RISK ANALYSIS UNDER CAPITAL BUDGETING

आप यह नहीं कह सकते कि आपके पास समय नहीं है क्योंकि आपको भी दिन में उतना ही समय (24 घंटे) मिलता है जितना समय महान एंव सफल लोगों को मिलता है|
आदित्य Jain

PROBABILITY DISTRIBUTION APPROACH

QUESTION NO.1 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:**

NPV Estimate	Project X Probability	NPV Estimate	Project Y Probability
3,000	0.1	3,000	0.2
6,000	0.4	6,000	0.3
12,000	0.4	12,000	0.3
15,000	0.1	15,000	0.2

(i)Compute the Expected Net Present Value of Projects X and Y.
(ii)Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.
(iii) Which project do you consider more risky and why?
(iv) Compute the Profitability Index of each project.

Solution:

(iii) Coefficient of variation = Standard Deviation/Expected net present value
In case of Project X : Coefficient of variation = 3795 / 90,000 = 0.042167
In case of ProjectY : Coefficient of variation = 4450 / 90,000 = 0.049444
Project Y is riskier since it has a higher coefficient of variation.

OR

Measurement of risk is made by the possible variation of outcomes around the expected value and the decision will be taken in view of the variation in the expected value where two projects have the same expected value, the decision will be the project which has smaller variation in expected value. In the selection of one of the two projects X and Y, Project X is preferable because the possible profit which may occur is subject to less variation (or dispersion). Much higher risk is lying with project Y.

QUESTION NO.2 Possible net cash flows of Projects A and B at year end 1 and their probabilities are given as below. Discount rate is 10 percent for both the project initially investment is ` 10,000. **Calculate** the expected net present value for each project. Which project is preferable?

PossibleEvent	Project A Cash Flow(`)	Probability	Project B Cash Flow (`)	Probability
A	8,000	0.10	24,000	0.10
B	10,000	0.20	20,000	0.15
C	12,000	0.40	16,000	0.50
D	14,000	0.20	12,000	0.15
E	16,000	0.10	8,000	0.10

Solution :

Calculation of Expected Value for Project A and Project B

Possible Event	Project A Net Cash Flow(`)	Probability	Expected Value(`)	Cash Flow(`)	Project B Probability	Expected Value(`)
A	8,000	0.10	800	24,000	0.10	2400
B	10,000	0.20	2,000	20,000	0.15	3,000
C	12,000	0.40	4,800	16,000	0.50	8,000
D	14,000	0.20	2,800	12,000	0.15	1,800
E	16,000	0.10	1,600	8,000	0.10	800
ENCF			12,000			16,000

The net present value for Project A is (0.909 x ` 12,000 - ` 10,000) = ` 908

The net present value for Project B is (0.909 x ` 16,000 - ` 10,000) = ` 4,544.

QUESTION NO.3 Probabilities for net cash flows for 3 years a project are as follows:

Year 1 Cash Flow(`)	Proba-bility	Year-2 Cash Flow(`)	Proba-bility	Year-3 Cash Flow(`)	Proba-bility
2,000	0.1	2,000	0.2	2,000	0.3
4,000	0.2	4,000	0.3	4,000	0.4
6,000	0.3	6,000	0.4	6,000	0.2
8,000	0.4	8,000	0.1	8,000	0.1

Calculate the expected net cash flows. Also calculate the present value of the expected cash flow, using 10 per cent discount rate. Initial Investment is ` 10,000.

Solution :

Year 1 Cash Flow	Proba-bility	Expected Value (`)	Year 2 Cash Flow (`)	Proba-bility	Expected Value (`)	Year 3 Cash Flow (`)	Proba-bility	Expected Value (`) (`)
2,000	0.1	200	2,000	0.2	400	2,000	0.3	600
4,000	0.2	800	4,000	0.3	1200	4,000	0.4	1,600
6,000	0.3	1,800	6,000	0.4	2400	6,000	0.2	1,200
8,000	0.4	3,200	8,000	0.1	800	8,000	0.1	800
ENCF		6,000			4,800			4,200

The present value of the expected value of cash flow at 10 per cent discount rate has been determined as follows:Present Value of cash flow= (6,000 x 0.909) + (4,800 x 0.826) + (4,200 + 0.751) = 12,573

Expected Net Present value = Present Value of cash flow - Initial Investment= ` 12,573 - ` 10,000 = ` 2,573.

QUESTION NO.4 Calculate Variance and Standard Deviation on the basis of figure given in above question.

Solution :

Project A: Variance = $(8,000 - 12,000)^2 (0.1) + (10,000 - 12,000)^2 (0.2) + (12,000 - 12000)^2 (0.4) + (14,000 - 12,000)^2 (0.2) + (16000 - 12,000)^2 (0.1) = 48,00,000$; Standard Deviation = $\sqrt{48,00,000} = 2190.90$

Project B: = 5059.64 [Self]

QUESTION NO.5 Calculate Coefficient of Variation based on the figure of Illustration 1 and Illustration 3

Solution :

Projects	Coefficient of variation	Risk	Expected Value
A	$\frac{2190.90}{12,000} = 0.1826$	Less	Less
B	$\frac{4195.23}{16,000} = 0.2622$	More	More

QUESTIONS NO.6 Samreen Project Ltd. is considering accepting one of the two mutually exclusive projects X & Y. **The cash flow and probabilities are estimated as under:**

Project X		Project Y	
Probability	Cash flow	Probability	Cash flow
0.10	12.000	0.10	8,000
0.20	14,000	0.25	12,000
0.40	16,000	0.30	16,000
0.20	18,000	0.25	20,000
0.10	20,000	0.10	24,000

Advise Samreen Projects Ltd. on the basis of risk.

Solution:

Project X			Project Y		
Probability	Cash flow	EV	Probability	Cash flow	EV
0.10	12,000	1,200	0.10	8,000	800
0.20	14,000	28,00	0.25	12,000	3,000
0.40	16,000	6,400	0.30	16,000	4,800
0.20	18,000	3,600	0.25	20,000	5,000
0.10	20,000	2,000	0.10	24,000	2,400
		16,000			16,000

On the basis of EV, one tends to be indifferent. Calculating the Standard Deviation

Project X		Project Y	
$0.10 (12-16)^2$	= 1.6	$0.10 (16-8)^2$	= 6.4
$0.20 (14-16)^2$	= 0.8	$0.25 (16-12)^2$	= 4.0
$0.40 (16-16)^2$	= 00	$0.30 (16-16)^2$	= 0.0
$0.20(18-16)^2$	= 0.8	$0.25 (20-16)^2$	= 4.0
$0.10 (20-16)^2$	= 1.6	$0.10 (24-16)^2$	= 6.4
	4.8		20.8
Standard Deviation = 2.19		Standard Deviation = 4.56	

Coefficient of variation = **Project X** : CV = (2.19/16) X 100 =13.68%; **Project Y** : CV = (4.56/16)X100=28.5%

Project Y is more risky as it is more succeptible to wider degree of variation around the most likely outcome than Project X. Project X should be preferred.

QUESTION NO.7 Cyber Company is considering two mutually exclusive projects. Investment outlay of both the projects is ` 5,00,000 and each is expected to have a life of 5 years. Under three possible situations their annual cash flows and probabilities are as under:

Situation	Probabilities	Project (A)	Project (B)
Good	0.3	6,00,000	5,00,000
Normal	0.4	4,00,000	4,00,000
Worse	0.3	2,00,000	3,00,000

The cost of capital is 7 percent, which project should be accepted? Explain with workings with the help of NPV and Standard Deviation.

Solution:

Project A :Standard Deviation : Expected Net Cash Flow = .3 (6,00,000 + .4 (4,00,000) + .3 (2,00,000) = 4,00,000

σ^2= .3 (6,00,000 – 4,00,000)^2 + .4 (4.00,000 – 4,00,000)^2 + .3 (2,00,000 – 4,00,000)^2=24,00,00,000

or $\sigma = \sqrt{24,00,00,000}$ = 1,54,919.33

Net Present Value : Expected Present Value of Cash Inflows = 4,00,000 × 4.100 = 16,40,000 or **Expected NPV** = 16,40,000 – 5,00,000 = 11,40,000

Project B :Standard Deviation : Expected Net Cash Flow = .3 (5,00,000) + .4 (4,00,000) .3 (3,00,000) = 4,00,000

σ^2= .3 (5,00,000 – 4,00,000)^2 + .4(4,00,000 – 4,00,000)^2

+ .3 (3,00,000 – 4,00,000)^2= 6,00,00,00,000 or $\sigma = \sqrt{6,00,00,00,000}$ = 77,459.66

Net Present Value : Expected Present Value of Cash Inflows = 4,00,000 × 4.100 = 16,40,000 or **Expected NPV =** 16,40,000 – 5,00,000 = 11,40,000

Recommendation :NPV in both projects being the same, the project should be decided on the basis of Standard Deviation and hence Project 'B' should be accepted having lower Standard Deviation, i.e having lesser risk .

Note: We can also take decision on the basis of CV

QUESTION NO.8 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

(i) Which project will you recommend based on the above data?

(ii) Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.

(iii) Which measure is more appropriate in this situation and why?

Solution

(i) On the Basis of Standard Deviation : Project X be choosen because it is less risky than Project Y since Project X has lower Standard Deviation and

On the Basis of Net Present Value : Project Y should be choosen as it's Present Value is more than Project X.

(ii) On the Basis of Coefficient Of Variation :

Project X : CVx = $\frac{SD}{ENPV} = \frac{90,000}{1,22,000}$ = .738 ; **Project Y** : CVy = $\frac{SD}{ENPV} = \frac{1,20,000}{2,25,000}$ = .533

On the basis of Co-efficient of Variation (C.V.) Project X appears to be more risky and hence **Y should be ac-**

cepted.

(iii) However, the NPV method in such conflicting situation is best because the NPV method is in compatibility of the objective of wealth maximisation in terms of time value.

QUESTION NO.9 KLM Ltd., is considering taking up one of the two projects-**Project-K and Project-S**. both the projects having same life require equal investment of ` 80 lakhs each. Both are estimated to have almost the same yield. As the company is new to this type of business, the cash flow arising from the projects cannot be estimated with certainty. An attempt was therefore, made to use probability to analyse the pattern of cash flow from other projects during the first year of operations. This pattern is likely to continue during the life of these projects. **The results of the analysis are as follows:**

Project K		Project S	
Cash Flow (in `)	**Probability**	**Cash Flow (in `)**	**Probability**
11	0.10	09	0.10
13	0.20	13	0.25
15	0.40	17	0.30
17	0.20	21	0.25
19	0.10	25	0.10

Required:(i) Calculate variance, standard deviation and co-efficient of variance for both the projects.?

