks. Over ten per cent of the banks in England and Wales failed, and the Bank of England had to resort to extraordinary amounts of emergency lending to preserve the rest.

The Bank of England looked enviously at Scotland, whose banks were relatively unscathed by the optimistic lending. England limited bank shareholders to no more than six individuals, meaning that there were many small and diverse banks, generally run by their owners. Scotland allowed joint stock banks with many shareholders and professional management.

At this point, a risk manager would say that England’s investors and small banks had endured the pain, and the surviving individuals and institutions would be wiser in the future. Losses had been borne directly the decision makers.

The Bank of England instead decided to ask Parliament to copy the Scottish model, and to promote a system of large banks, controlled by professional managers who were neither the owners of the banks nor the depositors whose money the bank invested. Thus decision making was divorced from direct-loss bearing, and the number and diversity of banks began a decline that has not been interrupted in nearly two centuries.

**Actual moral:** The concept of too big to fail was a historical choice, not an accident nor an economic necessity.

**24 September 1869: Black Friday**

**Conventional wisdom:** New York speculators and corrupt political insiders conspired to try to corner the gold market; the corner failed when President Grant realised that he had been manipulated and ordered the US Treasury to sell gold.

The United States went off the gold standard (backing currency with a set amount of gold) to fight the Civil War and fund Reconstruction. It issued $450 million of greenbacks, paper money not redeemable for gold. Due to uncertainty about if and when the greenbacks would be redeemed, it took $130 of greenbacks to buy $100 of gold when President Ulysses S Grant was inaugurated in March 1869. In his address, the new president discussed the issue:
‘A great debt has been contracted in securing to us and our posterity the Union. The payment of this principal and interest, as well as the return to a specie basis as soon as it can be accomplished without material detriment to the debtor class or to the country at large, must be provided for. To protect the national honor, every dollar of Government indebtedness should be paid in gold, unless otherwise expressly stipulated in the contract.’

An immediate return to the gold standard was impractical, as the government only held $95 million worth. But it would also cause hardship to debtors, who would have to repay debt with money worth more gold than what they had borrowed. On the other hand, delaying the return to gold, or even discussing the possibility of not returning, worked against the economic interests of creditors. Variants of when and how to return to the gold standard was one of the major issues in US politics until the creation of the Federal Reserve (Fed) in 1913; and have parallels even today as creditors and the bond market like the Fed to raise interest rates and make money expensive (similar to the government redeeming greenbacks for gold), while debtors and the stock market like the Fed to cut interest rates making money cheap (similar to the government selling gold for greenbacks).

In the summer of 1869, the betting in New York City was that the government would not sell gold. The wheat harvest was shaping up to be large, and good international demand meant that farmers could reap a windfall if the price of gold was high (international shipments were paid for in gold). This windfall would help farmers to get out of debt, making it much easier to redeem the greenbacks in the future. This political strategy seemed like a win/win: make the farmers grateful today, so you can make the bankers grateful tomorrow. Naturally, the bankers reacted by buying gold, both in anticipation of short-term profits, and to protect against expected losses as their loans were repaid in greenbacks with reduced purchasing power. The price of gold rose from $130 to $145.

A ring of speculators led by financier Jay Gould was not content to guess the future. They paid the president’s brother-in-law to urge Grant not to sell gold and a Treasury official to tip them off about any change in the government’s plans. Grant grew suspicious of his brother-in-law, and he reacted by ordering the government to sell $4 million of gold on Black Friday, 24 September
1869. In the morning, gold soared from $145 to over $180 before news of the gold sale hit and drove it back down to $133, essentially where it had been when this whole thing started. The sudden deflation was at least partly responsible for an immediate stock market crash and a severe two-year recession. Moreover, the entire affair caused a loss of confidence in both financiers and politicians, and the losses caused difficulties for several financial institutions.

All the morality tales about greedy speculators and corrupt officials misses the risk management point. Grant had no good options on gold, and greed and corruption didn’t have to be stirred in to cause both political and financial disaster. Moreover, greed and corruption are human constants, so blaming them is like blaming the air we breathe.

**Actual moral:** When elected officials choose the value of money, this is bad for the elected official and bad for the money.

### 31 July 1905: *Le roi du sucre et le roi du marché* (*The sugar king and the market king*)

**Conventional wisdom:** If you try to corner the market, nature will bring you down.

In 1900 Paris, Ernest Cronier, general manager of Say Sugar refineries, was the Sugar King (*le roi du sucre*). Jules Jaluxot’s giant Paris department store made him the Market King (*le roi de marché*); Jaluxot was also elected to the Chambre des députés, the French national assembly.

Say Sugar actually made its money from government bounties paid on the refining and export of French beetroot sugar. When a 1903 Brussels trade accord outlawed those bounties, it was assumed that the price of sugar beets would fall dramatically into line with prices of tropical sugarcane.

However, the beetroot prices did not fall, due to buying from French sugar dealers and politicians, most notably the two kings. Although details are murky, it seems likely there were plans afoot to get government support for high sugar prices via a loophole in the Brussels accord.
A drought in 1904 meant a poor crop for beetroot, and the price remained high. A bumper crop in 1905, however, caused prices to fall 40 per cent. At the end of July, the market king declared bankruptcy, and the Paris Sugar Bourse froze all transactions in beetroot futures. In September, the sugar king committed suicide. All contracts remained frozen. The government, financial and industry insiders were not forced to pay their gigantic losses, nor even post collateral to ensure eventual payment.

In the Spring of 1906, the Paris Sugar Bourse announced that the beetroot futures contracts would be settled but at the old high price rather than the low market price from 31 July when the contracts were frozen, or from Spring 1906. Insiders kept their profits; the people who bet correctly that sugar prices would fall were ruined.

Variants of this story have been repeated many times over the years: the Hunt Brothers in silver in 1980, Metallgesellschaft (a German industrial conglomerate) in oil in 1990; the New York Produce Exchange in soybean oil in 1962, the New York Mercantile Exchange in potatoes in 1976 and the London Metals Exchange in tin … twice!

**Actual moral:** People say clearinghouses don’t go bankrupt. They don’t, they bankrupt their customers instead.

**27 March 1980: Silver Thursday**

**Conventional wisdom:** If you try to corner the market, the law will bring you down.

By the late 1970s, a lot of people thought that the US dollar and most world currencies would be unable to avoid massive further inflation. This belief caused them to bid up the prices for hard assets in general and precious metals in particular. Billionaire brothers Nelson and William Hunt began to accumulate silver, both the physical metal and contracts for future delivery traded on the COMEX, a division of the New York Mercantile Exchange. At the peak, the brothers controlled 200 million ounces of silver, purchased at a total cost of about $3 billion. When the price of silver hit a peak near $50 an ounce in 1980, the position was worth almost $10 billion.

