

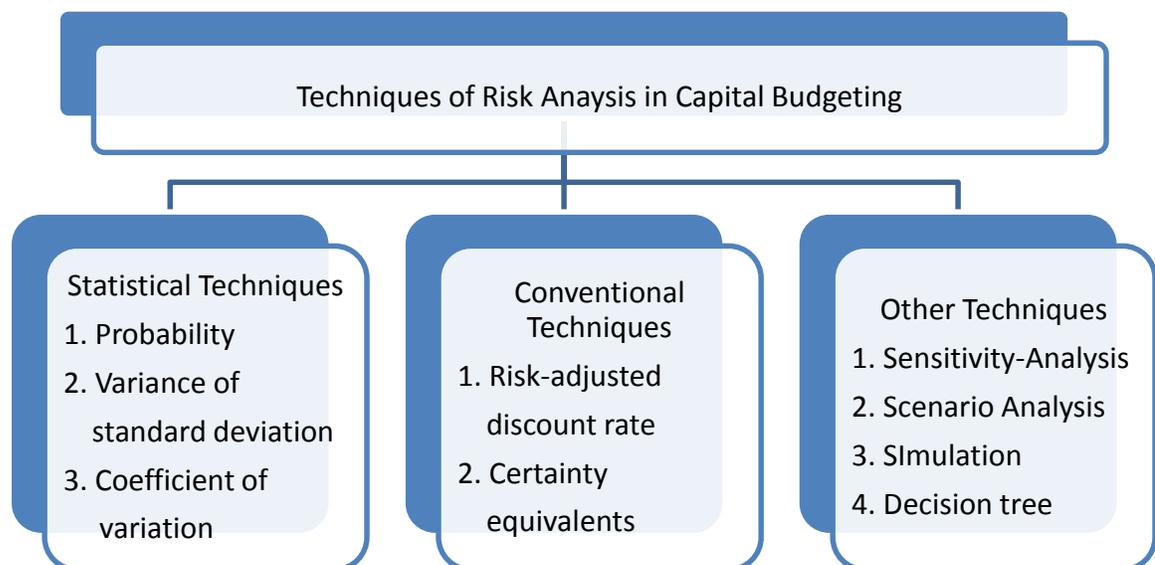
Chapter 8

Risk Analysis in Capital Budgeting

Q1. What are the different techniques of risk analysis in capital budgeting?

Answer:

The different techniques of risk analysis in capital budgeting has been mentioned below:



Q2. What are the different types of decision making that we can take considering the fact that investment projects are exposed to various degrees of risk?

Answer:

Considering the fact that investment projects are exposed to various degrees of risk, there can be **three** types of decision making, as mentioned below:

1. Decision making under certainty : When cash flows are certain
2. Decision making involving risk: When cash flows involve risk and probability can be assigned.
3. Decision making under uncertainty: When the cash flows are uncertain and probability cannot be assigned.

Q3. Briefly explain the terms “Risk” and “Uncertainty”. Also comment on their relationship. Can they be used interchangeably?

Answer:

The terms “Risk” and “Uncertainty” has been explained as below:

- ✓ Risk is the variability in terms of actual returns comparing with the estimated returns.
- ✓ Most common techniques of risk measurement are Standard Deviation and Coefficient of variations.
- ✓ There is a very thin difference between risk and uncertainty.
- ✓ In case of risk, probability distribution of cash flow is known.
- ✓ However, when no information is known to formulate probability distribution of cash flows, the situation is referred as uncertainty.
- ✓ However these two terms are often used interchangeably.

Q4. Mention and briefly explain the different sources of risk.

Answer:

Risk can arise from different sources, depending on the type of investment, the circumstances and the industry in which the organization is operating.

Some of the sources of risk are as follows:

1. Project-specific risk:
 - ✓ These risks are related to a particular project and they affect the project’s cash flows; it includes completion of the project in scheduled time, error of estimation in resources and allocation, estimation of cash flows etc.
 - ✓ For example, a nuclear power project of a power generation company has different risks than hydel projects.
2. Company specific risk:
 - ✓ Risk which arise due to company specific factors like downgrading of credit rating, changes in key managerial persons, cases for violation of Intellectual Property Rights (IPR) and other laws and regulations, dispute with workers etc.
 - ✓ All these factors affect the cash flows of an entity and access to funds for capital investments.

- ✓ For example, two banks have different exposure to default risk.
- 3. Industry-specific risk:**
 - ✓ These are the risks which affects the whole industry in which the company operates.
 - ✓ The risks include regulatory restrictions on industry, changes in technologies etc.
 - ✓ For example, regulatory restriction imposed on leather and breweries industries.
- 4. Market risk:**
 - ✓ The risk which arise due to market related conditions like entry of substitute, changes in demand conditions, availability and access to resources etc.
 - ✓ For example, a thermal power project gets affected if the coal mines are unable to supply coal requirements of a thermal power company etc.
- 5. Competition risk:**
 - ✓ These are risks related with competition in the market in which a company operates.
 - ✓ These risks are risk of entry of rival, product dynamism and change in taste and preference of consumers etc.
- 6. Risk due to Economic conditions:**
 - ✓ These are the risks which are related with macro-economic conditions like changes in monetary policies by central banks, changes in fiscal policies like introduction of new taxes and cess, inflation, changes in GDP, changes in savings and net disposable income etc.
- 7. International risk:**
 - ✓ These are risk which is related with conditions which are caused by global economic conditions like restriction on free trade, restrictions on market access, recessions, bilateral agreements, political and geographical conditions etc.
 - ✓ For example, restriction on outsourcing of jobs to overseas markets.

Q5. What are the reasons for considering risk in capital budgeting decisions?

Answer:

The reasons for considering risk in capital budgeting decisions are mentioned as below:

1. There is an opportunity cost involved while investing in a project for the level of risk. Adjustment of risk is necessary to help make the decision as to whether the returns out of the project are proportionate with the risks borne and whether it is worth investing in the project over the other investment options available.
2. Risk adjustment is required to know the real value of the Cash Inflows.

Q6. Briefly explain the term “probability” and “Expected Net Cash Flows” and “Expected Net present value”.

Answer:

Probability:

- ✓ Probability is a measure about the chances that an event will occur. When an event is certain to occur, probability will be 1 and when there is no chance of happening, an event probability will be 0.

Expected Net Cash Flows:

- ✓ Expected Cash flows are calculated as the sum of the likely Cash flows of the Project multiplied by the probability of cash flows. Expected Cash flows are calculated as below:
- ✓ It is given by:

$$E(R)/ENCF = \sum_{i=1}^n R_i \times P_i$$

Where,

$E(R)/ENCF$ = Expected Cash Flows

P_i = Probability of Cash flows

R_i = Cash Flows

Expected Net Present Value:

- ✓ Expected net present value = Sum of present values of expected net cash flows

- ✓ It is given by,

$$ENPV = \sum_{t=1}^n \frac{ENCF}{(1+k)^t}$$

- ✓ Where,

ENPV = Expected net present value,

ENCF = Expected net cash flows (including both inflows and outflows)

t = Period

k = Discount Rate

Q7. How will you classify Expected Net Present Value?

Answer:

Expected Net Present Value can be classified into following:

- Expected Net Present Value – Single Period
- Expected Net Present Value – Multiple Period

Q8. Briefly explain the meaning of the term “Variance”.

Answer:

- ✓ Variance is a measurement of the degree of dispersion between numbers in a data set from its average.
- ✓ In simple words, variance is the measurement of difference between the average of the data set from every number of the data set.
- ✓ Variance is calculated as below :

$$\sigma^2 = \sum_{j=1}^n (NCF_j - ENCF)^2 P_j$$

Where,

σ^2 = Variance in net cash flow

P = Probability

ENCF = Expected Net Cash Flow

- ✓ Thus, variance helps an organization to understand the level of risk it might face on investing in a project.

Q9. Different values of variance have different meanings. Explain those meanings.