(ii) Which of the two projects is more risky?

Solution:

Project K : Expected Net Cash Flow:

= (0.1 x 11) + (0.20 x13) + (0.40 x 15)+ (0.20 x 17) + (0.10 x 19) = 1.1 + 2.6 + 6 + 3.4 + 1.9 = 15

Standard Deviation: $\sigma^2 = 0.10\ (11-15)^2 + 0.20\ (13-15)^2 + 0.40\ (15-15)^2 + 0.20\ (17-15)^2 + 0.10\ (19-15)^2 = 1.6 + 0.8 + 0 + 0.8 + 1.6 = 4.8$ or $\sigma = \sqrt{4.8} = 2.19$

Project S : Expected Net Cash Flow

= (0.10 X 9) + (0.25 X 13) + (0.30 X 17) + (0.25 X 21) + (0.10 X 25) = 0.9 + 3.25 + 5.1 + 5.25 + 2.5 = 17

Standard Deviation: $\sigma^2 = 0.1\ (9-17)^2 + 0.25\ (13-17)^2 + 0.30\ (17-17)^2 + 0.25\ (21-17)^2 + 0.10\ (25-17)^2$

= 6.4 + 4 + 0 + 4 + 6.4 = 20.8 CT=V 20.8 = 4.56

Calculation of Coefficient of Variation: Coefficient of Variation = [Standard Deviation / Mean]

Project K = 2.19 / 15 =0.146 ; Project S = 4.56 / 17 =0.268

(ii) Decision:Project S is riskier as it has higher Coefficient of Variation.

QUESTION NO.10 Door Ltd. is considering an investment of ` 4,00,000. This investment is expected to generate substantial cash inflows over the next five years. Unfortunately, the annual cash flows from this investment is uncertain, and the following profitability distribution has been established.

Annual Cash Flow (`)	Probability
50,000	0.3
1,00,000	0.3
1,50,000	0.4

At the end of its 5 years life, the investment is expected to have a residual value of `40,000.The cost of capital is 5%.**(i)Calculate** NPV under the three different scenarios.**(ii)Calculate** Expected Net Present Value.**(iii)Advise** Door Ltd. on whether the investment is to be undertaken.

Year	1	2	3	4	5
DF @ 5%	0.952	0.907	0.864	0.823	0.784

Solution:

(i) Calculation of NPV under three different scenarios (Amount in `)

Particulars	1st Scenario	2nd Scenario	3rd Scenario
Annual Cash Flow	50,000	1,00,000	1,50,000
PV of cash inflows (Annual Cash Flow x 4.33*)	2,16,500	4,33,000	6,49,500
PV of Residual Value (‘ 40,000 x 0.784)	31,360	31,360	31,360
Total PV of Cash Inflow	2,47,860	4,64,360	6,80,860
Initial investment	4,00,000	4,00,000	4,00,000
NPV	(1,52,140)	64,360	2,80,860

* .952 + .907 + .864 + .823 + .784 = 4.33

(ii) Calculation of Expected Net present Value under three different scenarios

Particulars	1st Scenario	2nd Scenario	3rd Scenario	Total (`)
Annual Cash Flow	` 50,000	` 1,00,000	` 1,50,000	
Probability	0.3	0.3	0.4	
Expected Value	` 15,000	` 30,000	` 60,000	1,05,000
PV of Expected value (1,05,000 x 4.33)				4,54,650
PV of Residual Value (40,000 x 0.784)				31,360
Total PV of Cash Inflow				4,86,010
Initial investment				4,00,000
Expected Net Present Value				86,010

(iii) Since the expected net present value of the Investment is positive, the Investment should be undertaken.

RISK ADJUSTED DISCOUNT RATE (RADR)

QUESTION NO.11 Determine the risk adjusted net present value of the following projects:

	A	B	C
Net cash outlays (`)	1,00,000	1,20,000	2,10,000
Project life	5 years	5 years	5 years
Annual cash inflow (`)	30,000	42,000	70,000
Coefficient of variation	0.4	0.8	1.2

The company selects the risk-adjusted rate of discount on the basis of the co-efficient of variation:

Coefficient of Variation	RADR	Present Value Factor 1 to 5 years at Risk Adjusted Rate of Discount
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 2.0	25%	2.689

QUESTION NO.12 Determine the risk adjusted net present value of the following projects

	X	Y	Z
Net cash outlays	2,10,000	1,20,000	1,00,000

Project life	5 years	5 years	5 years
Annual Cash inflow (`)	70,000	42,000	30,000
Coefficient of variation	1.2	0.8	0.4

The Company selects the risk-adjusted rate of discount on the basis of the coefficient of variation

Coefficient of Variation	Risk-Adjusted rate of return RADR	PVF 1 to 5 years at
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 2.0	25%	2.689

Solution:

Statement Showing the Determination of the Risk Adjusted Net Present Value

Projects	Cash Outlays	Coefficient of Variation	RADR	Annual Cash Inflow	PVAF	PV of Cash Inflow	NPV
X	2,10,000	1.20	16%	70,000	3.274	2,29,180	19,180
Y	1,20,000	0.80	14%	42,000	3.433	1,44,186	24,186
Z	1,00,000	0.40	12%	30,000	3.605	1,08,150	8,150

CERTAINTY EQUIVALENT APPROACH

QUESTION NO. 13 The Globe Manufacturing Company Ltd. is considering an investment in one of the two mutually exclusive proposals - Projects X and Y, which require cash outlays of ` 3,40,000 and ` 3,30,000 respectively. The certainty-equivalent (CE) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bond is 8% and this be used as the riskless rate. **The expected net cash flows and their certainty-equivalents are as follows:**

	Project X		Project Y	
Year-end	Cash flow `	C.E.	Cash flow `	C.E.
1	1,80,000	.8	1,80,000	.9
2	2,00,000	.7	1,80,000	.8
3	2,00,000	.5	2,00,000	.7

Present value factors of `1 discounted at 8% at the end of year 1, 2 and 3 are .926, .857 and .794 respectively.
Required :(i) Which project should be accepted? **(ii)** If risk adjusted discounted rate method is used, which project would be discounted with a higher rate?

QUESTION NO.14 Investment Proposal - ` 45,00,000

Year	Expected cash flow	Certainty Equivalent coefficient
1	` 10,00,000	0.90
2	` 15,00,000	0.85
3	` 20,00,000	0.82
4	` 25,00,000	0.78

i = 5%. Calculate NPV ?

Solution:

$$NPV = \frac{10,00,000 \times .90}{(1+.05)^1} + \frac{15,00,000 \times .85}{(1+.05)^2} + \frac{20,00,000 \times .82}{(1+.05)^3} + \frac{25,00,000 \times .78}{(1+.05)^4} - 45,00,000 = ` 5,34,570$$

QUESTION NO.15 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*	Certainty-equivalent quotient
0 (Initial Outlays)	(£ 200,000)	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?

Note:**CFAT=**Cash Flow After Tax is given hence no adjustment of Depreciation.

Solution:

Determination of NPV:

Year	Expected CFAT	CE	Adjusted CFAT (CFAT X CE)	PV factor (at 0.06)	Total PV
0	(£ 200,000)	1.0	£ (2,00,000)	1.000	(£ 2,00,000)
1	£ 160,000	0.8	£ 1,28,000	0.943	£ 1,20,704
2	£ 140,000	0.7	£ 98,000	0.890	£ 87,220
3	£ 130,000	0.6	£ 78,000	0.840	£ 65,520
4	£ 120,000	0.4	£ 48,000	0.792	£ 38,016
5	£ 80,000	0.3	£ 24,000	0.747	£ 17,928
NPV					1,29,388

Since NPV is positive the project should be accepted.

QUESTION NO.16 Gauav Ltd. using certainty-equivalent approach in the evaluation of risky proposals. **The following information regarding a new project is as follows:**

Year	Expected Cash flow	Certainty-equivalent quotient
0	(4,00,000)	1.0
1	3,20,000	0.8
2	2,80,000	0.7
3	2,60,000	0.6
4	2,40,000	0.4
5	1,60,000	0.3

Riskless rate of interest on the government securities is 6 per cent. **DETERMINE** whether the project should be accepted?

Solution:

Year	Expected Cash flow (`)	Certainty-equivalent (CE)	Adjusted Cash flow (Cash flow x CE) (`)	PV factor (at 0.06)	Total PV
0	(4,00,000)	1.0	(4,00,000)	1.000	(4,00,000)

1	3,20,000	0.8	2,56,000	0.943	2,41,408
2	2,80,000	0.7	1,96,000	0.890	1,74,440
3	2,60,000	0.6	1,56,000	0.840	1,31,040
4	2,40,000	0.4	96,000	0.792	76,032
5	1,60,000	0.3	48,000	0.747	35,856
					2,58,776

Decision: As the Net Present Value is positive the project should be accepted.

QUESTION NO. 17 ***REMOVED***

SENSITIVITY ANALYSIS TAKING NPV = 0

QUESTION NO.18 A project with an initial outflow of ` 1,00,000 has a four year life and a 10% discount rate. The annuity cash inflow is ` 40,000
(i) Compute NPV **(ii) Calculate** sensitivity of the project to Initial Outflow, cash inflow, life and discount factor.

QUESTION NO.19 The following information applies to a new project:

Initial Investment	` 125,000
Selling price per Unit	` 100
Variable costs per unit	` 30
Fixed costs for the period	` 100,000
Sales volume	2,000
Life	5 years
Discount rate	10%

Required: Project's NPV and show how sensitive the results are to various input factors.
Solution:
NPV = –125,000 + [(100 – 30) 2,000 – 100,000] X 3.791 = ` 26,640
Sensitivity to changes to
(1) Selling Price: 125,000 = [(P – 30) 2,000 – 100,000] X 3.791 or P = 96.49 i.e. fall of 3.51% before NPV is zero
(2) Variable Costs: 125,000 = [(100 - v) 2,000 – 100,000] X 3.791 or V = 33.51
i.e. increase of 11.71% before NPV is zero
(3) Volume: 125,000 =[(100 - 30) q – 100,000] X 3.791 or q = 1,900 in fall of 5.02% before NPV is zero
(4) Initial cost : ` 26,640 rise in Initial cost before NPV is zero i.e. rise of 21.31% before NPV
(5) Fixed costs: 125,000 = [(` 100 – ` 30) 2,000 - F] X 3.791 or F =107,027
i.e. an increase of 7.03% before NPV is zero
(6) Life: ` 125,000 = ` 40,000 x PVAF [n , 10%] or 3.125 = PVAF [n , 10%] or PVAF for 4 years at 10% is 3.17
i.e. life can fall to approximately 4 years before NPV is zero
(7) Discount rate : 3.125 = PVAF for 5 years @ x %
From tables PVAF for 5 year @ 18% is 3.127, so x is approximately 18% i.e. an increase of 80% before NPV is zero

QUESTION NO.20 Unnat Ltd. is considering investing 50,00,000 in a new machine. The expected life of machine 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: **(i)** sale price; **(ii)** sales volume; **(iii)** 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	1,75000	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.