Then things started to go bad. A series of editorials and even a full-page advertisement by jeweller Tiffany appeared accusing the Hunts of driving up
the cost of silver. The brothers were accused of attempting to *corner the market*. In a corner, an investor quietly buys up the entire supply of a security or commodity, then demands that the *short sellers* (the people who sold more of the security or commodity than they owned) deliver immediately – because the only way to deliver is to buy from the investor running the corner, that person can demand any high price he wants.

In fact, the Hunts never attempted anything like this. They were aggressively vocal about their buying and never demanded delivery. They accepted cash settlement or other forms of silver or simply rolled over the contract pushing delivery out farther in the future. Lots of other people were buying silver at the time, and the price of silver did not increase any more than expected given the economic fundamentals of the time. Nevertheless, ancient rules against agricultural corners were dusted off and twisted to try to fit the facts of the silver case.

Wall Street dealers, who reportedly had losses of about $4 billion on silver, pushed through rule changes on the COMEX (the dealers mostly control the exchange and, while $4 billion doesn’t sound like a lot today, dealers were private partnerships in those days and the losses would have meant partners and retired partners could have had their personal assets seized). *Silver rule 7* said that only people who were short silver (the dealers) could buy silver, making it impossible for the price to be higher than what the dealers wanted. Another rule forced the long positions to post double margin (meaning that the Hunts had to come up with $1 billion cash immediately) while the short positions (the dealers) had no additional requirement. The Federal Reserve jacked up short-term interest rates to unprecedented levels, which made financing their positions expensive for the Hunts and reduced inflation fears, pushing down the price of silver. The Fed also put pressure on banks to reduce lending to asset purchasers like the Hunts. The brothers were hit with investigations by the Securities and Exchange Commission and the Commodity Futures Trading Commission, as well as numerous private lawsuits. What was the net result? A $7 billion profit got turned into a $4 billion loss.

You may see this situation as a gigantic conspiracy to vilify the Hunts and steal their money, but that’s not really what happened. Each of the actors did the rational thing, exactly what you would expect. Dealers didn’t want to pay losses. The Commodity Futures Trading Commission didn’t want the dealers
to go bankrupt because that would imperil the exchange and clearinghouse, leading to disruption and public losses. The Fed wanted to restore faith in the dollar, which meant both bringing the price of silver down and curbing inflation. The Fed also wanted to protect the banks against losses if its policies worked, so it had to restrain their lending to people betting against it. The Securities and Exchange Commission dislikes disruption in the financial markets, and also had some serious unrelated beefs with the Hunts including failing to report a 6.5 per cent stake in Bache, a brokerage firm that lent them much of the money to buy silver.

Newspaper editors love simple stories with rich villains – they sell more papers than accurate economic analysis. Lawsuits are filed because plaintiffs and their lawyers can make money that way.

You don’t have to be as rich or aggressive as the Hunts to think through the game theory considerations of your investments. Everyone who bought silver got robbed, not just the Hunts. A great investment isn’t a great investment if the losers aren’t going to pay, and for the Hunts to collect on their silver bets, a lot of people would have had to act against self-interest.

**Actual moral:** Financial markets are not just random walks and not just aggregators of fundamental economic information. They’re also games, and you have to know the players and who sets the rules.

**1986–1993: Savings and Loan Crisis**

**Conventional wisdom:** Rising interest rates squeezed savings-and-loans institutions (S&Ls) that had made long-term fixed-rate residential mortgage loans, funded by deposits that had to pay market rates. Congress liberalised investment rules so the S&Ls could earn more profits, but the new riskier loans went sour.

In this case, the conventional wisdom is true as far as it goes, but it describes two small-dollar problems. Of the $180 billion of S&L losses, less than $5 billion can be ascribed to rising interest rates in the early 1980s and perhaps $10 billion to legitimate loans under the new rules (and even that should be offset against the substantial additional profits that the legitimate loans generated in other cases).

In 1980, S&Ls really were run by people similar to Jimmy Stewart’s
character George Bailey in the movie *It’s a Wonderful Life*: honest, sensible and business-like; bent on making comfortable livings serving their communities; running institutions that were owned by the depositors. The S&Ls run by these people seldom went bankrupt and didn’t cost much when they did.

Another conventional version of the S&L crisis is that it was caused by fraud. This statement is also true, but relatively small dollar. Some conscious criminals took over S&Ls and looted them, but not many. It wasn’t a bright thing to do, because there were legal ways of getting the S&L’s money almost as easily and fast as looting it. Similarly, some losses were caused by wild and exotic investments. These losses were good for headlines, but not the main problem.

The vast bulk of S&L losses can be laid squarely at the door of what I call *collective embezzlement*: no one person commits a crime, and many of the unintentional co-conspirators are not particularly dishonest or greedy. But the overall result – removing money from a bank and putting it in an undeserving person’s pocket – is the same as the one a bank robber achieves with a gun: The money disappears from the bank into the pockets of people who didn’t earn it.

The large majority of the losses in the S&L crisis came from commercial real estate lending, half in Texas alone, and almost all the rest in Florida, California, Arizona, Colorado and Louisiana. The executives running the institutions were not bankers, they were politically connected people who created or took over S&Ls in the early 1980s to get in on the easy money. Many were real-estate developers, which is like hiring alcoholics to run liquor stores. Often there were corners cut and rules ignored, but generally not to the level of fraud or even civil culpability. Sometimes there were exotic deals, but mostly it was straightforward acquisition, development and construction lending. When times were good, everyone won; there were lots of jobs, development, votes, money and business. But times didn’t stay good, and the predictable hangover followed.

**Actual moral:** Bubble profiteers – those who make money riding unsustainable booms – are always more popular than risk managers – those who want to puncture the bubble before it does real damage.
19 October 1987: Black Monday

**Conventional wisdom:** Computerised program trading caused a panic and crash in the stock market.

The largest one-day decline in the Dow Jones Industrial Average was a 23 per cent loss on 19 October 1987, which came to be known as Black Monday. The drop was more than the largest one-day loss in the Great Depression (13 per cent on an earlier Black Monday, 28 October 1929) plus the largest loss in the 2007–2009 financial crisis (8 per cent on 15 October 2008, which was a Wednesday but doesn’t have a catchy name). Losses were higher in Asian markets (where most occurred on Tuesday due to the time-zone difference), similar in the UK, and somewhat smaller in the high teens in Japan and Europe.

The puzzling thing about the crash is it seemed to have no cause. There was no major news to justify it nor was there any significant shift in investor sentiment. The pattern of countries and industries hit didn’t correspond to any obvious theory. Program trading – computerised algorithms that traded stocks in New York against stock index futures in Chicago – ended up getting most of the blame, but the theory makes little sense and has no empirical support. Markets took the decline in their stride and made up the losses in a little over a year.