Answer:

- ✓ A variance value of zero would indicate that the cash flows that would be generated over the life of the project would be same.
- ✓ This might happen in a case where the company has entered into a contract of providing services in return of a specific sum.
- ✓ A large variance indicates that there will be a large variability between the cash flows of the different years.
- ✓ This can happen in a case where the project being undertaken is very innovative and would require a certain time frame to market the product and enable to develop a customer base and generate revenues.
- ✓ A small variance would indicate that the cash flows would be somewhat stable throughout the life of the project.
- ✓ This is possible in case of products which already have an established market.

Q10. Briefly explain the concept of standard deviation.

Answer:

- ✓ Standard Deviation is a degree of variation of individual items of a set of data from its average.
- ✓ For Capital Budgeting decisions, Standard Deviation is used to calculate the risk associated with the estimated cash flows from the project.
- ✓ Mathematically, the square root of variance is called Standard Deviation.

Q11. Briefly explain the concept of coefficient of variation.

Answer:

- ✓ The standard deviation helps in calculating the risk associated with the estimated cash inflows from an Investment.
- ✓ However in Capital Budgeting decisions, the management in several times is faced with choosing between many investments avenues.

- ✓ Under such situations, it becomes difficult for the management to compare the risk associated with different projects using Standard Deviation as each project has different estimated cash flow values.
- ✓ In such cases, the Coefficient of Variation becomes useful.
- ✓ The Coefficient of Variation calculates the risk borne for every percent of expected return.
- ✓ It is calculated as:

$$\text{Co-efficient of variation} = \frac{\text{Standard Deviation}}{\text{Expected Return or Expected Cash Flow}}$$

- ✓ When a selection has to be made between two projects, the management would select a project which has a **lower** Coefficient of Variation.

Q12. Briefly explain the concept of “risk-adjusted discount rate” as a conventional technique of risk analysis in capital budgeting.

Answer:

- ✓ The use of risk adjusted discount rate is based on the concept that investors demands higher returns from the risky projects.
- ✓ The required rate of return on any investment should include compensation for delaying consumption equal to risk free rate of return, plus compensation for any kind of risk taken on.
- ✓ In case, the risk associated with any investment project is higher than risk involved in a similar kind of project, discount rate is adjusted upward in order to compensate this additional risk borne.
- ✓ It is given by,

$$\text{NPV} = \sum_{t=0}^n \frac{\text{NCF}_t}{(1+k)^t} - I$$

Where,

NCF_t = Net Cash Flow

K = Risk adjusted discount rate

I = Initial Investment

Q13. What are the different concepts of “risk-adjusted discount rate”.Briefly explain such components.

Answer:

- ✓ A risk adjusted discount rate is a sum of risk free rate and risk premium.
- ✓ The Risk Premium depends on the perception of risk by the investor of a particular investment and risk aversion of the Investor.
So, Risks adjusted discount rate = Risk free rate+ Risk premium
- ✓ Risk Free Rate:
It is the rate of return on Investments that bear no risk. For e.g., Government securities yield a return of 6 % and bear no risk. In such case, 6 % is the risk-free rate.
- ✓ Risk Premium:
It is the rate of return over and above the risk-free rate, expected by the Investors as a reward for bearing extra risk. For high risk project, the risk premium will be high and for low risk projects, the risk premium would be lower.

Q14. Briefly explain the advantages and limitations of “risk-adjusted discount rate” as a conventional technique of risk analysis in capital budgeting.

Answer:

Advantages of Risk-adjusted discount rate:

1. It is easy to understand.
2. It incorporates risk premium in the discounting factor.

Limitations of Risk-adjusted discount rate:

1. Difficulty in finding risk premium and risk-adjusted discount rate.
2. Assumption that investors are risk averse is always not true.

Q15. Briefly explain the concept of “Certainty Equivalent (CE)” as a conventional technique of risk analysis in capital budgeting.

Answer:

- ✓ The definition of “Certainty Equivalent (CE)” as per CIMA terminology can be stated as below:
“An approach to dealing with risk in a capital budgeting context.”
- ✓ It involves expressing risky future cash flows in terms of the certain cash flow which would be considered, by the decision maker, as their equivalent.
- ✓ Thus, in this approach a set of risk less cash flow is generated in place of the original cash flows.
- ✓ As a result of this, the decision maker would be indifferent between the risky amount and the (lower) riskless amount, considering it to be equivalent.”
- ✓ The certainty equivalent is a guaranteed return that the management would accept rather than accepting a higher but uncertain return.
- ✓ This approach allows the decision maker to incorporate his or her utility function into the analysis.

Q16. Mention briefly the steps involved in “Certainty Equivalent (CE)”.

Answer:

Step 1:

- ✓ Remove risk by substituting equivalent certain cash flows from risky cash flows. This can be done by multiplying each risky cash flow by the appropriate α_t value (CE coefficient)
- ✓ For example,
 - Suppose on tossing out a coin, if it comes head you will get ₹ 10,000 and if it comes out to be tail, you will win nothing.
 - Thus, you have 50% chances of winning and expected value is ₹ 5,000.

Risk Analysis in Capital Budgeting

- In such case if you are indifferent at receiving ₹ 3,000 for a certain amount and not playing then ₹ 3,000 will be certainty equivalent and 0.3 (i.e. 3,000/10,000) will be certainty equivalent coefficient.

Step 2:

- ✓ Discounted value of cash flow is obtained by applying risk less rate of interest.
- ✓ Since you have already accounted for risk in the numerator using CE coefficient, using the cost of capital to discount cash flows will tantamount to double counting of risk.

Step 3:

- ✓ After that normal capital budgeting method is applied except in case of IRR method, where IRR is compared with risk free rate of interest rather than the firm's required rate of return.
- ✓ Certainty Equivalent Coefficients transform expected values of uncertain flows into their Certainty Equivalents.
- ✓ It is important to note that the value of Certainty Equivalent Coefficient lies between 0 & 1. Certainty Equivalent Coefficient 1 indicates that the cash flow is certain or management is risk neutral.
- ✓ In industrial situation, cash flows are generally uncertain and managements are usually risk averse.
- ✓ Under this method

$$NPV = \sum_{t=0}^n \frac{\alpha_t NCF_t}{(1 + k_f)^t} - I$$

Where,

NCF_t = the forecasts of net cash flow without risk-adjustment

α_t = the risk-adjustment factor or the certainty equivalent coefficient

K_f = risk-free rate assumed to be constant for all periods

Q17. Mention the advantages and disadvantages of Certainty Equivalent Method.

Answer:

Advantages of Certainty Equivalent Method:

1. The certainty equivalent method is simple and easy to understand and apply.
2. It can easily be calculated for different risk levels applicable to different cash flows. For example, if in a particular year, a higher risk is associated with the Cash Flow, it can be easily adjusted and the NPV can be recalculated accordingly.

Disadvantages of Certainty Equivalent Method:

1. There is no Statistical or Mathematical model available to estimate certainty Equivalent. **Risk** being subjective, it varies on the perception of the risk by the management because of bias and individual opinions involved.
2. There is no objective or mathematical method to estimate certainty equivalents. **Certainty Equivalent** is subjective and varies as per each individual's estimate.
3. Certainty equivalents are decided by the management based on their perception of risk. However the risk perception of the shareholders who are the money lenders for the project is ignored. Hence it is not used often in corporate decision making.

Q18. Write a short note on:

“Risk-adjusted discount rate Vs. Certainty-Equivalent”

Answer:

- ✓ Certainty Equivalent Method is superior to Risk Adjusted Discount Rate Method as it does not assume that risk increases with time at constant rate.
- ✓ Each year's Certainty Equivalent Coefficient is based on level of risk impacting its cash flow.
- ✓ Despite its soundness, it is not preferable like Risk Adjusted Discount Rate Method.

Risk Analysis in Capital Budgeting

- ✓ It is difficult to specify a series of Certainty Equivalent Coefficients but simple to adjust discount rates.

Q19. Briefly explain the concept of “Sensitivity Analysis” as one of the techniques of risk analysis in capital budgeting.