Solution

1. Calculation of NPV:=- 50,00,000 + [2,00,000 (30- 16.50)- 10,00,000] PVIAF(12%,5)=- 50,00,000 + [2,00,000 (13.50)- 10,00,000]3.605=- 50,00,000 + [27,00,000- 10,00,000]3.605=- 50,00,000 + 61,28,500 = 11,28,500

Measurement of Sensitivity Analysis

(a) Sales Price:- Let the sale price/Unit be S so that the project would break even with 0 NPV: 50,00,000
= [2,00,000 (S- 16.50)- 10,00,000] PVIAF(12%,5)
50,00,000 = [2,00,000S - 33,00,000- 10,00,000] 3.605
50,00,000 = [2,00,000S - 43,00,000] 3.605
13,86,963 = 2,00,000S - 43,00,000 or 56,86,963 = 2,00,000S
S =28.43 which represents a fall of (30 - 28.43)/30 or 0.0523 or 5.23%

(b) Sales volume:- Let V be the sale volume so that the project would break even with 0 NPV. :. 50,00,000
= [V (30- 16.50)- 10,00,000] PVIAF(12%,5)
50,00,000 = [V (13.50)- 10,00,000] PVIAF(12%,5)
50,00,000 =[13.50V- 10,00,000] 3.605
13,86,963 =13.50V - 10,00,000 or 23,86,963=13.50V
V = 1,76,812 which represents a fall of (2,00,000 - 1,76,812)/2,00,000 or 0.1159 or 11.59%

(c)Variable Cost:- Let the variable cost be V so that the project would break even with 0 NPV.:. 50,00,000
= [2,00,000(30- V)- 10,00,000] PVIAF(12%,5)
50,00,000 =[60,00,000- 2,00,000 v - 10,00,000] 3.605
50,00,000 =[50,00,000- 2,00,000 V] 3.605
13,86,963 =50,00,000 - 2,00,000V or 36,13,037 = 2,00,000V
V =18.07 which represents a fall of (18.07- 16.50)/16.50 or 0.0951 or 9.51%

(d) Value of expected sales volume

(1,75,000 X 0.30) + (2,00,000 X 0.60) + (2,25,000 X 0.10) = 1,95,000
NPV = [195000 X 13.50 - 10,00,000] 3.605- 50,00,000 = 8,85,163

Further NPV in worst and best cases will be as follows:

Worst Case: [1,75,000 X13.50- 10,00,000] 3.605- 50,00,000 =- 88,188

Best Case: [2,25,000 X 13.50 - 10,00,000] 3.605 - 50,00,000=23,45,188

Thus there are 30% chances that there will be a negative NPV and 70% chances of positive NPV. Since acceptable level of risk of Unnat Ltd. is 20% and there are 30% chances of negative NPV hence project should not be accepted.

SENSITIVITY ANALYSIS USING % ADVERSE VARIATION IN FACTORS

QUESTION NO.21 From the following details relating to a project, decide 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 (Years) 4
Cost of Capital 10%

To which of the three factors, the project is most sensitive?Check Sensitivity at 10 % (Use annuity factors: for 10% ..3.169 and 11% ..3.102).

QUESTION NO.22 Indian Newsprint Ltd. (INL) a leading manufacturer of newsprint in the country, is planning to start manufacturing card board unit. Planning & Strategy division of the company has placed before the board of directors the "Dental Project Repot" of the card board unit. The report inter alia, includes the following cash flow:**(Fig. in ` lakhs)**

Year	Cost of the plant	Recurring cost	Savings
0	1000		
1		400	1200
2		500	1400

The cost of the capital is 9%.

You are required to measure the sensitivity of the project to changes in the levels of plant value, recurring cost and savings (considering each factor at a time) such that the NPV becomes zero. The present value factor at 9% are given below:

Year	PVF 9%
0	1
1	0.917
2	0.842

Advise the board of directors which factor is the most sensitive to affect the acceptability of the project?

Solution:

PV of Cash Flows

			` Lacs
Year 1	Running Cost	400 x 0.917	= (366.80)
	Savings	1,200 x 0.917	= 1100.40
Year 2	Running Cost	500 x 0.842	= (421.00)
	Savings	1,400 x 0.842	= 1178.80
			1491.40
Year 0	Less: P.V. of Cash Outflow	1,000 x 1	1,000.00
		NPV	491.40

Sensitivity Analysis:Taking Adverse %

(i) If the initial project cost is varied adversely by say 10%*.

NPV (Revised)= (` 491.40 lacs - ` 100.00 lacs) = ` 391.40 lacs ;
% Change in NPV(49140 -39140) / 491.40= 20.35%

(ii) If Annual Running Cost is varied by say 10%*.

NPV (Revised) = (` 491.40 - ` 40 X 0.917 - ` 50 X 0.843)
= ` 491.40 lacs - ` 36.68 lacs - ` 42.15 lacs = ` 412.57 lacs
% Change in NPV = (491.40 - 412.60) / 491.40 = 16.04%

(iii) If Saving is varied by say 10%*.

NPV (Revised) = (` 491.40 lacs - ` 120 lacs X 0.917 - ` 140 lacs X 0.843)
= ` 491.40 lacs - ` 110.04 lacs - ` 118.02 lacs = ` 263.34 lacs
% Change in NPV = (491.40- 263.34) / 491.40 = 46.41%
Decision: Hence, savings factor is the most sensitive to affect the acceptability of the project.
* Any percentage of variation other than 10% can also be assumed by candidates.
Sensitivity Analysis:Taking NPV = 0
(i)Increase of Plant Value by ` 491.40 lacs : (491.40 / 1000) x 100 = 49.14%
(ii)Increase of Running Cost by ` 491.40 lacs :491.40 / (366.80 +421) = (491.40 / 787.70) x 100 = 62.38%
Proof:(not required for exam)
NPV = -[400 + 62.38% of Rs.400] x .917 + 1200 x .917-[500+62.38% of 500]x.842+1400x.842-1000 = 0
(iii)Fall in Saving by ` 491.40 lacs :491.40 / (1100.40 + 1178.80) = (491.40 / 2279.20) x 100 = 21.56%
Decision: Hence, savings factor is the most sensitive to affect the acceptability of the project as in comparison of other two factors as a slight % change in this factor will give more affect the NPV than others.
Note: Any one alternative can be used in exam

QUESTION NO.23 X Ltd. is considering its new product with the following details

Sr. No.	Particulars	Figures
1	Initial capital cost	` 400 Cr
2	Annual unit sales	5 Cr
3	Selling price per unit	`100
4	Variable cost per unit	`50
5	Fixed costs per year	` 50 Cr
6	Discount Rate	6%
7	Life	3 Years

1.Calculate the NPV of the project. **2. Find** the impact on the project's NPV of a 2.5 per cent adverse variance in each variable[except discount rate and life].Which variable is having maximum effect.
Solution :
1. Calculation of Net Cash Inflow per year:

	Particulars	Amount (`)
A	Selling Price Per Unit (A)	100
B	Variable Cost Per Unit (B)	50
C	Contribution Per Unit (C = A-B)	50
D	Number of Units Sold Per Year	5 Cr.
E	Total Contribution (E = C X D)	` 250 Cr.
F	Fixed Cost Per Year	` 50 Cr.
G	Net Cash Inflow Per Year (G =E - F)	` 200 Cr.

Calculation of Net Present Value (NPV) of the Project:

Year	Year Cash Flow (` in Cr.)	Discounting @6%	Present Value (PV) (` in Cr.)
0	-400	1.000	-400
1	200	0.943	188.60
2	200	0.890	178
3	200	0.840	168
Net Present Value (188.60+178+168)-400=			134.60

Here NPV represent the most likely outcomes and not the actual outcomes. The actual outcome can be lower or higher than the expected outcome.

2. Sensitivity Analysis considering 2.5 % Adverse Variance in each variable

	Changes	Base	Initial cash flow increased to ` 410 crore	Selling Price per Unit Reduced to ` 97.5	Variable Cost Per Unit increased to ` 51.25	Fixed Cost Per Unit increased to ` 51.25	Units sold per year reduced to ` 4.875 crore
	Particulars	Amount `	Amount `	Amount `	Amount `	Amount `	Amount `
A	Selling Price Per Unit(A)	100	100	97.5	100	100	100
B	Variable Cost Per Unit (B)	50	50	50	51.25	50	50
C	Contribution Per Unit (C = A-B)	50	50	47.5	48.75	50	50
D	Number of Units Sold Per Year (in Crores)	5	5	5	5	5	4.875
E	TotalContribution (E = C x D)	250	250	237.5	243.75	250	243.75
F	Fixed Cost Per Year (in Crores)	50	50	50	50	51.25	50
G	Net Cash Inflow Per Year (G=E-F)	200	200	187.5	193.75	198.75	193.75
H	(G x 2.673)	534.60	534.60	501.19	517.89	531.26	517.89
I	Initial Cash Flow	400	410	400	400	400	400
J	NPV	134.60	124.60	101.19	117.89	131.26	117.89
K	Percentage Change in NPV		-7.43%	-24.82%	-12.41%	-2.48%	-12.41%

The above table shows that the by varying one variable at a time by 2.5% while keeping the others constant, the impact in percentage terms on the NPV of the project. Thus it can be seen that the change in selling price has the maximum effect on the NPV by 24.82 %

QUESTION NO.24 ***REMOVED***

QUESTION NO.25 ***REMOVED***

PROBABILITY OF OCCURRENCE IF THE CASH FLOWS ARE (A) PERFECTLY DEPENDENT OVERTIME (B) INDEPENDENT OVERTIME

QUESTION NO.26 Following are the estimates of the net cash flows and probability of a new project of 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 inflows per year	1 to 5	1,00,000	1,10,000	1,20,000
Estimated salvage value (after tax)	5	20,000	50,000	60,000

Required Rate of Return from the project is 10%. **Find :**

(i) The expected NPV of the project and take decision.

(ii) The best case and the worst case NPVs.