What attracted much less notice at the time and since is that there was a massive quantitative realignment in the market. You had to be a quantitative trader active in the markets to notice, but if you were, it was unmistakable. I won’t go into the technical details, just the effects.

Most quantitative trading can be thought of as buying something cheap and selling something expensive to earn a small but steady return. In conventional thinking, quants and other smart investors bid up the price of the cheap assets and push down the prices of the expensive ones, making markets more efficient. When you get enough pressure, prices snap back into line. This snap gives the smart investors a large windfall profit, although their annuity of future profits has disappeared because prices are now correct.

From 19 to 22 October 1987, many market anomalies that had persisted for decades disappeared. But instead of delivering windfall gains, they took complex paths that wiped out most quantitative traders. At the same time,
new apparent anomalies appeared, some of which made sense in retrospect, others of which are mysterious, but continue to generate profits for quants. This is a different picture of the market than smart investors nibbling away at inefficiencies until prices smoothly correct. Understanding it, or at least respecting it, is a key to modern financial risk management.

**Actual moral:** The week beginning 19 October 1987 kicked off the investigations that led to modern financial risk management.

**18 April 1994: Rogue Trader Joseph Jett**

**Conventional wisdom:** A clever criminal defrauded securities firm Kidder Peabody.

From 1990 to March 1994, Joseph Jett was a star government bond trader at Kidder, Peabody & Company, making $255 million for the firm over the four years and pulling down a $9.3 million bonus in 1993. In April, Kidder announced that the profits were all an accounting fraud, and Jett had actually lost $93 million.

Jett had a different story. He admitted to entering trades with no substance into Kidder’s accounting system, but claimed that he did it at the direction of senior Kidder management in order to reduce the size of Kidder’s balance sheet (that is, although the trades had no economic substance, they caused the accounting system to offset some assets and liabilities, so that instead of reporting, say, $50 billion of assets and $48 billion of liabilities, the firm could report $10 billion of assets and $8 billion of liabilities and appear to have less leverage). Jett said his trading profits were real, and the losses were in fact caused by the mortgage structuring business run by Michael Vranos.

You might think that an investigation could determine quickly which version was correct. You would be wrong. Multiple investigations over four years basically called it a draw. Jett was censured for the violation he admitted to, entering trades to manipulate the balance sheet, but not for fraud or for rogue trading. General Electric (GE), which owned Kidder at the time, refused to allow investigation of its accounting system, which is at the heart of the dispute. GE told the Securities and Exchange Commission that it ‘lacked the
resources to preserve’ the accounting system, which makes zero sense because it ran on a single personal computer and would need to be preserved for audit reasons anyway.

There was a lot going on at Kidder Peabody in the early 1990s. Neither side produced a plausible story, and neither side produced evidence to back up its story. It might be nice to know the truth; but maybe that would be too messy and disturbing. Anyway, everyone seemed to decide, in the words of Jack Nicholson’s Colonel Jessup in A Few Good Men, ‘You can’t handle the truth.’

**Actual moral:** If enough people are playing games, even if none of them does anything criminal, the combined effect can be as bad as what a clever, malicious, trusted person can do.

### 6–10 August 2007: Quant Equity Crisis

**Conventional wisdom:** All quantitative equity strategies held the same positions, so when one lost money it triggered panic and extreme losses.

One of the enduring memories I have of the financial turmoil in world markets that begin in the summer of 2007 and lasted until the spring of 2009 was seeing CNBC stock market coverage the week of 6 August 2007. More shares were trading than had ever traded before, and panic was clearly in the air, but the equity indices were not moving. The newscasters knew something huge was going on, but what? Hints started leaking out by Wednesday, 8 August, most of the story was public by 13 August, and Joe Nocera wrote a reasonably complete account on 18 August. In 2010, Wall Street Journal reporter Scott Patterson published his book The Quants about that wild week.

Quantitative equity strategies sound intimidating, but are actually quite simple. Qualitative stock market investors look for good things in a stock – high earnings relative to stock price, steady earnings growth, solid balance sheet and so forth. Quantitative equity investors look for precisely the same things, only they use computers to comb through huge amounts of data systematically instead of hiring highly trained analysts to make judgements. Although no computer program is as sophisticated as a human analyst, the analyst may come up with half a dozen great picks, while the computer
churns out 2,000 pretty good picks. The additional diversification the computer allows means that quant equity can have a better risk/return ratio than a qualitative strategy, even if its picks have lower average return. Also, the computer is cheaper, more systematic, and doesn’t go rogue or get the company into trouble by cheating.

Quant equity is usually run market neutral, meaning that instead of ignoring the bad stocks, it shorts them (sells them without owning them, hoping to buy them back later at a lower price). Thus it can make money equally well when the general stock market goes up or down, as long as the stocks it likes do better than the stocks it dislikes.

Overlap certainly exists among different quant equity investors; some computer stock selection rules have been known for decades and have been published in papers. However, the real reason for overlap in holdings is simpler: Quant equity, unlike most investment systems, actually works. Tomorrow, some stocks are going to go up, and some are going to go down. If your system works, it has to hold more of the former than of the latter. You and I may have totally different approaches to rating equities, but if both our systems work, they have to overlap to some degree; and even if two randomly selected quant equity managers have only a small overlap in holdings, the set of all quant equity managers has substantial overlap. This situation is nothing special about quant equity – the combined portfolios of all investors who have genuine skill and take positions, long or short, in all or most stocks, has to show concentrated positions in many stocks.

Anyway, starting in July 2007, money started pulling out of quantitative strategies in general, including quantitative equity. When an investor removes $1 from a quant equity fund, the fund might have to sell $6 worth of long positions and cover $6 worth of short positions, or even more (since the quant equity crisis and the subsequent financial crisis, leverage in quant equity strategies has fallen so typical numbers are smaller today). The market react by pushing down prices of the long stocks and pushing up prices of the short stocks, causing losses for all quant equity investors.

This followed several years of strong money inflows, which had the opposite effects, and made these strategies appear both more profitable and less risky than they actually were. The change in fortunes spooked some newer entrants, and led experienced players to reduce positions. (Quants naturally
tend to cut positions when market risk increases in order to maintain constant risk exposure). The more quant equity funds pulled back, the bigger the losses and the higher the volatility, so the more pullback.

Quantitative equity firms trading large amounts of stock but equal amounts of buys and sells, explains why there was gigantic transaction volume in the stock market but overall prices didn’t move. The quant equity funds were buying as much stock as they were selling. Moreover, there seemed to be no pattern to the stocks being bought or sold, so the news analysts couldn’t fit a story around the activity.

Anyway, the crisis hit its low point on Thursday, 9 August 2007. Positions quickly rebounded as the losses were all from temporary transaction pressure rather than economics. A fund that had held its positions intact would have made back all losses on Friday, 10 August, but no quant fund would ever do that. Because positions were much smaller on 9 August than they had been on 6 August when the crisis began, it took most funds a year or more to get back to even.