Answer:

- ✓ Definition of sensitivity analysis: As per CIMA terminology, “A modeling and risk assessment procedure in which changes are made to significant variables in order to determine the effect of these changes on the planned outcome. Particular attention is thereafter paid to variables identifies as being of special significance”.
- ✓ Sensitivity analysis, in simple terms, is a modeling technique which is used in Capital Budgeting decisions which is used to study the impact of changes in the variables on the outcome of the project.
- ✓ In a Project, several variables like weighted average cost of capital, consumer demand, price of the product, cost price per unit etc. operate simultaneously.
- ✓ The changes in these variables impact the outcome of the project.
- ✓ However, it is very difficult to assess change in which variable impacts the project outcome in a significant way.
- ✓ In Sensitivity Analysis, the project outcome is studied after taking into change in only **one** variable.
- ✓ The more sensitive is the NPV, the more critical is that variable.

Q20. Mention the steps involved in Sensitivity Analysis.

Answer:

The steps involved in conducting sensitivity analysis are explained as below:

1. Finding variables, which have an influence on the NPV (or IRR) of the project
2. Establishing mathematical relationship between the variables.
3. Analysis the effect of the change in each of the variables on the NPV (or IRR) of the project.

Q21. Mention the advantages and disadvantages of Sensitivity Analysis.

Answer:

Advantages of Sensitivity Analysis:

1. Critical Issues:

This analysis identifies critical factors that impinge on a project's success or failure.

2. Simplicity:

This analysis is quite simple.

Disadvantages of Sensitivity Analysis:

1. Assumption of Independence:

This analysis assumes that all variables are independent i.e. they are not related to each other, which is unlikely in real life.

2. Ignore probability:

This analysis does not look to the probability of changes in the variables.

3. Not so reliable:

This analysis provides information on the basis of which decisions can be made but does not point directly to the correct decision.

Q22. Briefly explain the concept of "Scenario Analysis" as one of the techniques of risk analysis in capital budgeting.

Answer:

- ✓ Although sensitivity analysis is probably the most widely used risk analysis technique, it does have limitations.
- ✓ Therefore, we need to extend sensitivity analysis to deal with the probability distributions of the inputs.
- ✓ In addition, it would be useful to vary more than one variable at a time so we could see the combined effects of changes in the variables.
- ✓ Scenario analysis provides answer to these situations of extensions.
- ✓ This analysis brings in the probabilities of changes in key variables and also allows us to change more than one variable at a time.
- ✓ This analysis begins with base case or most likely set of values for the input variables.

Risk Analysis in Capital Budgeting

- ✓ Then, go for worst case scenario (low unit sales, low sale price, high variable cost and so on) and best case scenario.
- ✓ So, in a nutshell Scenario analysis examines the risk of investment, so as to analyze the impact of alternative combinations of variables, on the project's NPV (or IRR).

Q23. Write a short note on the following:

“Scenario Analysis vs. Sensitivity Analysis”

Answer:

- ✓ Sensitivity analysis and Scenario analysis both help to understand the impact of the change in input variable on the outcome of the project.
- ✓ However, there are certain basic differences between the two.
- ✓ Sensitivity analysis calculates the impact of the change of a single input variable on the outcome of the project viz., NPV or IRR.
- ✓ The sensitivity analysis thus enables to identify that single critical variable that can impact the outcome in a huge way and the range of outcomes of the project given the change in the input variable.
- ✓ Scenario analysis, on the other hand, is based on a scenario.
- ✓ The scenario may be recession or a boom wherein depending on the scenario, all input variables change.
- ✓ Scenario Analysis calculates the outcome of the project considering this scenario where the variables have changed simultaneously.
- ✓ Similarly, the outcome of the project would also be considered for the normal and recessionary situation.
- ✓ The variability in the outcome under the three different scenarios would help the management to assess the risk a project carries.
- ✓ Higher deviation in the outcome can be assessed as higher risk and lower to medium deviation can be assessed accordingly.
- ✓ Scenario analysis is far more complex than sensitivity analysis because in scenario analysis all inputs are changed simultaneously considering the situation in hand while in sensitivity analysis only one input is changed and others are kept constant.

Q24. Briefly explain “Monte Carlo Simulation” as one of the techniques of risk analysis in capital budgeting.

Answer:

- ✓ Monte Carlo simulation ties together sensitivities and probability distributions.
- ✓ This analysis starts with carrying out a simulation exercise to model the investment project.
- ✓ It involves identifying the key factors affecting the project and their inter relationships.
- ✓ This analysis specifies a range for a probability distribution of potential outcomes for each of model’s assumptions.
- ✓ Monte Carlo simulation is a computerized mathematical technique that allows decision makers to calculate risk and uncertainty in decision making.
- ✓ Monte Carlo simulation generates a range of possible outcomes and their probabilities associated with those outcomes.
- ✓ It also shows the probabilities of extreme possibilities like the probability of best case and the worst case along with the probabilities of a range of outcomes.
- ✓ The technique is widely used in fields as finance, project management, Portfolio Management, Stock Return Analysis etc. Under Simulation NPV can be calculated as

$$NPV = \sum_{t=0}^n \frac{NCF_t}{(1 + k_t)^t} - I$$

Where,

NCF_t = Net Cash flow

K_f = Risk free rate

I = Initial Investment

Q25. What are the different steps involved in Simulation Analysis.

Answer:

The following list down the different steps involved in Simulation Analysis:

1. Identification of variables that influence cash inflows and outflows.
2. Specify values of parameters and probability distributions of variables.
3. Select a value at random from probability distribution of each of the variables.
4. Determine NPV corresponding to the randomly generated value of variables.
5. Repeat steps (3) & (4) a large number of times to get a large number of simulated NPVs.
6. Plot probability distribution of NPVs.

Q26. What are the different applications of Simulation Analysis?

Answer:

The different applications of simulation analysis are mentioned as below:

1. It is used in Project Finance to model the random Variables with which uncertainty is associated viz., Cash flows, and variable expenses.
2. It is used for Options Pricing where the various factors like implied volatility, price of the underlying asset are the random variables and the different ranges of these individual random variables can be calculated using Monte Carlo Simulation.
3. It is used for making a judgment of the return out of a Stock or a Stock Portfolio. Thus it is of significant importance in Portfolio Management and Retirement Planning.

Q27. Mention the advantages and limitation of Simulation Analysis?

Answer:

Monte Carlo simulation has the following advantages for analysis of results where uncertainty is associated:

1. Monte Carlo simulation provides useful inputs for Sensitivity Analysis by helping to understand variability in which inputs affects the outcome to the biggest extent.
2. Using Monte Carlo simulation, a judgment can be made as to the range in which the input lies under a particular scenario. Thus using the results of Monte Carlo Simulation, different scenarios can be studied.
3. The results produced by Monte Carlo Simulation also show the associated probability of the results occurring. Thus it simplifies the decision making process of the management.
4. In a complex decision making environment, different variables are inter- dependent on each other and that impacts the end result out of a project. Monte Carlo simulation helps to understand the interdependency between input variables. Understanding this inter dependability, enables to reduce the complexity of decision.

The limitations of simulation analysis are mentioned as below:

1. Difficult to model the project and specify probability distribution of various variables.
2. Simulation provides only rough approximation of probability distribution of NPV.
3. Simulation model is complex and can be constructed by management expert and not by the decision maker.
4. Determine NPV in simulation run, risk free discount rate is used which may not give correct picture.

Q28. Write a short note on decision tree analysis.

Answer:

- ✓ Practically investment decisions may have implications for future or further investment decisions, and may also impact future decision and events.
- ✓ Such situation can be handled by taking a sequence of decisions over a period of time.
- ✓ The technique to handle this type of sequential decisions is done through “Decision Tree” technique.
- ✓ A Decision tree is a graphical representation of relationship between future decisions and their consequences.
- ✓ The sequence of events is shown in a format resembling branches of tree, each branch representing a single possible decision, its alternatives and the probable result in terms of NPV, ROI etc.
- ✓ The alternative with the highest amount of expected monetary value is selected.

