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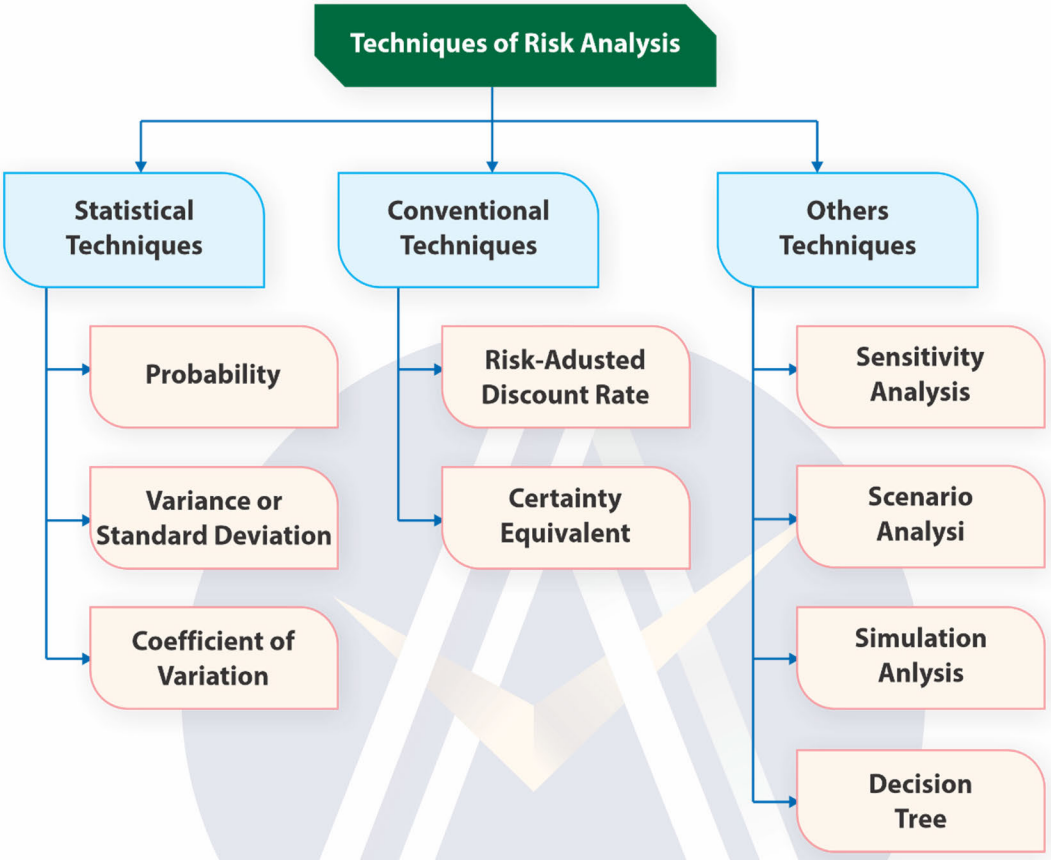
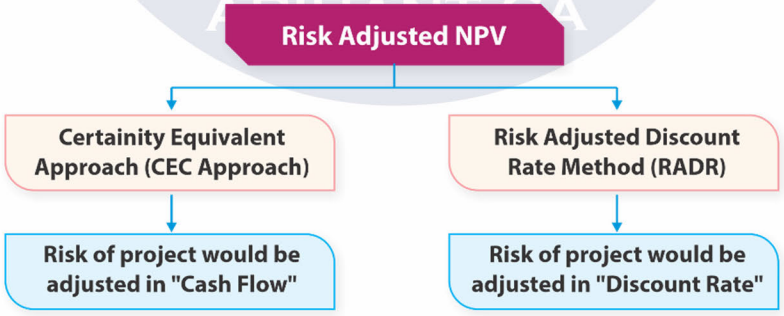
Advanced Capital Budgeting Decisions

Study Session 13



LOS 1 : Calculation of Risk Adjusted NPV



Note:

- Under this method, Project should be discounted using risk- adjusted discount rate rather than risk-free discount rate.
- Project having higher risk should be discounted with higher rate.
- Higher the risk of the project, higher should be the discount rate.
- NPV calculated by using RADR is known as "Risk Adjusted NPV".
- CV is a measure of risk, higher the CV, higher the risk.
- Imagine the firm to be market portfolio, K_o can be treated as R_m

$$RADR = R_F + \text{Risk Index } (K_o - R_F)$$

Certainty Equivalent Co-efficient (CEC) Method

It involves discounting of certain Cash Flows instead of Total Cash Flows.

Steps involved:

Step 1: Calculate all cash flows arising from the project.

Step 2: Calculate certain cash flow by using CEC (Certainty Equivalent Co-efficient)

Certain Cash Flow = Cash Flow × CEC

Step 3: Compute NPV by taking certain risk-free Cash Flow and risk-free discount rate.