In retrospect, quant equity went through in four days what the rest of the financial system would drag out for nearly two years. Quants have an engineer’s honesty, and it doesn’t occur to them to deny reality. (That doesn’t mean that they have financial honesty; it might occur to them to steal money when they got past seeing the situation realistically.) Because quants recognised losses immediately without accounting games or appeals to authorities to overrule the market or accusations about shadowy evil people, and because they cut their risk immediately when strategies stopped working, quants suffered severe, short-term, transparent pain; and then the survivors got back to work.

**Actual moral:** Massive economic pain comes from denying reality to protect reputations and cosy privilege or out of fear of chaos, not from financial miscalculations themselves.

**12 August 2012: The London Whale**

**Conventional wisdom:** A rogue trader who was supposed to be hedging risk instead made huge speculative and complicated bets that cost JP Morgan $6.2 billion in trading losses, over $1 billion in fines and lawsuits and over $50
billion loss in market equity.

I want to explain this one with an analogy. You decide to buy a $1 million life insurance policy to protect your family, and you pay $1,000 per year. The cost of life insurance drops to $800. This drop means that you have a mark-to-market loss of $200, because the asset you bought for $1,000 is now worth $800. However, at the cheaper price, you want to buy more insurance, so you pay $800 for another $1 million policy. An outsider would call this doubling up after a loss, but it makes perfect sense. Next, the price of insurance rises to $1,200. You sell your second policy for $1,200 and have now spent a net $600 ($1,000 + $800 – $1,200) and have a $1 million policy. You also have a mark-to-market gain of $600.

Next, the price of insurance rises to $2,000, which you think is much too high. You want to buy more insurance (say you had a baby), but the price is absurd. However, the price increases have driven down the price of insurance company stocks (the companies wrote policies at prices from $800 to $2,000, but all of those policies are now worth $2,000 so the companies are facing big mark-to-market losses). You decide to buy more insurance, and some insurance company stocks. If insurance prices continue to rise, you’re glad of the extra insurance. If insurance prices fall, you make big profits on your insurance company stocks.

So, you started with a simple hedge and ended up with a large and complex position. You doubled bets after losses, both with your insurance policy and insurance company stocks. Estimating the risk of your new position is hard. However, you didn’t do anything crazy, your actual position ($2 million of life insurance and some insurance company stocks bought cheap) is pretty reasonable.

Bruno Iksil, the JP Morgan trader who became known as the London Whale, started out buying simple insurance for JP Morgan’s credit risk. JP Morgan and all banks have massive exposure to credit. The Whale’s positions, taken as a whole, were always a hedge. That is, in a credit crisis when the bank was losing lots of money on its lending and other business, the Whale’s positions would make significant amounts of money to take the edge off the losses. There was no overhedge, and the losses on the Whale’s positions if credit improved would be small compared to the bank’s gain on its overall portfolio. However, although the Whale’s positions were a good hedge in this sense,
they were a bad hedge in another sense: They could have large gains and losses even if there was no change in the overall price of credit. As long as the firm was willing to hold the position through losses, the positions were probably sound. However, this portfolio was not one for weak hands. If the firm was going to close out positions in response to losses, the Whale was a blow-up waiting to happen.

Early on in the Whale’s trading, he made money buying insurance when it was cheap and selling it back when it was dear, like when you bought more insurance at $800 in the earlier example. His strategies got more complex, and he tended to buy more of things after losses, just as you did. The risk managers flip-flopped on the amount of risk, but estimating the risk of large, complicated positions is extremely difficult.

Now, to add one more feature: The positions got so large and complex that Boaz Weinstein, who runs the Saba Capital Management hedge fund, and other market players (including some other traders at JP Morgan) began to bet that the Whale could not sustain losses. If his positions declined in mark-to-market value, he would be forced to sell at distress prices. That encouraged the hedge funds to sell whatever the Whale owned, and buy whatever the Whale owed. How much of the Whale’s losses were due to market fundamentals and how much was the result of opportunistic opposition isn’t clear, but Weinstein and company were correct. When the portfolio losses got above $2 billion, JP Morgan was not willing to defend them, and the unravelling began.

Yes, there are risks attached to large positions, and to complex positions and to positions whose risks are hard to measure. But sophisticated financial institutions, including JP Morgan, can weigh those risks, and sometimes the potential rewards are enough to justify them. But the Whale’s idea of JP Morgan’s tolerance for losses in his hedge differed from JP Morgan’s actual tolerance. Risk managers must strive for clear agreement on risk tolerances from the executive suite to the trading floor.

**Actual moral:** There are always good and bad trading decisions, but institutions can survive bad luck with transparent risk; opaque risk is what causes disasters.
Chapter 22

Ten Great Risk Managers in History

In This Chapter

- Ideas ahead of – and lost in – time
- Groundbreakers and prophets

Although the modern field of financial risk management dates back only to 1987, it’s built on many older ideas. This chapter contains a more or less random list of people who illustrated important risk-management concepts over the years. Read it for inspiration or for examples to use in discussion and presentations.

Abraham Wald

Abraham Wald was one of many brilliant Jews chased out of Europe by the Nazis in the 1930s and 1940s who repaid the favour by lending their brains to the Allied war effort. Wald was a brilliant mathematician who played a key role in the post-World War II (WWII) applied mathematics revolution that turned quantitative analysis into a useful tool for real decision making, and laid important foundations for modern financial risk management.

During WWII, the US Army undertook a study of damage to bombers from enemy fire in order determine where to place additional armour on aircraft. Each additional pound of armour meant one less pound of bombs, which meant flying more missions for the same effect. More armour meant fewer lives lost, but more missions meant more lives lost. The Army wanted to know the optimal trade-off, so they asked Wald, who was teaching at Columbia University at the time, to analyse the data.

When Wald sent back his results, the Army engineers thought he had reversed things by mistake. He recommended placing no armour in the places damage
was frequently recorded and lots of armour in places where no damage had ever been observed. ‘Why do you want armour in this place,’ he was asked, ‘when we’ve never seen damage there?’ Wald replied, ‘The aircraft that were damaged there didn’t make it back.’

This anecdote is a handy way to remember a key concept of risk management that often reverses the straightforward interpretation of evidence: Sometimes the important information isn’t what you see, but what you don’t see. If you ever hear someone saying, ‘We don’t need to prepare for X because we’ve never seen X happen,’ be sure to ask yourself, ‘Is that because X never happens or because everyone who has seen X isn’t here?’