Q29. Mention the different assumptions used in decision tree analysis.

Answer:

The decision tree analysis approach assumes that there are only two types of situation that a finance manager has to face :

1. The first situation is where the manager has control or power to determine what happens next. This is known as “Decision”, as he can do what he desires to do.
2. The second situation is where finance manager has no control over what happens next. This is known as “Event”. Since the outcome of the events is not known, a probability distribution needs to be assigned to the various outcomes or consequences.
3. When a finance manager faced with a decision situation, he is assumed to act rationally. For example, in a commercial business, he will choose the most profitable course of action and in non-profit organization; the lowest cost may be rational choice.

Q30. What are the different steps involved in decision tree analysis?**Answer:**

The steps involved in decision tree analysis are mentioned as below:

Step 1: Define Investment:

- ✓ Decision tree analyses can be applied to a variety of business decision-making scenarios.
- ✓ Normally it includes following types of decisions.
 - Whether or not to launch a new product, if so, whether this launch should be local, national, or international.
 - Whether extra production requirement should be met by extending the factory or by out sourcing it to an external supplier.
 - Whether to dig for oil or not if so, up to what height and continue to dig even after finding no oil up to a certain depth.

Step 2: Identification of Decision Alternatives:

- ✓ It is very essential to clearly identify decision alternatives.
- ✓ For example, if a company is planning to introduce a new product, it may be local launch, national launch or international launch.

Step 3: Drawing a Decision Tree:

- ✓ After identifying decision alternatives, at the relevant data such as the projected cash flows, probability distribution expected present value etc. should be put in diagrammatic form called decision tree.
- ✓ While drawing a decision tree, it should be noted that NPVs etc. should be placed on the branches of decision tree, coming out of the decisions identified.
- ✓ While drawing a decision tree, it should be noted that:-
 - The decision point (traditionally represented by square □), is the option available for manager to take or not to take. This is known as decision node.
 - The event or chance or outcome (traditionally represented by circle O) which are dependent on chance process, along with the probabilities thereof, and monetary value associated with them. This is known as chance node.

Risk Analysis in Capital Budgeting

- This diagram is drawn from left to right.

Step 4: Evaluating the Alternatives:

- ✓ After drawing out the decision the next step is the evaluation of alternatives.
- ✓ The various alternatives can be evaluated as follows:
 - i. This procedure is carried out from the last decision in the sequence (extreme right) and goes on working back to the first (left) for each of the possible decision.
 - ii. At each final stage decision point, select the alternative which has the highest NPV and truncate the other alternatives. Each decision point is assigned a value equal to the NPV of the alternative selected at the decision point.
 - iii. Proceed backward in the same manner calculating the NPV at chance or event or outcome points (O) selecting the decisions alternative which has highest NPV at various decision points [□] rejecting the inferior decision option, assigning NPV to the decision point, till the first decision point is reached.

Q31. Mention the advantages and limitation of using decision tree analysis?

Answer:

The advantages of using decision tree analysis are mentioned as below:

1. The Decision nodes enable to set out the various options available thus ensuring that no option is left out to be considered.
2. All the options available can be considered simultaneously thus allowing comparison.
3. Risk is addressed in an objective manner by use of probabilities.
4. Decision Trees enable the evaluation of the options by considering the Cash Outflows and the Cash Inflows. Thus it enables to evaluate the different options on the basis of the Net benefit arising out of that project.
5. Simple to understand and apply.

The limitations of using decision tree analysis are mentioned as below:

1. Probabilities cannot be calculated objectively.
2. Decision Trees use only that data which can be quantified. It ignores qualitative aspects of decisions.
3. Assignment of probabilities and expected values do not have any relevant basis as it pertains to a future outcome which is uncertain.

Practical Problems

1. FMCG Ltd. is evaluating to spend ₹4 lakhs on a project to manufacture and sell a new product. The unit variable cost of the product is ₹6. It is expected that the new product can be sold at ₹10 per unit. The annual fixed cost (only cash) will be ₹20,000. The project will have a life of 6 years with a scrap value of ₹20,000. The cost of capital of the company is 15%. The only uncertain factor is the volume of sales. To start with the company expects to sell at least 40,000 units during the first year.

You are required to find out (ignoring tax):

- Net Present Value of the project based on the sales expected during the first year and on the assumption that it will continue at the same level during the remaining years.
 - The minimum volume of sales required to justify the project.
2. Jumble Consultancy Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows:

Cash	-15000	-10000	-4000	0	15000	10000	5000	1000
flow in								
Utilities	-100	-60	-3	0	40	30	20	10

The distribution of cash flows of Project A and Project B are as follows

Project A

Cash flow(₹)	-15000	-10000	15000	10000	5000
Probability	0.10	0.20	0.40	0.20	0.10

Project B

Cash flow(₹)	-10000	-4000	15000	5000	10000
Probability	0.10	0.15	0.40	0.25	0.10

Which project should be selected and why?

----- [May 2011, 8 Marks] -----

3. ABC Chemicals is evaluating two alternative systems for waste disposal, System A and System B, which have lives of 6 years and 4 years respectively. The initial investment outlay and annual operating costs for the two systems are expected to be as follows:

	System A	System B
Initial Investment Outlay	₹5 million	₹4 million
Annual Operating Costs	₹1.5 million	₹1.6 million
Salvage value	₹1 million	₹0.5 million

If the hurdle rate is 15%, which system should ABC Chemicals choose?

4. A firm has an investment proposal requiring an outlay of ₹80,000. The investment proposal is expected to have 2 years economic life with no salvage value. The probabilities assigned to cash inflows after tax are as follows.

Year 1	Probability	Year 2	Probability
50000	0.4	24000	0.2
		32000	0.3
		44000	0.5
60000	0.6	40000	0.4
		50000	0.5
		60000	0.1

The firm uses 10% discount rate for this type of investment.

Required:

- Construct a decision tree for the proposed investment project.
- What net present value will the project yield if the worst outcome is realized? What is the probability of occurrence of this NPV?
- What will be the NPV in best outcome and the probability of occurrence of that NPV?
- Will the project be accepted?
- Do the profitability index and the NPV criterion of evaluating investment proposals lead to the same acceptance-rejection and ranking decisions? In what situations will they give conflicting results?

----- [May 2004, 16 Marks] ----- [Nov 1999, 14 Marks] -----

Risk Analysis in Capital Budgeting

5. A company is considering Projects X and Y with following information:

Project	Expected NPV	Standard Deviation
X	₹1,22,000	₹90,000
Y	₹2,25,000	₹1,20,000

- a. Which project will you recommend based on the above data?
- b. Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.
- c. Which measure is more appropriate in this situation and why?

----- [May 2003, 3 Marks] -----

6. Gretel Limited is setting up a project for manufacture of boats at a cost of Rs.300 lakhs. It has to decide whether to locate the plant in next to the sea shore (Area A) or in an inland area with no access to any waterway (Area B). If the project is located in Area B then Gretel Limited receives a cash subsidy of Rs. 20 lakhs from the Central Government. Besides, the taxable profit to the extent of 20% is exempt for 10 years in Area B. The project envisages a borrowing of Rs. 200 lakhs in either case. The rate of interest per annum is 12% in area A and 10% in Area B.

The borrowing of principal has to be repaid in 4 equal installments beginning from the end of the 4th year.

With the help of the following information, you are required to suggest the proper location for the project to the CEO of Gretel Limited. Assume straight line depreciation with no residual value, income tax 50% and required rate of return of 15%.