(iii) The probability of occurrence of the worst case if the cash flows are

(a) Perfectly Dependent Overtime **(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 ranges between of 0.95 to 1.0.If the coefficient of variation of the project is found to be less riskier than average, 100 basis points are deducted from the Company's Cost of Capital.Should then the project be accepted by X Ltd.?

Solution:

(i) Expected NPV of the project :-

Year	Expected Cash Flows	PVF@10%	Present Value
0	(4,00,000 x 1)= (-) 4,00,000	1.000	(-) 4,00,000
1 to 5	(1,00,000 x 0.3 + 1,10,000 x 0.5 + 1,20,000 x 0.2) = 1,09,000	3.79	413110
5	(20,000 x 0.3 + 50,000 x 0.5 + 60,000 x 0.2)]=43000	0.621	26703
		Net Present Value =	**39,813**

(ii) Expected NPV [ENPV] When Probability is .3

ENPV = (-) 4,00,000 + 1,00,000 x 3.790 +20,000 x 0.621 = (-) ` 8,580

Expected NPV [ENPV] When Probability is .2

ENPV = (-) 4,00,000 + 1,20,000 x 3.79 + 60,000 x 0.621 = ` 92,060

Expected NPV [ENPV] When Probability is .5

ENPV = (-) 4,00,000 + 110000 x 3.79 + 50,000 x 0.621 = ` 47,950

Hence The Best Case NPV is 92060 when probability is .2 and

The Worst Case NPV is - 8580 when probability is .3

(iii) The probability of occurrence of the worst case if the cash flows are

(a) Perfectly Dependent Required Probability = 0.3

(b) Perfectly Independent Required Probability = $(0.3)^5$ = .00243

Explaination: If the cash flows are perfectly dependent, then the low cash flow in the first year will mean a low cash flow in every year. Thus, the probability of the worst case occurring is the probability of 30 percent first year. If the cash flows are independent, the cash flow in each year can be low,high, or average, and the probability of getting all low cash flows will be (0.3)(0.3)(0.3)(0.3)(0.3)= $(.3)^5$

(iv) **Given NPV**

When Probability is .5	NPV	=	` 47,950
When Probability is .3	NPV	=	(-) ` 8,580
When Probability is .2	NPV	=	` 92,060

Therefore Expected NPV = 0.5 x 47950 + 0.30 x (-) 8580 + 92060 x 0.20 = ` 39, 813 [or it is already calculated in part (i)]

Now Standard Deviation of Expected NPV will be :

$$\sigma ENPV = \sqrt{0.3(-8580-39813)^2 + 0.5(47950-39813)^2 + 0.2(92060-39813)^2}$$ = Rs. 35,800/-

Coefficient Of Variation [CV] = $\frac{\text{Standard Deviation}}{\text{Expected NPV}} = \frac{35800}{39813}$ = 0.90

(v) Risk Adjusted Cost of Capital of X Ltd. = 10% -1% = 9%.

Additional Analysis : Since Coefficient of Variation of the project is .90 which is less than the company's average Coefficient Of Variation which ranges betweeen .95 to 1 . Hence as per the requirement of the question 100 basic point i.e 1 % has been deducted from the company's Cost Of Capital .

Calculation of NPV at 9 % Cost of Capital :

Year	Expected Net Cash Flow	PVF@9%	Present Value
0	(-) 4,00,000	1.000	(-) 4,00,000
1 to 5	1,09,000	3.890	424010
5	43000	0.650	27950
		Expected NPV	51,851

Decision : Since NPV is positive , the project should be accepted by X Ltd.

Additional Analysis : It was certain that its expected NPV at 9 % would have come higher than Expected NPV at 10%.As we know that Lower the Discounting Rate Higher the Present Value .

Note : 1 % = 100 Basis Points

QUESTION NO.27 XY Ltd. has under its consideration a product 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 life is 5 years and the desired rate of return is 20%. The estimated terminal values for the project assets under three probabilities alternatives, respectively are ` 0, 20000 and 30,000. **You are required to :**

(i) Find the probable or Expected NPV **(ii)** Find the worst-case NPV and the best-case NPV; and **(iii)**State the probability occurrence of worst case, if the cash flows are perfectly positively correlated over time.

Solution:

When probability p = .1: NPV = 20,000 x PVAF (20% , 5 years) + 0 x PVF (20%,5 years) - 1,00,000 = - 40180

When probability p = .7: NPV = 30,000 x PVAF (20% , 5 years) + 20,000 x PVF (20%,5 years) - 1,00,000 = - 2230

When probability p = .2: NPV = 40,000 x PVAF (20% , 5 years) + 30,000 x PVF (20%,5 years) - 1,00,000 = + 31700

(i) Expected NPV = -40180 x .1 + -2230 x .7 + 31700 x .2 = + 761

(ii) Worst-case NPV = - 40180 ; Best-case NPV = + 31700

(iii) If the cash flows are perfectly dependent, then the low cash flow in the first year will mean a low cash flow in every year. Thus the possibility of the worst case occurring is the probability of .10.

QUESTION NO.28 The staff of Heman Manufacturing has estimated the following net cash flows and probabilities for a new manufacturing process:

		Net Cash Flows	
Year	Pr = 0.2	Pr = 0.6	Pr = 0.2
0	€(100,000)	€(100,000)	€(100,000)
1	€20,000	€30,000	€40,000

2	€20,000	€30,000	€40,000
3	€20,000	€30,000	€40,000
4	€20,000	€30,000	€40,000
5	€20,000	€30,000	€40,000
5*	0	€20,000	€30,000

5* indicates the estimated salvage values. Heman's required rate of return for an average-risk project is 10 %.

(a) Assume that the project has average risk. Find the project's expected NPV.

(b) Find the best-case and worst-case NPVs. What is the probability of occurrence of the worst case if the cash flows are perfectly dependent (perfectly positively correlated) over time? If they are independent over time?

(c) Assume that all the cash flows are perfectly positively correlated; that is, there are only three possible cash flow streams over time: (1) the worst, (2) the most likely, or base, case, and (3) the best case, with probabilities of 0.2, 0.6, and 0.2,respectively. Find the expected NPV, its standard deviation, and its coefficient of variation.

(d) The coefficient of variation of Heman's average project is in the range of 0.8 to 1.0.If the coefficient of variation of a project being evaluated is greater than 1.0, 2 percentage points are added to the firm's required rate of return. Similarly, if the coefficient of variation is less than 0.8,1 percentage point is deducted from the required rate of return. What is the project's required rate of return? Should Heman accept or reject the project?

Solution:

(a) First, find the expected cash flows:

Year	**Expected Cash Flows**	
0	0.2 x (-€100,000)+ 0.6 x (-€100,000) +0.2 x (-€100,000)	= (€100,000)
1	0.2 x €20,000 +0.6 x €30,000+0.2 x €40,000	= €30,0000
2	0.2 x €20,000 +0.6 x €30,000+0.2 x €40,000	= €30,0000
3	0.2 x €20,000 +0.6 x €30,000+0.2 x €40,000	= €30,0000
4	0.2 x €20,000 +0.6 x €30,000+0.2 x €40,000	= €30,0000
5	0.2 x €20,000 +0.6 x €30,000+0.2 x €40,000	= €30,0000
5 (Salvage Value)	0.2 x (€0) +0.6 x €20,000+0.2 x €30,000	= €18,000

Next, determine the NPV based on the expected cash flows:

$$NPV = -1,00,000 + \frac{30,000}{(1+.10)^1} + \frac{30,000}{(1+.10)^2} + \frac{30,000}{(1+.10)^3} + \frac{30,000}{(1+.10)^4} + \frac{48,000}{(1+.10)^5} = 24,900$$

Note: Expected NPV can also be calculated in a manner as covered in class in Question No. 17(i).Final Answer will be same.

(b) Calculation Of the worst case NPV :

$$NPV = -1,00,000 + \frac{20,000}{(1+.10)^1} + \frac{20,000}{(1+.10)^2} + \frac{20,000}{(1+.10)^3} + \frac{20,000}{(1+.10)^4} + \frac{20,000}{(1+.10)^5} = -24,184$$

Calculation Of the best case NPV

$$NPV = -1,00,000 + \frac{40,000}{(1+.10)^1} + \frac{40,000}{(1+.10)^2} + \frac{40,000}{(1+.10)^3} + \frac{40,000}{(1+.10)^4} + \frac{70,000}{(1+.10)^5} = +70259$$

If the cash flows are perfectly dependent, then the low cash flow in the first year will mean a low cash flow in every year.Thus If the cash flows are perfectly dependent, the probability of the worst case is 20 percent.

If the cash flows are independent, the cash flow in each year can be low,high, or average.Thus If the cash flows are independent,the probability of the worst case will be (0.2)(0.2)(0.2)(0.2)(0.2)= 0.25 = 0.00032 = 0.032%

(c) Worst case NPV -24184 [Already Calculated]

Best case NPV +70259[Already Calculated]
Most likely NPV +26142

NPV= $-1{,}00{,}000+\frac{30{,}000}{(1+.10)^1}+\frac{30{,}000}{(1+.10)^2}+\frac{30{,}000}{(1+.10)^3}+\frac{30{,}000}{(1+.10)^4}+\frac{30{,}000}{(1+.10)^5}+\frac{20{,}000}{(1+.10)^5}$ **=26142**

The **expected NPV** is 0.2(-€24,184) + 0.6(€26,142) + 0.2(€70,259)= €24,900

Prob	NPV	NPV-ExpNPV	(NPV- Expected NPV)²	(NPV- Expected NPV)² P	0.2
(24,184)	-49,084		2,409,239,056	481,847,811	
0.6	26,142	1,242	1,542,564	925,538	
0.2	70,259	45,359	2,057,438,881	411,487,776	
				894,261,126	

$\sigma_{NPV} = \sqrt{894261126}$ = €29,904

The coefficient of Variation, CV, is €29,904/€24,900=1.20.

(d) Because the project's coefficient of variation is 1.20, the project is riskier than average, and hence the project's risk-adjusted cost of capital is 10% +2% = 12% .The Project now should be evaluated by finding the NPV of the expected cash flows, as in Part a, but using a 12 percent discount rate.

NPV= $-1{,}00{,}000+\frac{30{,}000}{(1+.12)^1}+\frac{30{,}000}{(1+.12)^2}+\frac{30{,}000}{(1+.12)^3}+\frac{30{,}000}{(1+.12)^4}+\frac{48{,}000}{(1+.12)^5}$ **= €18,357**

The risk-adjusted NPV is €18,357, and therefore the project should be accepted.