Alhazen

Abū Alī al-Ḥasan ibn al-Ḥasan ibn al-Haytham, Alhazen for short, was one of the most important scientists in the golden age of medieval Islamic science – one of the greatest periods of innovation and learning in the history of the world. Working from around 1000 to his death in 1040, Alhazen helped transition to questioning ancient wisdom and advancing science by experiment. He would try anything. One of his lost works reportedly concerned his results of the effect of music on working animals – he wanted to know whether he could speed up his camel with lively ditties?

The ideas of Ptolemy (probably an ethnic Greek, but a Roman citizen) on astronomy held sway in Europe until the Copernican revolution in the 1500s. Alhazen demolished Ptolemy’s theories on both logical and empirical grounds over 600 years before Kepler.

He was an energetic and brilliant research scientist and a first-rate mathematician as well, but Alhazen’s greatest contribution was in his methodology – primarily his influence on early European scientific investigators such as Roger Bacon, Witelo and the great renaissance scientists including Da Vinci, Galileo, Huygens, Descartes and Kepler.

Although Alhazen was an important influence on later Islamic scientists, his energetic experimentation and aggressive challenge of ancient authority failed to take deep root in the Middle East. As Jesus complains in Mark, ‘A prophet is not without honour, but in his own country, and among his own kin, and in his own house.’
Dwight Eisenhower

Eisenhower is famous for many things, including being supreme commander of allied forces in Europe during WWII and a two-term president of the United States. But I include him here for an anecdote he related in his Crusade in Europe (an excellent book that I could have included in Chapter 23 but didn’t).

Early in the North African campaign, a battlefield commander called for more half-tracks (vehicles with wheels on the front for steering but continuous treads like a tank on the rear for traction over soft or uneven ground). The nearest ones were 800 miles away, and no transport was available. ‘Just find some guys to drive them here,’ the commander told the supply lieutenant. The lieutenant refused on the grounds that 800 miles was more than half the useful life of the vehicles, and it would be a tremendous waste. This statement led Eisenhower to the second most famous thing he ever said, ‘War is waste’. (The most famous is, ‘We must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military industrial complex.’). He said the supply lieutenant was a ‘peacetime officer’.

A little research shows that Eisenhower repeated the story frequently, at the time and afterwards, until it was well known throughout the military. I include Eisenhower not because his ‘war is waste’ insight is so unusual, but because he understood how important that insight was, and was shrewd about communicating it in a way far more effective than an order. A memo from the supreme commander would be watered down at each step in the hierarchy until it faded into the huge mass of ignored paperwork a WWII-era army generated. A story with enough details to be memorable repeated by the supreme commander on a few key occasions would be efficiently transmitted and taken to heart by every single soldier from rawest private to top commanders – and more to the point, can change behaviour.

Everyone knows about fear leading to panic and pointless actions and horror leading to frozen inaction, and even peacetime military officers are trained against them. But denial (focusing on stuff that matters in normal times to avoid having to react to the actual situation) is actually more common than the first two in modern situations far from the physical manifestations of
danger. It can be seen in the trader who is ordered to liquidate positions at any cost in order to meet a margin call that will blow up the firm if missed, but who refuses to sell because the price is five per cent less than she thinks is fair. It can be seen in the investment banker who doesn’t want to cancel a botched initial public offering because it would waste all the work that’s been done.

All these people, like Eisenhower’s supply lieutenant, have concerns that are valid in normal times but completely inappropriate in crises. Risk managers must insist on realistic drills to train people in crisis behaviour and offer clear instructions that frightened people can follow when confused and pressured. However, those are only partial remedies. The most important thing is that when war is declared, you make sure that everyone really, really gets the news. You may find it hard to break ingrained behaviour patterns that people get rewarded for in normal times; you must give people the clear direction to do that hard thing. In the fog of war, good stories influence behaviour far more than rules and regulations.

Epicurus

In the 4th century BC, Epicurus inscribed on his garden gate, ‘Stranger, here you will do well to tarry; here our highest good is pleasure.’ This inscription was not an invitation to hedonistic orgies, but a statement that the purpose of life isn’t to serve God or honour ancestors or obey kings or defend homelands, but to do the things you decide for yourself are meaningful and good.

This idea is the most subversive possible one to the powers that be, whoever they are – anyone who calls for sacrifice (yours) for victory (hers) over an enemy (probably people like you). Similar ideas sprang up in all the major Old World civilisations within a few centuries before or after Epicurus. All these movements were attacked and parodied as reckless pursuit of short-term physical pleasure and riotous excess, although adherents in fact prefer simple moderation and harmless lives.

Big ideas urging war or other reckless acceptance of danger in pursuit of mystical or ill-defined goals divorced from everyday pleasure cause most of the damage in the world. Basing actions instead on reality that individuals can feel, pleasure and pain, is much better risk management.
Epicurus also insisted on testing ideas by direct experimentation and subjecting all claims to logical analysis. His garden attracted like-minded men and women (he was the first Greek philosopher to admit women on the same basis as men) who discussed and built on his ideas. While Epicureanism has never been a widely held philosophy, its elegant simplicity has influenced thinkers in the right risk management direction for nearly 25 centuries.

**Gideon**

Gideon was the sixth judge of Israel. If you’re not up on your Bible studies, that puts him about 1150 or 1200 years BCE.

The disruption of the times allowed alliances of desert nomads to cross the Jordan River at harvest time and to steal the crops and animals of the Israelites. Gideon and his tribe were forced to hide in the mountains with whatever food and goods they could carry, letting the eastern tribes steal the rest.

The Lord tells Gideon to destroy the raiders and free his people. Gideon politely but firmly insists on proof including – and I approve of this part – two miracles the precise opposites of each other. He goes another step further by smashing an altar to Ba’al, to test whether Ba’al has any power to avenge insults. After three miracles from the Lord versus none from Ba’al, Gideon is willing to go to war.

A large army of farmers collects around Gideon, but he realises that they’re no match for the even larger army of raiders who are more experienced fighters with better weapons. So he winnows his fighting force down to 300 people, starts a rumour that God is going to destroy the raiders then has his force of 300 jump out from the north, west and south to surprise the enemy camp in the middle of the night with fire and trumpets. The frightened raiders, composed of disparate groups and better at raiding than organising a disciplined defence, end up attacking each other, and fleeing to the east, back to the Jordan.

Meanwhile Gideon’s farmers who were dismissed from the noisemaking assault on the raiders’ camp were more than up to the task of slaughtering a fleeing rabble trying to cross a river.

Many different historical and religious interpretations of the story of Gideon
have been made, some of which contradict elements of mine. I include Gideon here as a symbol of the first emergence of rationalism that would reach its zenith in the classical civilisations of Greece and Rome.

**Henry Petroski**

The only living person on this list, Petroski is a professor of civil engineering at Duke University and a prolific author. Among his many great books is *To Engineer Is Human: The Role of Failure in Successful Design*. My favourite Petroski quote (from among many) is, ‘No one wants to learn from mistakes, but we don’t learn enough from successes to advance the state of the art.’