Year	Earnings before depreciation, Interest and Tax (EBIDT) (Rs. In lakhs)	
	Area A	Area B
1	(6)	(50)
2	34	(50)
3	54	10
4	74	20
5	108	45
6	142	100

7	156	155
8	230	190
9	330	230
10	430	330

The PVIF @ 15% for 10 years are as below:

Year	1	2	3	4	5	6	7	8	9	10
PVIF	0.87	0.76	0.66	0.57	0.50	0.43	0.38	0.33	0.28	0.25

----- [Nov 2014, 10 Marks] -----

7. A company is considering two mutually exclusive projects X and Y. Project X costs ₹30,000 and Project Y ₹36,000. You have been given below the net present value & probability distribution for each project

Project X

NPV Estimate	Probability
₹3000	0.1
₹6000	0.4
₹12000	0.4
₹15000	0.1

Project Y

NPV Estimate	Probability
₹3000	0.2
₹6000	0.3
₹12000	0.3
₹15000	0.2

1. Compute the expected net present value of Project X and Y.
2. Compute the risk attached to each project (SD).
3. Which project is more risky? Give reasons.
4. Compute the profitability index of each project.

-----[May 1999, 14 Marks]-----[June 2009, 14 Marks]-----

Risk Analysis in Capital Budgeting

8. XYZ Ltd. an infrastructure company is evaluating a proposal to build, operate and transfer a section of 35 km of road at a project cost of ₹200 crores to be financed as follows. Equity share capital ₹50 crores, loans at the interest rate of 15% p.a. from financial institutions ₹150 crores. The project after completion will be open to traffic and a toll will be collected for a period of 15 years from the vehicles using the road. The company is also required to maintain the road during the above 15 years and after the completion of that period, it will be handed over to NHAI at zero value. It is estimated that the toll revenue will be ₹50 crores per annum and the annual toll collection expenses including maintenance of roads will amount to 5% of the project cost. The company considers writing off the total cost of the project in 15 years on a straight line basis. For corporate income tax purposes the company is allowed to take depreciation @ 10% on WDV basis.

The financial institutions are agreeable for the repayment of the loan in 15 annual installments- consisting of principle and interest.

Calculate project IRR and equity IRR. Ignore corporate tax.

----- [Nov 2001, 14 Marks] -----

9. A company named Roby's cube decided to replace the existing computer system of their organisation. Original cost of old system was ₹25,000 and it was installed 5 years ago. Current market value of old system is ₹5,000. Depreciation of the old system was charged with life of 10 years. Depreciation of the new system will be charged with life of 5 years. Estimated salvage value of the old system was Nil. Present cost of the new system is ₹50,000. Estimated salvage value of the new system is ₹1,000. Estimated cost savings with new system is ₹5,000 per year. Increase in sales with new system is assumed at 10% per year based on original total sales of ₹1,00,000. Company follows the straight line method of depreciation. Cost of capital of the company is 10% whereas tax rate is 30%. Advise the company for replacement option.

10. DL Services is in the business of providing home services like plumbing, sewerage line cleaning etc. There is a proposal before the company to purchase mechanised sewerage cleaning line for a sum of ₹20 lacs. The life of the machine is 10 years. The present system of the company is to use manual labour for the job. You are provided with the following information.

Cost of the machine	₹20 lacs
Depreciation	20% straight line
Operating cost	₹5 lacs p.a.
Present system	
Manual labour	200 Labour
Cost of Manual Labour	₹10,000 per labour p.a.

The company has an after tax cost of funds of 10% p.a. Tax rate applicable is 35%

Based on the above you are required to: a) state whether it is advisable to purchase the machine. b) Compute the savings/additional cost as applicable if the machine is purchased.

----- [May 2008, 12 Marks] -----

11. XYZ Food Pvt. Ltd., a franchisee of Domino's (World famous food chain for delivering pizza at home) is considering a proposal of acquiring a fleet of motorbikes for delivery of pizzas at home of customers. Since pizzas are also delivered in late night and bikes are handled by different delivery boys (due shift working) the use of fleet will be very heavy. Hence it is expected that the motorbike shall be virtually worthless and scrapped after a period of 3 years. However they are taken out of services before 3 years there will be a positive 'abandonment' cash flow.

The initial cost of the bike will be ₹1,00,000. The expected post tax benefit (cash inflows) from the use of bike and abandonment cash inflows are as follows:

Risk Analysis in Capital Budgeting

Year	Operating Cash Flows	Abandonment cash flows at the end of the year
1	42,000	62,000
2	40,000	40,000
3	35,000	0

The cost of capital of XYZ Pvt. Ltd. is 10%. You are required to evaluate the proposal of acquisition of bikes and recommend preferable life of the same.
[Nov 14 RTP]

- 12.** A machine used on a production line must be replaced at least every four years.

Costs incurred to run the machine according to its age are:

	Age of the Machine (years)				
Figures in (₹)	0	1	2	3	4
Purchase Price	60,000				
Maintenance		16,000	18,000	20,000	20,000
Repair		0	4,000	8,000	16,000
Scrap Value		32,000	24,000	16,000	8,000

Future replacement will be with identical machine with same cost. Revenue is unaffected by the age of the machine. Ignoring inflation and tax, determine the optimum replacement cycle. PV factors of the cost of capital of 15% for the respective four years are 0.8696, 0.7561, 0.6575 and 0.5718.

----- **[May 2012, 10 Marks]** -----

- 13.** Company Y is operating an elderly machine that is expected to produce a net cash inflow of ₹40,000 in the coming year and ₹40,000 next year. Current salvage value is ₹80,000 and next year's value is ₹70,000. The machine can be replaced now with a new machine, which costs ₹1,50,000, but is much more efficient and will provide a cash inflow of ₹80,000 a year for 3 years. Company Y wants to know whether it should replace the equipment now or wait a year with the clear understanding that the new machine is the best of the available alternatives and that it in turn be replaced at the optimal point. Ignore tax. Take opportunity cost of capital as 10 per cent. Advise with reasons.

14. A company has an old machine having book value zero – which can be sold for ₹50,000. The company is thinking to choose one from following two alternatives:

- i. To incur additional cost of ₹10,00,000 to upgrade the old existing machine.
- ii. To replace old machine with a new machine costing ₹20,00,000 plus installation cost ₹50,000.

Both above proposals envisage useful life to be five years with salvage value to be nil. The expected after tax profits for the above three alternatives are as under:

Year	Old Existing Machine	Upgraded Machine	New Machine
1	5,00,000	5,50,000	6,00,000
2	5,40,000	5,90,000	6,40,000
3	5,80,000	6,10,000	6,90,000
4	6,20,000	6,50,000	7,40,000
5	6,60,000	7,00,000	8,00,000

The tax rate is 40 per cent.

The company follows straight line method of depreciation. Assume cost of capital to be 15 per cent.

P.V.F. of 15%, 5 = 0.870, 0.756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

15. A & Co. is contemplating whether to replace an existing machine or to spend money on overhauling it. A & Co. currently pays no taxes. The replacement machine costs ₹90,000 now and requires maintenance of ₹10,000 at the end of every year for eight years. At the end of eight years it would have a salvage value of ₹20,000 and would be sold. The existing machine requires increasing amounts of maintenance each year and its salvage value falls each year as follows:

Year	Maintenance	Salvage
Present	0	₹40,000
1	₹10,000	₹25,000

Risk Analysis in Capital Budgeting

2	₹20,000	₹15,000
3	₹30,000	₹10,000
4	₹40,000	0

The opportunity cost of capital is 15% and you are required to find out when the company should replace the machine.

16. Examine Well Ltd. has a limit of ₹10,00,000 available for investment in the current year. The cost of capital of the firm is 10%. There is no capital rationing in future. The company has five indivisible projects for evaluation.

Project	Initial Cost	NPV@ 10%
I	3,50,000	1,75,000
II	4,00,000	2,25,000
III	6,50,000	3,80,000
IV	4,80,000	3,15,000
V	2,30,000	90,000

Suggest an optimum investment plan if

- There is no alternative investment for surplus funds, or
 - The surplus funds can be invested to produce 12% in perpetuity.
17. A company engaged in manufacturing of toys is considering a line of stationery items with an expected life of 5 years. From past experience the company has a conservative view in its investment in new products. Accordingly the company considers the stationery items an abnormally risky project. The company's management is of the view that normally required rate of return of 10% will not be sufficient and hence the minimum required rate of return should be 15%. The initial investment in the project will be of ₹1,10,00,000 and expected free cash flows to be generated from the project is ₹30,00,000 for 5 years. Determine whether the project should be accepted or not.