QUESTION NO.29 ***REMOVED***

QUESTION NO.30 ***REMOVED***

SENSITIVITY ANALYSIS WITH NPV = 0 WITH BREAK EVEN UNITS CONCEPTS

QUESTION NO.31 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 the 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) : 70%,Variable cost :` 60 per unit ; Annual Cash Inflow : ` 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%
3.993	3.890	3.791	3.696	3.605	3.517
14%	**15%**	**16%**	**17%**	**18%**	
3.433	3.352	3.274	3.199	3.127	

Solution:
(i) Initial Investment: IRR = 16% (Given) ; At IRR, NPV shall be zero, therefore Initial Cost of Investment = PVAF (16%,5) x Cash Flow (Annual) = 3.274 x ` 57,500 = ` 1,88,255
(ii) Net Present Value (NPV) : Let Cost of Capital be X, then 16 - X / X =60% or X = 10%
Thus NPV of the project = Annual Cash Flow x PVAF (10%, 5) – Initial Investment

= ` 57,500 x 3.791 – ` 1,88,255 = ` 2,17,982.50 – ` 1,88,255 = ` 29,727.50

Tutorial Note : Why 16-x/x why not x-16/16 ? Since x will always be lower than 16 since at x project must give positive NPV.If it would have been negative NPV project ,then there was no point of undertaking sensitivity analysis test.

(iii) Annual Fixed Cost : Let change in the Fixed Cost which makes NPV zero is X. Then,
` 29,727.50 – 3.791X = 0 Thus X = ` 7,841.60 ; Let original Fixed Cost be Y then,Sensitivity (%)
= Change/Base x 100 or 7.8416% = ` 7,841.60/Y x 100 or Y = ` 1,00,000
Thus Fixed Cost is equal to ` 1,00,000

(iv) Estimated Annual Units of Sales

Sales	200 x 1125(bal fig) (100%)	225000
Variable Cost 60	x 1125(bal fig)(30%)	67500
Contribution		157500
(-)Fixed Cost		100000
Profit/Cash Flow		57500

(v) Break Even Units : Fixed Cost /Contribution Per Unit =1,00,000 / 140 = 714.285 units

SENSITIVITY ANALYSIS TAKING NPV = 0 & USING FACTOR LIKE SELLING PRICE PER UNIT; COST PER UNIT & SALES VOLUME

QUESTION NO.32 XYZ Ltd. is considering a project for which the following estimates are available :

Initial Cost of the project	10,00,000
Sales price/unit	60
Cost/unit	40
Sales volumes	
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 : **(a)** Sales Price/unit **(b)** Unit cost **(c)** Sales volume **(d)** Initial outlay and **(e)** Project lifetime . Taxation may be ignored.

Solution:

Calculation of NPV : $NPV = -10,00,000 + \frac{20,000 \times 20}{(1+.10)^1} + \frac{30,000 \times 20}{(1+.10)^2} + \frac{30,000 \times 20}{(1+.10)^3}$

= -10,00,000 + 3,63,600 + 4,95,600 + 4,50,600 = ` 3,09,800

Measurement of Sensitivity Of The Project : -

(a) Sales Price : Let the Sales price per unit be S at which project would just breakeven i.e. NPV = 0 ;Therefore we have, $NPV = -10,00,000 + \frac{20,000 \times (S-40)}{(1+.10)^1} + \frac{30,000 \times (S-40)}{(1+.10)^2} + \frac{30,000 \times (S-40)}{(1+.10)^3}$

$\Rightarrow 0 = -10,00,000 + 20,000 \times (S-40) \times .909 + 30,000 \times (S-40) \times .826$ or $+ 30,000 \times (S-40) \times .751 \Rightarrow S =$ ` 55.26

$\therefore$ Sensitivity (%) $= \frac{\text{Change}}{\text{Base}} \times 100 = \frac{60-55.26}{60} \times 100 = 7.9\ \%$

(b) Unit Cost : Let the unit cost be Rs. C at which the project would just be breakeven. Therefore we have,

$$NPV = -10,00,000 + \frac{20,000 \times [60 - C]}{(1+.10)^1} + \frac{30,000 \times [60 - C]}{(1+.10)^2} + \frac{30,000 \times [60 - C]}{(1+.10)^3}$$

$\Rightarrow 0 = -10,00,000 + (60-C)\ [\ 18180 + 24780 + 22530\ ] \Rightarrow 0 = -10,00,000 + 65490\ (60-C) \Rightarrow C = Rs.\ 44.74$

$$\text{Sensitivity (\%)} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{44.74 - 40}{40} \times 100 = 11.85\ \%.$$

(c) Sales Volume : $\text{Sensitivity (\%)} = \frac{13,09,800 - 10,00,000}{13,09,800} = 23.65\%$

(d) Initial Outlay : If total Initial Outlay increases by ` 3,09,800, i.e. if it becomes ` 13,09,800 NPV will become zero.

$$\text{Sensivity (\%)} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{3,09,800}{10,00,000} \times 100 = 31.00\%\ (\text{approx})$$

(e) Project Lifetime : -

Calculate Discounted Pay Back Period :

Year	CF	PVF@10%	PV	Cumulative CF
1	4,00,000	.909	363600	363600
2	6,00,000	.826	495600	859200
3	6,00,000	.751	450600	1309800

Therefore Discounted Payback Period

$$= \text{Completed Years} + \frac{\text{Remaining Amount}}{\text{Available Amount}} = 2 + \frac{(10,00,000 - 859200)}{450600} = 2 + \frac{140800}{450600}$$

= 2.31247 years or 2 year 114 days . Hence at 2.31 years project will just breakeven

$$\therefore\ \text{Sensitivity (\%)} = \frac{\text{Change}}{\text{Base}} \times 100 = \frac{[3 - 2.31247]}{3} \times 100 = 22.92\ \%$$

EQUITY IRR/NPV & PROJECT IRR/NPV

QUESTION NO.33 XYZ Ltd an infrastructure company is evaluating a proposal to build, operate and transfer a part of 35 kms. of road at a project cost of ` 200 crores to be financed as follows:
Equity Shares Capital ` 50 crores, loans at the rate of interest of 15% p.a. from financial institutions ` 150 crores. The Project after completion will be opened 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 the Highway authorities at zero value. It is estimated that the toll revenue will be ` 50 crores per annum and the annual toll expenses including maintenance of the roads will amount to 5% of the project cost. The company considers to write 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 allowed for the repayment of the loan in 15 equal annual. Instalments - consisting of principal and interest.
Calculate Project IRR and Equity IRR. Ignore Corporate taxation. **Explain** the difference in Project IRR and Equity IRR.
[Hint: PVAF(18%,15Years) = 5.092 ; PVAF(19%,15Years) = 4.876 ;Ans- 18.43%
Hint: PVAF(25%,15Years) = 3.859;PVAF(30%,15Years)3.268;Ans-28.17%

Solution :

Computation of Project IRR : Project IRR means that discount rate at which Project NPV of the project is zero.Therefore we have ` 40 × PVAF ( r % , 15 Years ) - ` 200 = 0

Let r = 18 % :Net Present Value = 40 × 5.092 - 200 = 3.68

Let r = 19 % :Net Present Value = 40 × 4.876 - 200 = - 4.06

Now excat IRR can be found out by using following relation :IRR = $18\% + \frac{3.68}{3.68 - (-4.06)} \times 1\% = 18.43\%$

Computation of Equity IRR : Equity IRR means that discount rate at which Equity NPV of the project is zero .Therefore we have ` 14.35 × PVAF ( r % , 15 Years ) - ` 50 = 0

Let r = 28 % :Net Present Value = ` 14.35 × 3.484 - ` 50 = 0

Since Net Present Value comes to zero it means Equity IRR is 28 % .

Working Notes : (i) Project IRR : An approximation of IRR is made on the basis of cash flow data. A rough approximation may be made with reference to the payback period. The payback period in the given c ase is 5 years $\left(\frac{200\,\text{crores}}{40\,\text{crores}}\right)$. From the PVAF table the closest figures are given in rate 18% (5.092) and the rate 19% (4.876). This means the IRR of the project is expected to be between 18% and 19%.

(ii) Net cash inflow of the project for Project IRR :

Cash inflow	`
Toll revenue	50 crores p.a. for 15 years
Cash outflow	`
Total collection expenses including maintenance of the roads (5% of ` 200 crores)	10 crores p.a. for 15 years
Net cash inflow	40 crores p.a. for 15 years

Note : Since corporate taxes is not payable. The impact of depreciation need not be considered.

(iii) Equity IRR An approximation of IRR is made on the basis of cash flow data. A rough approximation may be made with reference to the payable period. The payback period in the given case is 3.484 $\left(\frac{50\ \text{crores}}{14.35\,\text{crores}}\right)$.

From the PVAF table at 28% the cumulative discount factor for 1-15 years is 3.484. Therefore, the equity IRR of project is 28%.

(iv) Equated annual instalment (i.e. principal + interest) of loan from financial institution :

Amount of loan from financial institution	` 150 crores
Rate of interest	15% p.a.
No. of years	15
Cumulative discount factor for 1-15 years	5.847
Hence, Equated Yearly Instalment will be Rs. 150 crores/5.847 i.e. Rs. 25.65 crores.	
Cash inflow available for equity shareholders	
Net cash inflow of the project [50 - 10]	` 40.00 crores
Equated Yearly Instalment of the Project [Refer to working note (ii)]	` 25.65 crores
Cash inflow available for equity shareholders	` 14.35 crores

Difference in Project IRR and Equity IRR :

Project IRR: It reflects the overall rate of return earned by a project (both for term lenders and shareholders).

Equity IRR: It reflects the rate of return a project earns for the holders of equity .

The project IRR is 18.4% whereas Equity IRR is 28.2%. This is attributed to the fact that XYZ Ltd. is earning 18.4%

on the loan from financial institution but paying only 15%. The difference between the return and cost of funds from financial institution has enhanced equity IRR. The 3.4% (18.4% - 15%) earnings on Rs. 150 crores goes to equity shareholders who have invested ` 50 crore i.e.
3.4% x Rs.150/ Rs.50 =10.2% is added to the project IRR which gives equity IRR of 28.2%

SELECTION OF PROJECT BASED ON EXPECTED UTILITY

QUESTION NO.34 Jumble Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows :

Cash Flow (`)	- 15000	-10000	-4000	0	15000	10000	5000	1000
Utilities(points)	-100	-60	-30	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 selectect on the basis of expected utility and why ?