One of the reasons I chose to go into finance is that no one dies from your mistakes. If you lose money trading, you can make it back the next day. If you bring down the financial system and cause massive economic damage, you can rebuild it and stimulate a great boom. I prefer to avoid the heavy psychological and moral consequences of gambling with lives.

Nevertheless, I frequently get drawn into life-and-death decisions, and you will too if you pursue a risk-management career. Risk officers get put on committees responsible for physical safety and get roped into working groups and advisory committees investigating disasters or assessing preparedness. Your co-members are likely to be military officers, security professionals, practicing engineers and others whose jobs require decisions that weigh lives in the balance.

Petroski distilled from history and engineering principles the support you need to face these groups without being intimidated. As a financial risk manager, you have quantitative knowledge and practical experience that can improve risk decisions about life and death as well as money. But you’ll likely need help to stand up to people who have made more life-and-death decisions, but whose careers have not allowed the same degree of experimentation. Petroski’s writings are what helped me.

**John Kelly**

John Kelly was born in Texas and flew combat missions for the Navy for four years in WWII. He survived a plane crash into the ocean (on another flight,
he earned a reprimand for flying his plane under the George Washington Bridge in New York City). He was a champion pistol shot and top amateur bridge player.

After the war, Kelly got a PhD in physics, which he first tried to apply to finding oil wells. When he discovered that his equations did not do as well as the intuition of experienced oilmen, he accepted a job at Bell Labs instead. One of his jobs there involved speech synthesis. He taught a computer to sing Bicycle Built for Two in 1962. Coincidentally, author Arthur C Clarke was visiting Bell Labs at the time and heard the computer sing. He was so impressed, he included the computer singing in one of the climatic scenes from 2001: A Space Odyssey.

Kelly makes it into this chapter due to his paper originally titled ‘Information Theory and Gambling’ but changed due to pressure from his employer to, ‘A New Interpretation of Information Rate’. Most people assume that increasing risk leads to increasing probability of good and bad outcomes. Kelly was the first person to realise that, beyond a certain point, increasing risk only adds to the probability of bad outcomes. He was also the first person to give rigorous mathematical form to the idea that precisely calibrated amounts of risk are guaranteed to produce better long-term outcomes than less risk or more risk.

Kelly’s fundamental insights would not be appreciated widely for years, although early adopters like Ed Thorp would get rich using what Thorp renamed ‘Fortune’s Formula.’ Today Kelly’s ideas form the basis of modern financial risk management.

Nathan Bedford Forrest

You can say a lot of bad things about Confederate Civil War general Nathan Bedford Forrest. He made his fortune as a slave trader, commanded troops that massacred black Union soldiers at Fort Pillow and was an early leader in the Ku Klux Klan. He did some good things as well, and his shrewd appreciation for risk cannot be questioned.

Forrest was born poor but energetic. Risk-taking and lack of scruples brought him a fortune of £1 million ($1.6 million), making him one of the richest men in the South before the Civil War. He enlisted in the Confederate Army as a private, and rose to the rank of lieutenant general.
Unhindered by any formal training or experience in war, Forrest developed an innovative set of tactics relying on mobility, surprise, bluff and daring that led to some spectacular successes. His innovations helped inspire a style of special operations warfare that continues to develop today.

Forrest got a chance to demonstrate his cunning when Union Colonel Abel Streight led his mule brigade on a raid in Alabama to destroy railroads and ironworks and to recruit Union sympathisers. Forrest’s 600 men were too weak to attack the mule brigade’s 1,500, but with knowledge of the local terrain and cooperation of local residents, his troops were able to harass the Union forces and prevent them from accomplishing their mission. Over 17 days, Forrest managed to deny his enemies rest, to erode their supplies and morale, to get them hopelessly lost and to convince them they were severely outnumbered.

At Cedar Bluff, Forrest requested a meeting, ‘to prevent the further effusion of blood’. During the meeting, he had his men march around a nearby hill, giving the impression (from the conference point) that there were many thousands of troops and 15 cannon. Forrest had couriers ride up announcing that Generals Roddy and Van Dorn were nearby with their troops and awaiting orders (neither was in Alabama at the time, let alone nearby).

The Union colonel surrendered and Forrest later recounted, ‘I ordered my men to come up and take possession of the arms. When Streight saw they were barely 600, boy did he rear! Demanded to have his arms back and that we should fight it out. I just laughed and patted him on the shoulder. ‘Ah Colonel. All’s fair in love and war, you know.’

Although no reliable contemporary record from that day at Cedar Bluff remains, an unshakeable legend holds that one of Forrest’s poker playing officers yelled out, ‘Cheer up, Colonel, it’s not the first time a Streight has lost in a bluff.’

**Rituparna**

Nala is a raja who is cheated out of his kingdom in a dice game. But Nala’s not the sort of guy to mope about his lost wealth and family. He heads over to a neighbouring kingdom ruled by Rituparna and takes a job in the stables. He rises quickly as he is an expert horseman. One day on a ride, Rituparna
examines a branch from a nearby tree and announces that the tree has exactly 50 million leaves and 2,905 fruits. Nala insists on counting to verify (to the king’s annoyance) and finds that the numbers are exactly correct.

The king mentions that the secret knowledge called Aksahrdaya was useful for determining the number of leaves on a tree from examining a branch and also for winning at dice. It would be over 2,500 years before the connection between random events like dice throws and reasoning from a sample to a population would be analysed mathematically in Jakob Bernoulli’s Ars Conjectandi in 1713.

Nala proposes to trade horsemanship lessons for dice lessons. Rituparna agrees and Nala is able to return home to win back his kingdom.

**Zu Chongzhi**

Zu Chongzhi lived from 429 to 500 in Jiankang, China (modern Nanjing). He was one of the great mathematicians and scientists of the period, but he makes this list because he was the first person known to include explicit error bounds on his calculations. For example, he computed pi, the ratio of a circle’s circumference to its diameter, and gave two *rational* approximations (a rational approximation is the ratio of two integers), Yuelü as 22/7 and Milü as 355/113. Milü was later renamed Zulü (Zu’s ratio) in Zu’s honour. Yuelü has been discovered many times, before and since, but Zu’s computation is the first recorded discovery of Milü. It stood as the most accurate known approximation of pi for nearly 1,000 years until it was surpassed by the Indian mathematician Madhava of Sangamagrama.

Impressive as that is, and Zu had many other accomplishments, it would not put him on the list of risk people. What distinguishes Zu was his refusal to assign mystical significance to his ratio. He wrote that people should use Yuelü for practical work, and that Milü was slightly larger than pi. In fact he computed that the exact numerator was smaller by between 1/24,576 and (1/2)/24,576. This computation is correct, the exact numerator is about 355 – (3/4)/24,576.