18. Determine the risk adjusted net present value of the following projects

	X	Y	Z
Net Cash outlays	210000	120000	100000
Project life	5 years	5 years	5 years
Annual cash inflow	70000	42000	30000
Coefficient of variation	1.2	0.8	0.4

The company selects the risk adjusted discount factor on the basis of the coefficient of variation as follows:

Coefficient of variation	RADR	Present value factor of 1-5 years @ RADR
0.0	10%	3.791
0.4	12%	3.605
0.8	14%	3.433
1.2	16%	3.274
1.6	18%	3.127
2.0	22%	2.864
More than 2	25%	2.689

----- [Nov 2005, 6 Marks] ----- [May 1999, 6 Marks] -----

19. New projects Ltd. is evaluating 3 projects P-I, P-II, P-III. Following information is available in respect of these projects.

	P-I	P-II	P-III
Cost Inflows	₹15,00,000	₹11,00,000	₹19,00,000
Year 1	6,00,000	6,00,000	4,00,000
Year 2	6,00,000	4,00,000	6,00,000
Year 3	6,00,000	5,00,000	8,00,000
Year 4	6,00,000	2,00,000	12,00,000
Risk Index	1.80	1.00	0.60

Minimum required rate of return of the firm is 15% and applicable tax rate is 40%. The risk free interest rate is 10%

Required

1. Find out the risk adjusted discounted rate (RADR) for these projects.
2. Which project is best?

-----[Nov 2009, 10 Marks]-----

20. The globe manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals – Project X and Project Y, which require cash outlays of ₹3,40,000 and ₹3,30,000 respectively. The certainty-equivalent approach is used in incorporating risk in capital budgeting decisions. The current yield on government bond is 8% and this is to be used as the riskless rate. The expected net cash flows and their certainty equivalents are as follows:

Year	Project X		Project Y	
	Cash flow	C.E.	Cash flow	C.E.
1	1,80,000	0.8	1,80,000	0.9
2	2,00,000	0.7	1,80,000	0.8
3	2,00,000	0.5	2,00,000	0.7

Required:

1. Which project should be accepted?
 2. If risk adjusted discount rate method is used, which project would be analysed with higher rate?
21. The following information applies to a new project:

Initial investment	₹125,000
Selling price per unit	₹100
Variable cost per unit	₹30
Fixed cost for the period	₹1,00,000
Sales Volume	2,000
Life	5 years
Discount rate	10%

Required: Projects NPV and show how sensitive the results are to various factors.

22. XYZ Ltd. is considering a project for which the following estimates are available:

Initial cost of the outlay	₹10,00,000
Selling price /unit	₹60
Cost/unit	₹40
Sales Volume	
Year 1	20000 units
Year 2	30000 units
Year 3	30000 units
Discount rate 10% p.a.	

You are required to measure the sensitivity of the project in relation to each of the following parameters

- I. Selling price/unit.
- II. Unit cost.
- III. Sales volume.
- IV. Initial outlay.
- V. Project lifetime.

-----[May 2007, 16 Marks]-----

Risk Analysis in Capital Budgeting

- 23.** Unnat Ltd. is considering investing ₹50,00,000 in a new machine. The expected life of machines is five years and has no scrap value. It is expected that 2,00,000 units will be produced and sold each year at a selling price of ₹30.00 per unit. It is expected that the variable costs to be ₹16.50 per unit and fixed costs to be ₹10,00,000 per year. The cost of capital of Unnat Ltd. is 12% and acceptable level of risk is 20%

You are required to measure the sensitivity of the project's net present value to a change in the following project variables.

- a) Sale Price.
- b) Sales Volume.
- c) Variable Cost.

And discuss the use of sensitivity analysis as a way of evaluating project risk. On further investigation it is found that there is a significant chance that the expected sales volume of 2,00,000 units per year will not be achieved. The sales manager of Unnat Ltd. suggests that sales volumes could depend on expected economic states that could be assigned the following probabilities.

State of Economy	Annual Sales (in units)	Prob.
Poor	1,75,000	0.30
Normal	2,00,000	0.60
Good	2,25,000	0.10

Calculate expected net present value of the project and give your decision whether company should accept the project or not.

- 24.** The Easygoing Company Limited is considering a new project with initial investment, for a product "Survival". It is estimated that IRR of the project is 16% having an estimated life of 5 years.

Financial Manager has studied that project with sensitivity analysis and informed that annual fixed cost sensitivity is 7.8416%, whereas cost of capital (discount rate) sensitivity is 60%.

Other information available are:

Profit Volume Ratio (P/V) is	70%,
Variable cost	₹60/- per unit
Annual Cash Flow	₹57,500/-

Ignore Depreciation on initial investment and impact of taxation.

Calculate

- I. Initial Investment of the Project.
- II. Net Present Value of the Project.
- III. Annual Fixed Cost.
- IV. Estimated annual unit of sales.
- V. Break Even Units.

Cumulative Discounting Factor for 5 years

8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%
3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127

25. S Ltd finds an opportunity to invest in a 2 year project and will cost ₹1 lakh.

The estimated cash flows for the first year are given below

Cash Flows	Probability
₹40000	30%
₹60000	40%
₹80000	30%

The second year cash flows with conditional probability are

Scenario 1

Cash Flows	Probability
₹20000	20%
₹50000	60%
₹80000	20%

Scenario 2

Cash Flows	Probability
₹70000	30%
₹80000	40%
₹90000	30%

Scenario 3

Cash Flows	Probability
₹80000	10%
₹100000	80%

Risk Analysis in Capital Budgeting

₹120000 10%

The relevant cost of capital is 8% find the project's NPV.

26. ABC and Co. is considering a proposal having an initial outlay of ₹1,50,000 and a life of 2 years. The firm's required rate of return is 10%. It is expected that the cash inflow for year 2 is affected by the cash flow of year 1. Other details of the cash inflows are as follows:

Year 1		Year 2	
Cash Inflows	Probability	Cash Inflows	Probabilities
1,00,000	0.4	1,40,000	0.5
		60,000	0.3
		70,000	0.2
60,000	0.6	2,00,000	0.6
		1,20,000	0.3
		80,000	0.1

Evaluate the proposal.

27. XY Ltd. has under its consideration a project with an initial investment of ₹1,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow (₹)	20,000	30,000	40,000
Probability	0.1	0.7	0.2

The project's life is 5 years and the desired rate of return is 20%. The estimated terminal values for the project assets under the three probability alternatives, respectively are ₹0, ₹20,000 and ₹30,000.

You are required to:

- Find the probable NPV
- Find the worst case NPV and the best case NPV and
- State the probability of occurrence of the worst case, if the cash flows are perfectly positively correlated over time.

----- [May 2010, 12 Marks] -----

28. Following are the estimates of the net cash flows and probabilities of a project of M/s X Ltd.

	Year	P=0.3	P=0.5	P=0.2
Initial investment	0	4,00,000	4,00,000	4,00,000
Estimated net after tax cash flows per year	1 to 5	1,00,000	1,10,000	1,20,000
Estimated after tax salvage value	5	20,000	50,000	60,000

Required rate of return for the project is 10%

Find:

- i) The expected NPV of the project
- ii) The best case and worst case NPVs
- iii) The probability of occurrence of the worst case, if the cash flows are
 - a. Perfectly dependent over time
 - b. Independent overtime
- iv) Standard deviation and coefficient of variation assuming that there are only three streams of cash flow, which are represented by each column of the table with the given probabilities.
- v) Coefficient of variation of X Ltd. on its average project which is in the range of 0.95 to 1.0. If the coefficient of variation of the project is found to be less risky than average, 100 basis points are deducted from the company's cost of capital to calculate the NPV again.