Solution:

Evaluation of project utilizes of Project A and Project B

Project A

Cash flow (in `)	Probability	Utility	Utility value
-15,000	0.10	-100	-10
-10,000	0.20	-60	-12
15,000	0.40	40	16
10,000	0.20	30	6
5,000	0.10	20	2
			2

Project B

Cash flow (in `)	Probability	Utility	Utility value
-10,000	0.10	-60	-6
-4,000	0.15	-30	-4.5
15,000	0.40	40	16
5,000	0.25	20	5
10,000	0.10	30	3
			13.50

Project B should be selected as its expected utility is more

DETERMINATION OF OPTIMUM REPLACEMENT YEAR

QUESTION NO.35 A & Co. is contemplating whether to replace an existing machine (asset) 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
2	20,000	15,000
3	30,000	10,000
4	40,000	0

The opportunity cost of capital for A & Co. is 15%.

Required: When should the company replace(change) the machine (asset)?

(**Notes:** Present value of an annuity of ` 1 per period for 8 years at interest rate of 15% : 4.4873; present value of ` 1 to be received after 8 years at interest rate of 15% : 0.3269).Students can take any reasonable assumption required.

QUESTION NO.36 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 percent. Advise with reasons.

QUESTION NO.37 ***REMOVED***

HILLER 'S MODEL-WHEN WE HAVE MORE THAN ONE STANDARD DEVIATION

QUESTION NO. 38 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 three years is as follows:**

Year 1		Year 2		Year 3	
CFAT	Probability	CFAT	Probability	CFAT	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 an airline operations. **The company wants to know:**

(i) The expected NPV of this venture assuming **independent probability distribution** with 6 per cent risk free rate of interest.

(ii) The possible deviation in the expected value.Use Hiller's Model

(iii) How would standard deviation of the present value distribution help in Capital Budgeting decisions?

Solution:

Additional Analysis : Question has asked us to assume independent probability distribution.It means it is a case of Independent Cash Flows .

(i) Expected NPV (` in lakhs)

Year I			Year II			Year III		
CFAT	P	CfxP	CFAT	P	CFxP	CFAT	P	CFxP
14	0.1	1.4	15	0.1	1.5	18	0.2	3.6
18	0.2	3.6	20	0.3	6.0	25	0.5	12.5
25	0.4	10.0	32	0.4	12.8	35	0.2	7.0

40	0.3	12.0	45	0.2	9	48	0.1	4.8
		27.0			**29.3**			**27.9**

Year	Expected Cash Flow after Tax	PVF@ 6%	Present Value
1	27	0.943	25.461
2	29.3	0.890	26.077
3	27.9	0.840	23.436
		Present Value of Cash Inflow	74.974
		Less : Cash Outflow	50.000
		Net Present Value	24.974

(ii) Possible Deviation in the Expected Value :

Year I

X	AX	X –AX	$(X-AX)^2$	P	$(X-AX)^2P$
14	27	–13	169	0.1	16.9
18	27	–9	81	0.2	16.2
25	27	–2	4	0.4	1.6
40	27-13	169	0.3		50.7
					85.4

$\sigma_1 = \sqrt{85.4} = 9.241$

Year II

X	AX	X –AX	$(X-AX)^2$	P	$(X-AX)^2P$
15	29.3	–14.3	204.49	0.1	20.449
20	29.3	–9.3	86.49	0.3	25.947
32	29.3	2.7	7.29	0.4	2.916
45	29.3	15.7	246.49	0.2	49.298
					98.61

$\sigma_2 = \sqrt{98.61} = 9.930$

Year III

X	AX	X –AX	$(X-AX)^2$	P	$(X-AX)^2P$
18	27.9	-9.9	98.01	0.2	19.602
25	27.9	-2.9	8.41	0.5	4.205
35	27.9	7.1	50.41	0.2	10.082
48	27.9	20.1	404.01	0.1	40.401
					74.29

$\sigma_3 = \sqrt{74.29} = 8.619$

Overall Standard Deviation of the Project can be found by using following formula : (Cash Flows are independent as given in question) =

$$\sqrt{(SD_1 \times PVF_1)^2 + ((SD_2 \times PVF_2)^2 + (SD_3 \times PVF_3)^2} = \sqrt{\left(\frac{9.291}{(1.06)^1}\right)^2 + \left(\frac{9.930}{(1.06)^2}\right)^2 + \left(\frac{8.619}{(1.06)^3}\right)^2} = 14.3695$$

(iii) Standard Deviation is a unit of measure with which we can assess the extent to which the possible cashflows can deviate from the expected cash flows .
Higher the Standard Deviation of possible cash flows in a project, higher is the risk associated with a project.

If two projects have the same expected cash flows , then one which has a greater Standard Deviation will be said to have higher degree of uncertainty or risk.
Standard Deviation is an absolute measure which can be applied when the projects involve the same outlay.
Standard Deviation can be misleading in comparing the uncertainty of alternative projects, if they differ in size i.e. when project involves different oulays. In such case coefficient of variation is the correct technique.

It is calculated as follows :Coefficient Of Variation = $\frac{\text{Standard Deviation}}{\text{Expected Cash Flow}}$

QUESTION NO.39 Project X and Project Y are under the evaluation of XY Co. **The estimated cashflows and their probabilities are as below.**

Project X : Investment (year 0) ` 70 lakhs

Probability Weights	0.30	0.40	0.30
Years	**` Lacs**	**` Lacs**	**` Lacs**
1	30	50	65
2	30	40	55
3	30	40	45

Project Y : Investment (Year 0) Rs. 80 lakhs.Life :3 Years

Probability weights	**` Lacs**
0.20	40
0.50	45
0.30	50

(a) Which project is better based on NPV criterion with a discount rate of 10%?
(b) Compute the standard deviation of the present value distribution and analyse the inherent risk of the projects.Use Hiller's Model.

Solution:

Project X : Expected Cash Flow

	Year 1			**Year 2**			**Year 3**	
CF	**P**	**CF X P**	**CF**	**P**	**CF X P**	**CF**	**P**	**CF X P**
30	.30	9	30	.30	9	30	.30	9
50	.40	20	40	.40	16	40	.40	16
65	.30	19.5	55	.30	16.5	45	.30	13.5
		48.50			**41.50**			**38.50**

Computation of Net Present Value :

Year	**Expected Cash Flow**	**PVF @ 10%**	**Present Value**
0	(70.00)	1	(70.00)
1	48.50	.909	44.0865
2	41.50	.826	39.2790
3	38.50	.751	28.9135
			37.2790

Project Y : Expected Cash Flow [assuming same for year 1,2 and 3]

CF	**P**	**CF X P**
40	.20	8.00
45	.50	22.50
50	.30	15.00
		45.50

Computation of Net Present Value

Year	Expected Cash Flow	PVF @ 10%	Present Value
0	(80.00)	1	(80.00)
1	45.50	.909	41.3595
2	45.50	.826	37.583
3	45.50	.751	34.1705
			33.16

Decision : Project X has the higher NPV and should be selected.

(b)Calculation of Standard Deviation

Project X

Year 1 : $\sqrt{.30\times(30-48.5)^2+.40\times(50-48.5)^2+.30\times(65-48.50)^2}=13.611$

Year 2 : $\sqrt{.30\times(30-41.5)^2+.40\times(40-41.5)^2+.30\times(55-41.50)^2}=9.76$

Year 3 : $\sqrt{.30\times(30-38.5)^2+.40\times(40-38.5)^2+.30\times(45-38.50)^2}=5.94$

Project Y : $\sqrt{.20\times(40-45.5)^2+.50\times(45-45.5)^2+.30\times(50-45.50)^2}=3.5$

[same for year 1,2 and 3]

Overall Standard Deviation Of Project X :: $\sqrt{\left[\frac{(13.611)}{(1+.10)^1}\right]^2+\left[\frac{(9.76)}{(1+.10)^2}\right]^2+\left[\frac{(5.94)}{(1+.10)^3}\right]^2}=15.43$

Overall Standard Deviation Of Project Y: : $\sqrt{\left[\frac{3.5}{(1+.10)^1}\right]^2+\left[\frac{3.5}{(1+.10)^2}\right]^2+\left[\frac{3.5}{(1+.10)^3}\right]^2}=5.041$

Note: Overall Standard Deviation Of the project has been calculated on the assumption that Cash Flows are independent .

QUESTION NO.40 Aeroflot airlines 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:(` in lakh)**

Year 1		Year 2		Year 3	
CFAT	Probability	CFAT	Probability	CFAT	Probability
15	.1	15	.1	18	.2
18	.2	20	.3	22	.5
22	.4	30	.4	35	.2
35	.3	45	.2	50	.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 percent risk free rate of interest, and
(ii) the possible standard deviation on expected values.Use Hiller's Model.

Solution:

(i) Determination of expected CFAT `in lakh

Year-1 **Year-2** **Year - 3**

CFAT	P1	Cash flow	CFAT	P2	Cash flow	CFAT	P3	Cash flow		
15		0.1 1.5		15	0.1	1.5		18	0.2	3.6
18		0.2 3.6		20	0.3	6		22	0.5	11
22		0.4 8.8		30	0.4	12		35	0.2	7
35		0.3 10.5		45	0.2	9		50	0.1	5
CF1		**24.4**		**CF2**		**28.5**		**CF3**		**26.6**

CFAT (` in lakh)	PVF@ 6%	Total PV (` in lakh)
24.4	0.943	23.009
28.5	0.890	25.365
26.6	0.840	22.344
		70.718
Less Cash flow		50.000
Expected NPV		20.718

(ii) Determination of Standard deviation for each year

Year 1: Standard deviation= 7.282; **Year 2:** Standard deviation= 9.76;**Year 3:** Standard deviation= 9.70

Overall Standard deviation as per Hiller's Model : $\sqrt{\frac{(7.282)^2}{(1+.06)^2}+\frac{(9.76)^2}{(1+.06)^4}\frac{(9.7)^2}{(1+.06)^6}}$ = 13.75

QUESTION NO.41 ***Removed***

QUESTION NO.42 ***Removed***

SCENARIO ANALYSIS

QUESTION NO.43 XYZ Ltd. is considering a project "A" with an initial outlay of ` 14,00,000 and the possible three cash inflow attached with the project as follows:(` '000)

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

(i) Assuming the cost of capital as 9%, determine NPV.