The explicit acknowledgment of error, and stressing the importance of calculating the possible range of error, is an important advance in separating mathematics from mysticism. This idea is an essential precursor to
quantitative analysis of risk.
Chapter 23

Ten Great Risk Books

In This Chapter
- Exploring the history of risk management
- Digging into key ideas

Risk managers need to have as wide a range of knowledge and experience as possible. So you need to put your nose in a lot of books, and pull your nose out to do stuff as well. Anyway, here are ten good books to improve your risk management thinking. I chose them for their variety – they all focus on different aspects of risk. The one common denominator is something that Emanuel Derman (whose wonderful books My Life as a Quant and Models. Behaving. Badly. were left off this list but could easily have been included) said defined Fischer Black (whose wonderful books Business Cycles and Equilibrium and Exploring General Equilibrium were left off this list but could easily have been included): ‘unafraid hard thinking’.

A Demon of Our Own Design by Richard Bookstaber

Rick Bookstaber has managed financial risk for some of the world’s most complex financial institutions and nimblest hedge funds, and also tried his hand at regulating market risk with the Securities and Exchange Commission. He explains the lessons from his decades of experience in clear terms.

This book fits neatly into the engineering and sociologic risk literature that focuses on how risk emerges from system design and human interaction. Bookstaber writes that complex, tightly coupled systems – ones in which one component’s behaviour is quickly and strongly influenced by other components’ behaviour – smooth away everyday risk, but lead to sudden catastrophic failures.
Bookstaber’s ideal is the cockroach that has survived, ‘many unforeseeable changes – jungles turning to deserts, flatland giving way to urban habitat and predators of all types coming and going’, for 300 million years while other types of creatures rose and fell. Cockroaches are not fast, or strong, or clever or exquisitely adapted to any particular environment or strategy. They’ve one basic rule: move away from puffs of air that may signal a predator. That rule is encoded in the cockroach nervous system. It doesn’t rely on the brain, and in fact, if you cut off a cockroach’s head, both the body and head survive for weeks.

**Beat the Market by Ed Thorp**

Ed Thorp is the most accomplished risk manager of all time. He is the mathematics professor who figured out how to beat casino blackjack (and wrote *Beat the Dealer* to tell everyone else the secret), and working with Claude Shannon (the father of information theory), he built the world’s first wearable computer to beat casino roulette. In addition to beating most of the rest of the popular casino games, Thorp invented or perfected most of the quantitative hedge fund strategies in use today, and ran up the most statistically impressive investment performance in history over more than 40 years. He also popularised John Kelly’s work in a famous American Mathematical Society address, ‘Fortune’s Formula’. William Poundstone used that title for a great book about Kelly’s work that includes a lot of information about Ed Thorp.

*Beat the Market* was written with Sheen Kassouf in 1967 and is a unique opportunity to observe the key principles of modern financial risk management at the time they were first conceived and applied.

**Dynamic Hedging by Nassim Taleb**

Before he dazzled the world with bestsellers like *Fooled by Randomness, The Black Swan, The Bed of Procrustes* and *Antifragile*, Nassim Taleb was famous among quantitative traders. In the early 1990s he was regularly to be found at a table at the Odeon bar in New York City, where the mathematical principles of modern financial risk management were thrashed out. His 1997 book *Dynamic Hedging* is the most important financial risk management
work from this period.

The book is written at a moderately high mathematical level, but the important concepts are explained in clear, non-mathematical language, with illustrations and anecdotes. Although it is specifically aimed at traders running portfolios of derivatives, it links the ideas to more general applications. And like Ed Thorp’s book above, it allows you to see the ideas as they were conceived originally, before they acquired official credentials.

**Expert Political Judgment by Philip Tetlock**

Psychologist Philip Tetlock created a sensation with the 20-year experiment described in this book. He carefully recorded forecasts made by all types of experts from 1984 to 2003 and checked them for accuracy. The tagline everyone remembers is that experts have worse results than random predictions, and that the more famous the expert, the worse the performance.

Although that’s an entertaining bit of knowledge, it’s not the important message in this book. Tetlock also showed that it’s possible to make useful forecasts and that doing so doesn’t require any mysterious or rare intuition, just application of simple principles. This aspect of his work is described more fully in another great book of his, *Superforecasting* (co-written with Dan Gardner, who also wrote *The Science of Fear*, another wonderful book that could have made this list, but didn’t).

Even more important for a risk manager, however, is Tetlock’s masterful and comprehensive demolition of all the counterarguments people make to justify relying on experts who are wrong more often than they’re right. ‘Experts alert us to possibilities,’ people say, but Tetlock shows that they don’t. ‘Experts are directionally correct, but project overconfidence to get attention.’ Nope. ‘Experts give reasons for their predictions which give important insight into how events evolve, even if they guess wrong about the final outcome.’ Nope again. ‘The experts who get attention are irresponsible showmen and idiots, but serious people paid large salaries by banks or employed at the highest level of intelligence agencies make accurate judgements.’ Sorry, that’s not true either. ‘The forecasts may not be literally correct, but when balanced by other information, they lead to good decisions.’ Wrong.
It’s not enough to believe me; you have to read through the careful parsing of evidence. If you do, you can learn something of extreme value that most people do not learn in a lifetime of painful experience.

**Finding Alpha by Eric Falkenstein**

Quantitative finance divides an investor’s return into three components:

- **The risk-free rate** is what you get for just showing up. Put your money in low-risk investments like treasury bills or bank accounts and you earn some interest. It takes no skill, and involves little risk (theoretically, no risk).

- **Beta** is the compensation the market voluntarily pays you for accepting risk that other people want to avoid. For example, business activity creates risk: new companies may fail, money advanced to existing businesses for supplies and wages may not create enough revenue to cover the costs, unexpected events may derail plans. If an investor is willing to accept some of this risk, to advance money that may not be repaid if things don’t work out, he can expect to earn on average (but not every time, of course) a premium beyond the risk-free rate.

- **Alpha** is a return in addition to the risk-free rate; beta is anything you earn through investment skill.

If investors were content with the average return, with the risk-free rate and beta, we would need much less risk management. Falkenstein’s book is the best account of what alpha actually is, how to find it, and how to avoid disaster in the process. The most important insight is that alpha isn’t a treasure you find, like a nugget of gold or a secret formula no one else knows. Alpha is a niche in which you do something better than anyone else.

**Fischer Black and the Revolutionary Idea of Finance by Perry Mehrling**

I vacillated between this book and the equally great *The Myth of the Rational Market* by Justin Fox. Both get to the heart of the revolutionary ideas that
underlie modern finance, in both historical and philosophic terms. I finally came down on the side of Mehrling’s book due to its focus on the single most important academic thinker on the subject: Fischer Black. (Ed Thorp would take honours on the practitioner side, although Thorp was in fact an academic and Black spent years as a practitioner at Goldman Sachs.)