----- [Nov 2006, 16 Marks] -----

29. L & R Limited wishes to develop new virus-cleaner software. The cost of the pilot project would be ₹2,40,000. Presently, the chances of the product being successfully launched on a commercial scale are 50%. L&R can invest the sum of ₹20 lacs to market the product. Such an effort can generate perpetually, an annual net after tax cash income of ₹4 lacs. Even if the commercial launch fails, they can make an investment of smaller amount of ₹12 lacs with the hope of gaining perpetually a sum of ₹1 lac. Evaluate the proposal, adopting the decision tree approach. The discount rate is 10%.

Risk Analysis in Capital Budgeting

30. Big oil is wondering whether to drill for oil in X country. The prospects are as follows:

Depth of well (feet)	Total cost (Millions of dollars)	Cumulative probability of finding oil	PV of oil (if found) Millions of dollars
2000	4	0.5	10
4000	5	0.6	9
6000	6	0.7	8

Draw a decision tree showing the successive drilling decisions to be made by Big Oil. How deep should it be prepared to drill?

31. You own an unused gold mine that will cost ₹10,00,000 to reopen. If you open the mine, you expect to be able to extract 1000 ounces of gold a year for each of three years. After that the deposit will be exhausted. The gold price is currently ₹5,000 an ounce, and each year the price is equally likely to rise or fall by ₹500 from its level at the start of the year. The extraction cost is ₹4,600 an ounce and the discount rate is 10%.

Required:

- Should you open the mine now or delay by one year in the hope of a rise in the gold price?
- What difference would it make to your decision if you could shut down the mine at any stage? Show the value of abandonment option.

----- [Nov 2004, 20 Marks] -----

32. Project X and Project Y are under the evaluation of XY & Co. The estimated cash flows and their probabilities are as below:

Project X: Investment at year "0" ₹70 lacs

Probability	0.30	0.40	0.30
Year	₹in lacs	₹ in lacs	₹in lacs
1	30	50	65
2	30	40	55

3	30	40	45
---	----	----	----

Project Y: Investment at year "0" ₹80 lacs

Probability	Annual cash flows through life (₹ in lacs)
0.20	40
0.50	45
0.30	50

Required:

- Which project is better based on NPV @ discount rate of 10%?
- Compute the standard deviation of present value distribution and analyse the inherent risk of the projects.

----- [May 2005, 12 Marks] -----

33. Skylark Airways is planning to acquire a light commercial aircraft for flying class clients at an investment of ₹50,00,000. The expected cash flow after tax for the next 3 years is as follows:

CFAT Year 1	Probability	CFAT Year 2	Probability	CFAT Year 3	Probability
14,00,000	0.1	15,00,000	0.1	18,00,000	0.2
18,00,000	0.2	20,00,000	0.3	25,00,000	0.5
25,00,000	0.4	32,00,000	0.4	35,00,000	0.2
40,00,000	0.3	45,00,000	0.2	48,00,000	0.1

The company wishes to take into consideration all possible risk factors relating to airline operations. The company wants to know:

- The expected NPV of this venture assuming independent probability distribution with 6% risk free of interest.
- The possible deviation in the expected value.
- How would standard deviation of the present value distribution help in capital budgeting decisions?

----- [Nov 2002, 14 Marks] -----

Risk Analysis in Capital Budgeting

34. XY Ltd. which specializes in manufacturing garments is planning for expansion to handle a new contract which it expects to obtain. An investment bank has approached the company and asked whether the Co. had considered venture Capital financing. In 2001, the company borrowed ₹100 lacs on which interest is paid at 10% p.a. The Company shares are unquoted and it has decided to take your advice in regard to the calculation of the value of the Company that could be used in negotiations using the following available information and forecast.

Company's forecast turnover for the year to 31st March, 2005 is ₹2,000 lacs which is mainly dependent on the ability of the Company to obtain the new contract, the chance for which is 60%, turnover for the following year is dependent to some extent on the outcome of the year to 31st March, 2005. Following are the estimated turnovers and probabilities:

Year - 2005		Year – 2006	
Turnover (in lacs)	Prob.	Turnover (in lacs)	Prob.
2,000	0.6	2,500	0.7
		3,000	0.3
1,500	0.3	2,000	0.5
		1,800	0.5
1,200	0.1	1,500	0.6
		1,200	0.4

Operating costs inclusive of depreciation are expected to be 40% and 35% of turnover respectively for the years 31st March, 2005 and 2006. Tax is to be paid at 30%. It is assumed that profits after interest and taxes are free cash flows. Growth in earnings is expected to be 40% for the years 2007, 2008 and 2009 which will fall to 10 % each year after that. Industry average cost of equity (net of tax) is 15%.

----- [Nov 2007, 10 Marks] -----

Practice Problems

- 35.** A pencil manufacturing company is considering the introduction of a line of a gel pen with an expected life of 5 years. In the past the firm has been quite conservative in its investment in new projects, sticking primarily to standard pencils. In this context the introduction of a line of gel pen is considered an abnormal risky project. The CEO of the company is of the opinion that the normal required rate of return for the company of 12% is not sufficient. Therefore the minimum acceptable rate of return on this project should be 18%. The initial outlay of the project is ₹10,00,000 and the expected free cash flows from the projects are given below.

Year	Cash Flow
1	₹2,00,000
2	₹3,00,000
3	₹4,00,000
4	₹3,00,000
5	₹2,00,000

Advice whether the project should be accepted or not.

- 36.** Investment proposal - ₹45,00,000

Year	Expected Cash Flow	Certainty Equivalent Co-efficient
1	₹10,00,000	0.90
2	₹15,00,000	0.85
3	₹20,00,000	0.82
4	₹25,00,000	0.78

Assuming $i = 5\%$, calculate NPV.

Risk Analysis in Capital Budgeting

37. XYZ PLC employs certainty-equivalent approach in the evaluation of risky investments. The finance department of the company has developed the following information regarding a new project:

Year	Expected CFAT	CE Coefficient
0	(£200000)	1.0
1	£160,000	0.8
2	£140,000	0.7
3	£130,000	0.6
4	£120,000	0.4
5	£80,000	0.3

The firm's cost of equity capital is 18%; its cost of debt is 9% and the riskless rate of interest in the market on the treasury bonds is 6%. Should the project be accepted?

38. XYZ Ltd. is considering a project "A" with an initial outlay of ₹14,00,000 and the possible three cash flows attached to the project are as follows.

	(₹000)		
	Year 1	Year 2	Year 3
Worst case	450	400	700
Most likely	550	450	800
Best case	650	500	900

Assuming the cost of capital as 9%, 1) determine whether the project should be accepted or not. 2) The manager of XYZ Ltd. is confident about the estimates of the first 2 years but not sure about the third year's high cash flow. What will happen to NPV in the first case if third year turns out to be bad?

[SM_2.34_9]

39. Alpha Limited is considering five capital projects for the years 2012 and 2013. The company is financed by equity entirely and its cost of capital is 12%. The expected cash flows of the projects are as follows:

Project	2012	2013	2014	2015
A	(70)	35	35	20
B	(40)	(30)	45	55
C	(50)	(60)	70	80
D	-	(90)	55	65
E	(60)	20	40	50

Note: Figures in brackets represent cash outflows.

All projects are divisible i.e. size of investment can be reduced, if necessary in relation to availability of funds. None of the projects can be delayed or undertaken more than once.

Calculate which project Alpha Limited should undertake if the capital available for investment is limited to ₹1,10,000 in 2012 and with no limitation in subsequent years. For your analysis, use the following present value factors:

Year	2012	2013	2014	2015
Factor	1.00	0.89	0.80	0.71

40. Trouble Free Solutions (TFS) is an authorized service center of a reputed domestic air conditioner manufacturing company. All complaints/ service related matters of Air conditioner are attended by this service center. The service center employs a large number of mechanics, each of whom is provided with a motor bike to attend the complaints. Each mechanic travels approximately 40000kms per annual. TFS decides to continue its present policy of always buying a new bike for its mechanics but wonders whether the present policy of replacing the bike every three year is optimal or not. It is of believe that as new models are entering into market on yearly basis, it wishes to consider whether a replacement of either one year or two years would be better option than present three year period. The fleet of bike is due for replacement shortly in near future.