(ii) Now suppose that CEO of XYZ Ltd. is bit confident about the most likely estimates in the first two years,but not sure about the third year's high cash inflow. He is interested in knowing what will happen to traditional NPV if 3rd year turn out the bad contrary to his optimism.**Decide**

Solution:

(i) The possible outcomes will be as follows:Rs.000

Year	PVF@9%	Worst Case		Most likely		Best case	
		Cash Flow	PV	Cash Flow	PV	Cash Flow	PV
0	1	(1400)	(1400)	(1400)	(1400)	(1400)	(1400)
1	0.917	450	412.65	550	504.35	650	596.05
2	0.842	400	336.80	450	378.90	500	421
3	0.772	700	540.40	800	617.60	900	694.80
NPV			**-110.15**		**100.85**		**311.85**

(ii) The NPV in such case will be as follows : = $-1400000+\frac{550000}{(1+.09)^1}+\frac{450000}{(1+.09)^2}+\frac{700000}{(1+.09)^3}$

= - ` 1400000 + ` 504587 + ` 378756 + ` 540528.44 = ` 23871.44

Thus, CEO's concern is well founded that, as a worst case in the third year alone yield a marginally positive NPV.Since NPV is positive,we should accept the project.

QUESTION NO.44 From the following information compute the Net Present Value (NPVs) of the two projects for each of the possible cash flows, using Scenario Analysis:

	Project X (000 `)	Project Y (000 `)
Initial Cash Outflows (t=0)	30	30
Cash Inflows estimates (t=1-10)		
Worst	5	8
Most likely	8	10
Best	15	20
Required Rate of Return	14%	14%
Economic Life (years)	10	10

Solution:

Determination of Net Present Value under each Possible Outcome

	Project X		Project Y
Outcome	**Net Present Value**	**(000'`)**	**Net Present Value (000'`)**
Worst	5 × 5.216 - 30 =	(–3.92)	8 × 5.216 -30 =11.73
Most Likely	8 × 5.216 - 30 =	11.73	10× 5.216 - 30 =22.16
Best	15 × 5.216 - 30 =	48.24	20× 5.216 - 30 =74.32

Conclusion :

In case of Project X : Under worst circumstances there is negative NPV whereas in case of most likely and best circumstances there is positive NPV.

In case of Project Y : There is positive NPV under all the circumstances, at the same time cash inflows are more than project X. Hence, Project Y is more profitable and hence be accepted.

QUESTION NO.45 Kanoria Enterprises wishes to evaluate two mutually exclusive projects X and Y.

The particulars are as under:	Project X (`)	Project Y (`)
Initial Investment	1,20,000	1,20,000
Estimated cash inflows (per annum for 8 years)		
Pessimistic	26,000	12,000
Most Likely	28,000	28,000
Optimistic	36,000	52,000

The cut off rate is 14%. The discount factor at 14% are :

Year	1	2	3	4	5	6	7	8	9
Discount	0.877	0.769	0.675	0.592	0.519	0.456	0.400	0.351	0.308

Advise: management about the acceptability of projects X and Y.

Solution:

The possible outcomes of Project X and Project Y are as follows

Estimates	Estimated Annual	PVF @ 14%	PV of Cash Flow	NPV (`)	Estimated Annual	PVF @14%	PV of Cash	NPV (`)

	Cash inflows	for 8 years	(`)		Cash Inflows	for 8 years	Flow (`)	
Pessimistic	26,000	4.639	1,20,614	614	12,000	4.639	55,668	(-64,332)
Most likely	28,000	4.639	1,29,892	9,892	28,000	4.639	1,29,892	9,892
Optimistic	36,000	4.639	2,41,228	47,004	52,000	4.639	2,41,228	1,21,228

In pessimistic situation project X will be better as it gives low but positive NPV whereas Project Y yeld highly negative NPV under this situation. **In most likely situation** both the project will give same result. However, **in optimistic situation** Project Y will be better as it will gives very high NPV.

So, project X is a risk less project as it gives positive NPV in all the situation whereas Y is a risky project as it will result into negative NPV in pessimistic situation and highly positive NPV in optimistic situation.

So acceptability of project will largely depend on the risk taking capacity [Risk seeking i.e those who wants to tale risk]/Risk aversion i.e those who wants to avoid risk) of the management.

EXTRA PRACTICAL QUESTIONS

QUESTION NO.1(4 Marks) Invest Corporation Ltd. adjusts risk through discount rates by adding various risk premiums to the risk free rate. Depending on the resultant rate, the proposed project is judged to be a low, medium or high risk project.

Risk level	Risk free rate(%)	Risk Premium(%)
Low	8	4
Medium	8	7
High	8	10

DEMONSTRATE the acceptability of the project on the basis of Risk Adjusted rate.

Solution:

Calculation of Risk Adjusted rate:

Risk level	Risk free rate (%)	Risk Premium (%)	Risk adjusted rate (%)
Low	8	4	12
Medium	8	7	15
High	8	10	18

The cash flows of the project considered are as following:

Point in time (yearly intervals)	0	1	2
Cash flow (Rs. in crore)	(100)	45	80

If the project is judged to be Low risk

Years	0	1	2
PV (` in crore)	(100)	45 / 1 + 0.12= 40.18	80/ $(1.12)^2$ = 63.78

NPV = 40.18 + 63.78 - 100 = 3.96: **Decision:** Accept

If the project is judged to be Medium risk

Years	0	1	2
PV (` in crore)	(100)	45 / 1 + 0.15= 39.13	80/ $(1.15)^2$ = 60.49

NPV = 39.13 + 60.49 - 100 = (0.38): **Decision:** Reject

If the project is judged to be High risk

Years	0	1	2
PV (` in crore)	(100)	45/ 1 + 0.18 = 38.14	80/ $(1.18)^2$ = 57.45

NPV = 38.14 + 57.45 - 100 = (4.41) ; **Decision:**Reject
Note: Any other CF can be assumed.

QUESTION NO.2 Sea Rock Ltd. has an excess cash of ` 30,00,000 which it wants to invest in short-term marketable securities.
(i) Expenses resulting to investment will be ` 45,000. The securities invested will have an annual yield of 10%. The company seeks your advice as to the period of investment so as to earn a pre-tax income of 6%.
(ii) Also find the minimum period for the company to break-even its investment expenditure. Ignore time value of money
Note: Breakeven means No Profit Loss situation.
Solution:
(i)Period of investment: Let the period of Investment be P and return required on investment ` 1,80,000 (` 30,00,000 x 6%) ; Accordingly, (` 30,00,000 x (10 / 100) x P / 12 ) - ` 45,000 = ` 1,80,000 or P = 9 months
(ii)Break-Even its investment expenditure :(` 30,00,000 x (10 / 100) x P/12) -` 45,000 = 0 or P = 1.80 months

QUESTION NO.3 A Ltd. proposes to launch a new product. The company appointed a Consultant to conduct market study. The consultant suggested that the price of product can be set £36 or £38 or £40 per unit. The company intends to hire a machinery(asset) to manufacture the product at £400 000 per annum. However, if annual production exceeds 60000 units, additional cost of £ 160000 per annum will be incurred for hire of machinery (asset). The following data is related to the estimated sale and possible selling prices.
Table I

Selling Price	Units	£36	Units	£38	Units	£40
Pessimistic	70 000	0.3	60 000	0.1	30 000	0.4
Most likely	80 000	0.5	70 000	0.7	60 000	0.5
Optimistic	90 000	0.2	90 000	0.2	70 000	0.1

Table - II

Variable Cost	Prob.
£10	0.6
£12	0.4
	1.00

The company has committed publicity expenditure of £80 000per annum.**You are required to** analyse and advise which selling price shall lead to maximization of profit.
Solution
In the given case, the selling price may be 36 or 38 or 40, and the variable cost of the production may be 10 or 12. This would affect the contribution per unit. The entire informations can be presented as follows :
If Variable Cost = 10, then contribution is 26 or 28 or 30
If Variable Cost = 12, then contribution is 24 or 26 or 28.
The total expenses are : 4,00,000 + 80,000 = 4,80,000 or, 4,00,000 + 1,60,000 + 80,000 = 6,40,000.

Units	Cont. p.u.	Total Contribution	Expenses	Net Income	Prob	Expected Value
Selling Price 36 :						
70,000	26	18,20,000	6,40,000	11,80,000	0.3 × 0.6=0.18	2.12,400
	24	16,80,000	6,40,000	10,40,000	0.3 × 0.4=0.12	1,24,800
80,000	26	20,80,000	6,40,000	14,40,000	0.5 × 0.6=0.30	4,32,000
	24	19,20,000	6,40,000	12,80,000	0.5 × 0.4=0.20	2,56,000
90,000	26	23,40,000	6,40,000	17,00,000	0.2 × 0.6=0.12	2,04,000

	24	21,60,000	6,40,000	15,20,000	0.2 × 0.4=0.08	1,21,600
					1.00	**13,50,800**

Selling Price 38 :

60,000	28	16,80,000	4,80,000	12,00,000	0.1 × 0.6=0.06	72,000
	26	15,60,000	4,80,000	10,80,000	0.1 × 0.4=0.04	43,200
70,000	28	19,60,000	6,40,000	13,20,000	0.7 × 0.6=0.42	5,54,400
	26	18,20,000	6,40,000	11,80,000	0.7 × 0.4=0.28	3,30,400
90,000	28	25,20,000	6,40,000	18,80,000	0.2 × 0.6=0.12	2,25,600
	26	23,40,000	6,40,000	17,00,000	0.2 × 0.4=0.08	1,36,000
					1.00	**13,61,600**

Selling Price 40 :

30,000	30	9,00,000	4,80,000	4,20,000	0.4 × 0.6=0.24	1,00,800
	28	8,40,000	4,80,000	3,60,000	0.4 × 0.4=0.16	57,600
60,000	30	18,00,000	4,80,000	13,20,000	0.5 × 0.6=0.30	3,96,000
	28	16,80,000	4,80,000	12,00,000	0.5 × 0.4=0.20	2,40,000
70,000	30	21,00,000	6,40,000	14,60,000	0.1 × 0.6=0.06	87,600
	28	19,60,000	6,40,000	13,20,000	0.1 × 0.4=0.04	52,800
					1.00	**9,34,800**

The expected value of profit is maximum at the selling price of £ 38. So the firm should fix up the price at £ 38.
Note: Student may solve the same question by any other method,but final answer must be same.

QUESTION NO.4 Airborne Ltd. wants to take advantage of a new government scheme of connecting smaller towns and wants to purchase one-turboprop airplane at a cost of 5 crores. It has obtained permission to fly on 4 sectors.
The company had provided the following estimates of its costs and revenues. The cost of capital is 16% and the company depreciates its assets over a period of 25 years on a straight-line basis. Currently it is operating in a 30% tax regime and under the new government scheme it enjoys a 100% tax waiver for the first 3 years.