In 1950, finance was entirely a descriptive field, like biology before Darwin. Students were taught what paperwork was required to issue a bond and how compound interest worked, but there was no theory. Business students with maths skills studied accounting or operations, creative ones went into marketing, competent ones went into management. Finance was for the students without useful skills. There were two stereotypical types – the white-shoe investment banker, low in both golf handicap and IQ, who knew a lot of CEOs from his Harvard years; and the tough street kid from Chicago who flunked out of high school but had the sharpest elbows and loudest voice in the pork bellies trading pit.

Over the next 20 years, the academic field of quantitative finance was invented, and in the following 20 years, from 1970 to 1990, it took over the global economy. Understanding how and why this rapid expansion happened is essential for anyone working in finance, especially in financial risk management.

Gambling and Speculation by Reuven and Gabrielle Brenner

In the interests of transparent disclosure, I have to tell you that I was a co-author on the second edition of this book (published under a different title, A World of Chance, in 2008). I have not recommended my own books, excellent as they are, in this chapter due to decorum, not modesty. I’m allowing this partial exception because I recommend the original 1990 edition. Both editions are good, but the 1990 has more historical material and less focus on the financial system.

This book is the best account we have of the history of human risk taking, written by two top-flight economists. Unlike conventional accounts that treat recreational gambling, insurance, economic risk taking, adventure and financial speculation as distinct topics, this classic work traces the history and
theory of risk taking in general.

**Iceberg Risk by Kent Osband**

*Iceberg Risk* is the only novel on the list, and one of the few quantitative finance novels ever published. The book is also one of the most realistic and honest accounts of a risk manager in action. Osband is one of the subtlest thinkers about risk, and his perspective benefits from a high degree of skill in mathematics combined with a career in intelligence as a Sovietologist, someone who tried to guess what the Soviet Union would do – a career that ended with the dissolution of that entity in 1991.

**Risk Intelligence by Dylan Evans**

Evans is both a philosopher and a psychologist and has a colourful career including founding a utopian community as an experiment, working in robotic intelligence and being an aggressive proponent of atheism. He got interested in risk while teaching in a medical school, noticing how bad doctors are at risk management.

*Risk Intelligence* combines philosophic and psychological insights along with some fascinating experimental results and personal experiences.

**The Foundations of Statistics by Leonard J Savage**

Jimmie Savage, as he was known, wrote this astoundingly deep and comprehensive account of uncertainty, inference and decision in 1954. Today, it’s considered a classic of Bayesian statistics (a probability theory that starts with subjective beliefs as its core definition), but it speaks to all flavours of quantitative analysis under uncertainty. It does have a moderate amount of maths in it, but it’s worth reading even if you skip the equations.

On the other hand, if you’re really allergic to maths, Sam Savage, Jimmie’s son, wrote *The Flaw of Averages*, which makes some of the same key points of risk management with absolutely no math.
About the Author

Aaron Brown is nearing his 35th anniversary on Wall Street. He has worked as a portfolio manager, trader, head of mortgage securities and risk manager for Morgan Stanley, Citigroup, Rabobank and JP Morgan; and he has served a stint as a finance professor as well. Currently he is managing director and chief risk officer at AQR Capital Management, a $140 billion hedge fund headquartered in Greenwich, Connecticut.

He is the author of Red-Blooded Risk (John Wiley & Sons, Inc.), The Poker Face of Wall Street (John Wiley & Sons, Inc., named one of the ten best business books of the year by Business Week) and A World of Chance (Cambridge University Press with Reuven and Gabrielle Brenner).

The Global Association of Risk Professionals selected him as its 2011 Risk Manager of the Year. The readers of Wilmott magazine voted him Financial Educator of the Year, his website won the Forbes Best of the Web for Theory and Practice of Investing, and the editors of Algorithm magazine selected his Alphabet Soup as the top shareware algorithm pick. He was profiled in Espen Haug’s Derivatives Models on Models (John Wiley & Sons, Inc.), and by Adam Leitzes and Joshua Solan in Bulls, Bears, and Brains (John Wiley & Sons, Inc.).

He has a BSc in Applied Mathematics from Harvard University and an MBA in finance from the University of Chicago. He lives on the Upper West Side of New York City with his wife Deborah and has two wonderful children pursuing their own dreams.
Dedication

Unlike most fields, modern financial risk management was conceived at a very specific time and place, the literal Wall Street between October 19, 1987 and 1992. Of course, we were just a bunch of math guys who came to beat the Street and we drew on a lot of older knowledge and practice, and the ideas have been advanced and refined considerably since. But the core fusion of ideas that animates the field happened once and hasn’t been altered fundamentally since.

At the time, I wasn’t conscious of witnessing historic events, nor was I particularly impressed with myself or my co-conspirators. We found ourselves to our surprise still there a decade after arrival – and thanks to plenty of painful, expensive, humiliating tuition – just a little bit smarter than when we arrived. The even bigger surprise was that everyone was looking to us for answers about risk. Finance had changed too much for traditional wisdom to be much use, but advice from people who had never gotten into the ring to slug it out with markets was no good either.

The biggest surprise of all was that we really had some answers. Not secrets of instant wealth, but careful techniques that made a little difference each day and led to a fighting chance of exponentially increasing success instead of certain ruin – of having odds a tiny sliver in our favor instead of a tiny sliver against us.

But this book isn’t dedicated to the people who did the work 25 years ago. They don’t need it. It’s dedicated to anyone who ever personally did a calculation and made a significant bet on the result. Win or lose, that’s what makes you a quant. Quants invented modern financial risk management, and quants are our hope for the future.
Author’s Acknowledgments

Writing a For Dummies book is a humbling experience for a writer. It’s like a solo singer-songwriter who joins a rock band expecting to write all the material and be the front man, lead guitar and singer, but who then discovers nobody knows his name and all the fans came to see the band. Those other people, on stage and off, are the real stars of the For Dummies brand, and I’m pretty sure you’re considering this book due to the color of its cover, not my name on that cover.

I’m used to working with therapist editors who gently cajole me away from my faults as a writer and flatter me that they’re polishing up my genius. The For Dummies team is more like (paraphrasing Robert Heinlein’s Starship Troopers) “I need an author. You’re it, until you’re dead or I find someone better.”

I want to thank Annie Knight who suckered me into this project by playing “good cop” and Steve Edwards who took on the thankless job of forging a For Dummies quality masterpiece (if I say so myself) out of the meandering reminisces, academic lectures and disorganized instructions manuals I sent him. Kathleen Dobie developed the text, and Kim Vernon served in the essential but underappreciated copy editor slot. And I owe special thanks to Peter Urbani, a top risk manager in his own right, who checked the information in the book as technical reviewer. Of course, I remain responsible for all errors.
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