The purchase price of latest model bike is ₹55,000. Resale value of used bike at current prices in market is as follows:

Risk Analysis in Capital Budgeting

Period	₹
1 year	35,000
2 year	21,000
3 year	9,000

Running and Maintenance expenses (excluding depreciation) are as follows:

Year	Road, Taxes & Insurance	Petrol, Maintenance and Repair
1	3,000	30,000
2	3,000	35,000
3	3,000	43,000

Using opportunity cost of capital as 10% you are required to determine optimal replacement period of bike.

----- [May 2004, 10 Marks]-----[June 2009, 10 Marks]-----

- 41.** A firm has capital budget constraint of ₹30,00,000. The expected outlay and cash flows of various projects is as follows:

Project	Outlay	NPV
A	18	7.5
B	15	6
C	12	5
D	7.5	3.6
E	6	3

Projects B & C are mutually exclusive while other projects are interdependent. Determine which possible combination the firm should select.

- 42.** Determine NPV of the project with the following information:

Initial Outlay of project	₹40000
Annual revenues (Without inflation)	₹30000
Annual costs excluding depreciation (Without inflation)	₹10000
Useful life	4 years
Salvage value	Nil
Tax Rate	50%
Cost of Capital (Including inflation premium of 10%)	12%

43. X Ltd. is a taxi operator. Each taxi cost to company ₹4,00,000 and has a useful life of 3 years. The taxi's operating cost for each of 3 years and salvage value at the end of year is as follows:

	Year 1	Year 2	Year 3
Operating Cost	1,80,000	2,10,000	2,38,000
Resale Value	2,80,000	2,30,000	1,68,000

You are required to determine the optimal replacement period of taxi if cost of capital of X Ltd. is 10%.

44. X Ltd. an existing profit making company is planning to introduce a new product with a projected life of 8 years. Initial equipment cost will be ₹120 lakhs and additional equipment costing ₹10 lakhs will be needed at the beginning of the third year. At the end of the 8th year the original equipment will have a resale value equivalent to the cost of removal, but the additional equipment would be sold for ₹1 lakh. Working capital of ₹15 lakhs will be needed. The 100% capacity of the plant is 4,00,000 units per annum, but the production and sales volume expected are as under.

Year	Capacity
1	20%
2	30%
3-5	75%
6-8	50%

A sale price of ₹100 per unit with a profit volume ratio of 60% is likely to be obtained. Fixed operating cash cost is likely to be ₹16 lakhs per annum. In addition to this the advertisement expenditure will have to be incurred as under:

Year	1	2	3-5	6-8
Expenditure in ₹ lakhs each year	30	15	10	4

The company is subject to 50% tax, straight line method of depreciation (permissible for tax purposes also) and taking 12% as appropriate after tax cost of capital, should the project be accepted?

----- [May 2002, 14 Marks] -----

Risk Analysis in Capital Budgeting

45. An Aeroflot airline is planning to procure a light commercial aircraft for flying class clients at an investment of ₹50 lakhs. The expected cash flow after tax for next three years is as follows:

Year 1		Year 2		Year 3	
CFAT	Prob.	CFAT	Prob.	CFAT	Prob.
15	0.1	15	0.1	18	0.2
18	0.2	20	0.3	22	0.5
22	0.4	30	0.4	35	0.2
35	0.3	45	0.2	50	0.1

The company wishes to consider all possible risk factors relating to an airline.

The company wants to know-

- (i) The expected NPV of this proposal assuming independent probability distribution with 6 per cent risk free rate of interest.
 - (ii) The possible deviation on expected values.
46. From the following details relating to project, analyse the sensitivity of the project to changes in initial project cost, annual cash inflow, and cost of capital.

Initial project cost	₹1,20,000
Annual cash inflow	₹45,000
Project life	4 years
Cost of capital	10%

To which of the three factors the project is more sensitive? (Annuity factors of 10% 3.169 and for 11% 3.109)

----- [Nov 2009, 10 Marks] -----

47. XYZ Ltd. is evaluating a new project which involves expenditure of ₹20,000 and this will be payable in two equal installments at the time of acquisition and a year later. The scrap value of the plant is ₹4000 in present day's prices. The life of the project is estimated at 3 years. The annual cash inflows are ₹25,000 in real terms. The annual cash outflows are estimated to be ₹18,000 in year 1 and ₹19,000 p.a. thereafter stated in terms of year 1 prices. The inflation rate is 8% p.a. and all cash flows rise with general inflation except the annual cash

outflows which will be subject to inflation of 10% p.a. The appropriate money discount rate (i.e. nominal discount rate or inflation adjusted discount rate) may be taken at 18%. Find out the NPV of the project.

48. XYZ Ltd. is planning to procure a machine at an investment of ₹40 lakhs. The expected cash flow after tax for next three years is as follows:

(₹ in lakh)					
Year 1		Year 2		Year 3	
CFAT	Probability	CFAT	Probability	CFAT	Probability
12	0.1	12	0.1	18	0.2
15	0.2	18	0.3	20	0.5
18	0.4	30	0.4	32	0.2
32	0.3	40	0.2	45	0.1

The company wishes to consider all possible risks factors relating to the machine.

The company wants to know

1. The expected NPV of this proposal assuming independent probability distribution with 7% risk free rate of interest
2. The possible deviations on expected values.

----- [May 2013, 8 Marks] -----

49. A manufacturing unit engaged in the production of automobile parts is considering a proposal of purchasing one of the two plants, details of which are given below:

	Plant A	Plant B
Cost	₹20,00,000	₹38,00,000
Installation Charges	₹4,00,000	₹2,00,000
Life	20 years	15 years
Scrap Value after Full Life	₹4,00,000	₹4,00,000
Output per minute (units)	200	400

The annual costs of the two plants are as follows:

Risk Analysis in Capital Budgeting

	Plant A	Plant B
Running hours per annum	2500	2500
Costs		
Wages	1,00,000	1,40,000
Indirect Materials	4,80,000	6,00,000
Repairs	80,000	1,00,000
Power	2,40,000	2,80,000
Fixed Cost	60,000	80,000

Will it be advantageous to buy Plant A or Plant B? Substantiate your answer with the help of comparative unit cost of the plants. Assume interest on capital at 10 percent. Make other relevant assumptions.

- 50.** ABC & Co. has the following information relating to an investment proposal: The initial outlay of ₹24,00,000 is expected at year 0 with a life of 4 years. The firm has an annual profit before tax and depreciation of ₹10,00,000 and pays tax @ 40%. The annual cash inflows (i.e. profit after tax + dep) of ₹8,40,000 is expected. Assuming that the real discount rate is 5%, find out NPV of the proposal given that
- There is no inflation
 - There is an inflation of 5% and the annual profits keep pace with the inflation.
- 51.** The textile manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals – Project M and Project N, which require cash outlays of ₹8,50,000 and ₹8,25,000 respectively. The certainty-equivalent approach is used in incorporating risk in capital budgeting decisions. The current yield on government bond is 6% and this is to be used as the riskless rate. The expected net cash flows and their certainty equivalents are as follows:

Year	Project M		Project N	
	Cash flow	C.E.	Cash flow	C.E.
1	4,50,000	0.8	4,50,000	0.9
2	5,00,000	0.7	4,50,000	0.8
3	5,00,000	0.5	5,00,000	0.7

Present value factors of ₹1 discounted at 6% at the end of year 1, 2 and 3 are 0.943, 0.890 and 0.840 respectively.

Required:

1. Which project should be accepted?
2. If risk adjusted discount rate method is used, which project would be analyzed with higher rate?

----- [Nov 2003, 12 Marks]-----[Nov 1999, 6 Marks]-----