- Passenger Capacity of the aircraft: 60 passengers
- Expected Operational Capacity: 80%
- Per aircraft no. of trips on a daily basis: 4

	Amount in (`)
Average realization per passenger	2,000
Annual Cost of Manpower	250,00,000
Airport handling charges - Fixed per day	10,000
Annual Repairs and Maintenance	50,00,000
Daily Operating Costs	75,000

The costs with the exception of Airport handling charges are expected to increase 10% year on year and the Operational Capacity would go up to 90% from Year 3.
The certainty of achieving the projected cash flows in the first five years are 0.8, 0.9, 0.75,0.7 and 0.7 and PV at 16% are 0.862, 0.743, 0.641,0.552, 0.476 respectively.**Advise** the management on the feasibility of the project, assuming the aircraft operates on all the 365 days in a year.

Solution:

Working Notes:

(i) Depreciation = ` 5,00,00,000 / 25 = ` 20,00,000 Per Annum

(ii) Realization from Passenger

	Year 1	Year 2	Year 3	Year 4	Year 5
Passenger Capacity	60	60	60	60	60
Exp. Operational Capacity	80%	80%	90%	90%	90%
No. of Trips per Day	4	4	4	4	4
Average Realization Per Passenger (`)	2,000	2,000	2,000	2,000	2,000
No. of Days	365	365	365	365	365
Realizations (`)	14,01,60,000	14,01,60,000	15,76,80,000	15,76,80,000	15,76,80,000

(iii) Statement Showing Cost **(`)**

	Year 1	Year 2	Year 3	Year 4	Year 5
Annual Cost of Manpower	2,50,00,000	2,75,00,000	3,02,50,000	3,32,75,000	3,66,02,500
Airport Handling Charges	36,50,000	36,50,000	36,50,000	36,50,000	36,50,000
Annual Repair & Maintenance	5,00,00,000	5,50,00,000	6,05,00,000	6,65,50,000	7,32,05,000
Operating Exp.	2,73,75,000	3,01,12,500	3,31,23,750	3,64,36,125	4,00,79,738
Total	10,60,25,000	11,62,62,500	12,75,23,750	13,99,11,125	15,35,37,238

(iv)Statement Showing NPV **(Amount in `)**

	Year 1	Year 2	Year 3	Year 4	Year 5
Realizations	14,01,60,000	14,01,60,000	15,76,80,000	15,76,80,000	15,76,80,000
Cost of Operations	10,60,25,000	11,62,62,500	12,75,23,750	13,99,11,125	15,35,37,238
Depreciation	20,00,000	20,00,000	20,00,000	20,00,000	20,00,000
Profit Before Tax	3,21,35,000	2,18,97,500	2,81,56,250	1,57,68,875	21,42,762
Less: Tax*	-	-	-	47,30,663	6,42,829
Profit after Tax	3,21,35,000	2,18,97,500	2,81,56,250	1,10,38,212	14,99,933
Add: Depreciation	20,00,000	20,00,000	20,00,000	20,00,000	20,00,000
	3,41,35,000	2,38,97,500	3,01,56,250	1,30,38,212	34,99,933
CE Factor	0.8	0.9	0.75	0.70	0.70
Certain Cash Flow	2,73,08,000	2,15,07,750	2,26,17,188	91,26,748	24,49,953
PVF@16%	0.862	0.743	0.641	0.552	0.476
PV of Cash Inflow	2,35,39,496	1,59,80,258	1,44,97,618	50,37,965	11,66,178

Total PV of Cash Inflow	6,02,21,515
PV of Cash Ouflow	5,00,00,000
NPV	1 0221 515

Decision: Since NPV is positive Airborne Ltd. should accept the project.
Note: Question clearly stated that no tax will apply in first 3 years.

QUESTION NO.5 An enterprise is investing ` 100 lakhs in a project. The risk-free rate of return is 7%. Risk premium expected by the Management is 7%. The life of the project is 5 years. Following are the cash flows that are estimated over the life of the project.

Year	Cash flows (` in lakhs)
1	25
2	60
3	75
4	80
5	65

Calculate Net Present Value of the project based on Risk free rate and also on the basis of Risks adjusted

discount rate.

Solution:

The Present Value of the Cash Flows for all the years by discounting the cash flow at 7% is calculated as below:

Year	Cash flows ` in lakhs	Discounting Factor@7%	Present value of Cash Flows ` in lakhs
1	25	0.935	23.38
2	60	0.873	52.38
3	75	0.816	61.20
4	80	0.763	61.04
5	65	0.713	46.35
Total of present value of Cash flow		244.34	
Less Initial investment		100	
Net Present Value (NPV)		144.34	

Now when the risk-free rate is 7 % and the risk premium expected by the Management is 7 %. So the risk adjusted discount rate is 7 % + 7 % =14%.

Discounting the above cash flows using the Risk Adjusted Discount Rate would be as below:

Year in Lakhs	Cash flows ` Factor@14%	Discounting Cash Flows ` in lakhs	Present Value of
1	25	0.877	21.93
2	60	0.769	46.14
3	75	0.675	50.63
4	80	0.592	47.36
5	65	0.519	33.74
Total of present value of Cash flow			199.79
Initial investment			100
Net present value (NPV)			99.79

QUESTION NO.6 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	` 15,00,000	` 11,00,000	` 19,00,000
Inflows—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 (Beta)	1.80	1.00	0.60

Minimum required rate of return of the firm is 15% which can be considered as market rate and applicable tax rate is 40%. The risk free interest rate is 10%. Required:

(i) Find out the risk-adjusted discount rate (RADR) for these projects using CAPM Approach**(ii)** Which project is the best?

[Tutorial Note: Since Inflow is given ,it means the given figure is already adjusted for tax]

Solution:

(i) The risk free rate of interest and risk factor for each of the projects are given. **The risk adjusted discount rate (RADR) for different projects can be found on the basis of CAPM as follows:**

For P-I : RADR = 0.10 + (0.15 – 0.10) 1.80 = 19%

For P-II : RADR = 0.10 + (0.15 – 0.10) 1 = 15 %

For P-III : RADR = 0.10 + (0.15 – 0.10) 0.60 = 13 %

(ii) The three projects can now be evaluated at 19%, 15% and 13% discount rate as follows:

Project P-I

Annual Inflows	` 6,00,000
PVAF (19 %, 4)	2.639
PV of Inflows (` 6,00,000 x 2.639)	` 15,83,400
Less: Cost of Investment	` 15,00,000
Net Present Value	` 83,400

Project P-II

Year	Cash Inflow (`)	PVF (15%,n)	PV (`)
1	6,00,000	0.870	5,22,000
2	4,00,000	0.756	3,02,400
3	5,00,000	0.658	3,29,000
4	2,00,000	0.572	1,14,400
Total Present Value			12,67,800
Less: Cost of Investment			11,00,000
Net Present Value			1,67,800

Project P-III

Year	Cash Inflow (`)	PVF (13%,n)	PV (`)
1	4,00,000	0.885	3,54,000
2	6,00,000	0.783	1 4,69,860
3	8,00,000	0.693	5,54,400
4	12,00,000	0.613	7,35,600
Total Present Value			21,13,860
Less: Cost of Investment			19,00,000
Net Present Value			2,13,860

Decision : Project P-III has highest NPV. So, it should be accepted by the firm

QUESTION NO.7 MNL Ltd. is considering investment in one of three mutually exclusive projects: AB, BC, CD. The company's cost of capital is 15% which is to be treated as market return and the risk-free interest rate is 10%. The income-tax rate for the company is 34%. **MNL has gathered the following basic cash flows and risk index data for each project:**

Projects	AB	BC	CD
Initial Investment	12,00,000	10,00,000	15,00,000
Cash Inflows - Year			
1	5,00,000	5,00,000	4,00,000
2	5,00,000	4,00,000	5,00,000
3	5,00,000	5,00,000	6,00,000
4	5,00,000	3,00,000	10,00,000
Risk Index	1.80	1.00	0.60

Using the Risk Adjusted Discount Rate, **determine** the risk adjusted NPV for each of the project. Which project should be accepted by the company?

Solution:

(i) The risk free rate of interest and risk factor for each of the projects are given. The risk adjusted discount rate (RADR) for different projects can be found on the basis of CAPM as follows:Required Rate of Return = I_{RF}+ (ke - I_{RF})

Risk Factor

For AB: RADR =0.10+ (0.15 - 0.10)1.80 = 0.19 or 19%

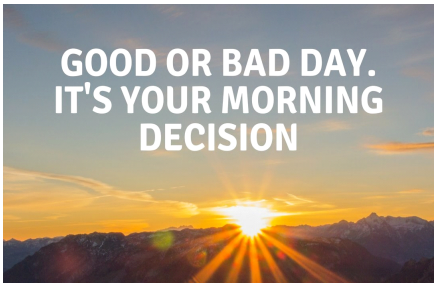
For BC : RADR =0.10+ (0.15 - 0.10) 1.00 = 0.15 or 15 %

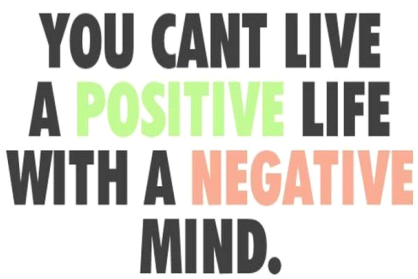
For CD: RADR =0.10+ (0.15 - 0.10) 0.60 = 0.13 or 13 %

(ii) The three projects can now be evaluated at 19%, 15% and 13% discount rate as follows:

Project AB

Annual Inflows	`	5,00,000
PVAF (19 %, 4)		2.639
PV of Inflows (` 5,00,000 x 2.639)	`	13,19,500
Less: Cost of Investment	`	12,00,000
Net Present Value	`	1,19,500





A BEAUTIFUL STORY

***A little boy went to a telephone booth which was at the cash counter of a store and dialed a number.**

The store-owner observed and listened to the conversation:

Boy : "Lady, Can you give me the job of cutting your lawn?

Woman : (at the other end of the phone line) "I already have someone to cut my lawn."

Boy : "Lady, I will cut your lawn for half the price than the person who cuts your lawn now."

Woman : I'm very satisfied with the person who is presently cutting my lawn.

Boy : (with more perseverance) "Lady, I'll even sweep the floor and the stairs of your house for free.

Woman : No, thank you.

With a smile on his face, the little boy replaced the receiver.

The store-owner, who was listening to all this, walked over to the boy.

Store Owner : "Son… I like your attitude; I like that positive spirit and would like to offer you a job."

Boy : "No thanks,

Store Owner : But you were really pleading for one.

Boy : No Sir, I was just checking my performance at the job I already have. I am the one who is working for that lady I was talking to!" *

**** This is called self Appraisal"** Give your best and the world comes to you!!!!!**