Note:

- Higher the CEC, lower the risk and vice-versa.
- CEC of cash flow arising in year 0 will always be One.

QUESTION NO. 1A :

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.

QUESTION NO. 1B :

If Investment Proposal is ₹ 45,00,000 and risk free rate is 5%, calculate Net present value under certainty equivalent technique.

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

QUESTION NO. 1C

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	P.V. 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. 1D :

The Textile Manufacturing Company Ltd. is considering one of two mutually exclusive proposals, Project M and N, which require cash outlays of ₹ 8,50,000 and ₹ 8,25,000 respectively. The certainty equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 6% and this is used as the risk free rate. The expected net cash flows and their certainty equivalents are as follows:

Project M			Project N	
Year-end	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:
(i) ANALYSE which project should be accepted?
(ii) If risk adjusted discount rate method is used, IDENTIFY which project would be appraised with a higher rate and why?

QUESTION NO. 1E :

New Projects Ltd. is evaluating 3 projects, P-I, P-II, P-III. Following informationis 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	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 :
(i) Find out the risk-adjusted discount rate (RADR) for these projects.
(ii) Which project is the best?

LOS 2 : Probability Distribution Approach

Expected Cash Flow

$$\sum ENCF \times Probability$$

Standard Deviation:

$$\sigma = \sqrt{\sum[\text{probability} \times (\text{Given NPV} - \text{Expected NPV})^2]}$$

- Higher the S.D, Higher the risk & Vice-versa.

Co-efficient of Variation (CV):

$$CV = \frac{\text{Standard Deviation}}{\text{Expected NPV}}$$

Higher the CV, higher the risk & vice-versa

QUESTION NO. 2A :

Possible net cash flows of Projects A and B at the end of first year and their probabilities are given as below. Discount rate is 10 per cent for both the project initially investment is ₹ 10,000. Calculate the expected net present value for each project. State which project is preferable?

	Project A		Project B	
Possible Event	Cash Flow (₹)	Probability	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

QUESTION NO. 2B :

Probabilities for net cash flows for 3 years a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (₹)	Probability	Cash Flow (₹)	Probability	Cash Flow (₹)	Probability
2,000	0.10	2,000	0.20	2,000	0.30
4,000	0.20	4,000	0.30	4,000	0.40
6,000	0.30	6,000	0.40	6,000	0.20
8,000	0.40	8,000	0.10	8,000	0.10

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.

QUESTION NO. 2C :

CALCULATE Variance and Standard Deviation of Project A and Project B on the basis of following information:

Possible Event	Project A		Project B	
	Cash Flow (₹)	Probability	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

QUESTION NO. 2D :

Shivam Ltd. is considering two mutually exclusive projects A and B. Project A costs ₹ 36,000 and project B ₹ 30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimates (₹)	Probability	NPV estimates (₹)	Probability
15,000	0.2	15,000	0.1
12,000	0.3	12,000	0.4
6,000	0.3	6,000	0.4
3,000	0.2	3,000	0.1

(i) Compute the expected net present values of projects A and B.
(ii) Compute the risk attached to each project i.e. standard deviation of each probability distribution.
(iii) Compute the profitability index of each project.
(iv) Which project do you recommend? State with reasons.

QUESTION NO. 2E :

TIP Ltd. is considering two mutually exclusive projects M and N. You have been given below the Net Cash flow probability distribution of each project:

Project-M		Project-N	
Net Cash Flow (₹)	Probability	Net Cash Flow (₹)	Probability
62,500	0.30	1,62,500	0.20
75,000	0.30	1,37,500	0.30
87,500	0.40	1,12,500	0.50

(i) REQUIRED:
- a) Expected Net Cash Flow of each project.
- b) Variance of each project.
- c) Standard Deviation of each project.
- d) Coefficient of Variation of each project.

(ii) IDENTIFY which project would you recommend? Give reasons.

QUESTION NO. 2F :

A Ltd. is considering two mutually exclusive projects X and Y.
You have been given below the Net Cash flow probability distribution of each project:

Project-X		Project-Y	
Net Cash Flow (₹)	Probability	Net Cash Flow (₹)	Probability
50,000	0.30	1,30,000	0.20
60,000	0.30	1,10,000	0.30
70,000	0.40	90,000	0.50

(i) Compute the following :
- a) Expected Net Cash Flow of each project.
- b) Variance of each project.
- c) Standard Deviation of each project.
- d) Coefficient of Variation of each project.

(ii) Identify which project do you recommend ? Give reason.

QUESTION NO. 2G :

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:

		Cash Flow	
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 per cent, which project should be accepted? Explain with workings.

QUESTION NO. 2H :

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?

QUESTION NO. 21 :

KLM Ltd., is considering taking up one of the two projects-Project-K and Project-So 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:

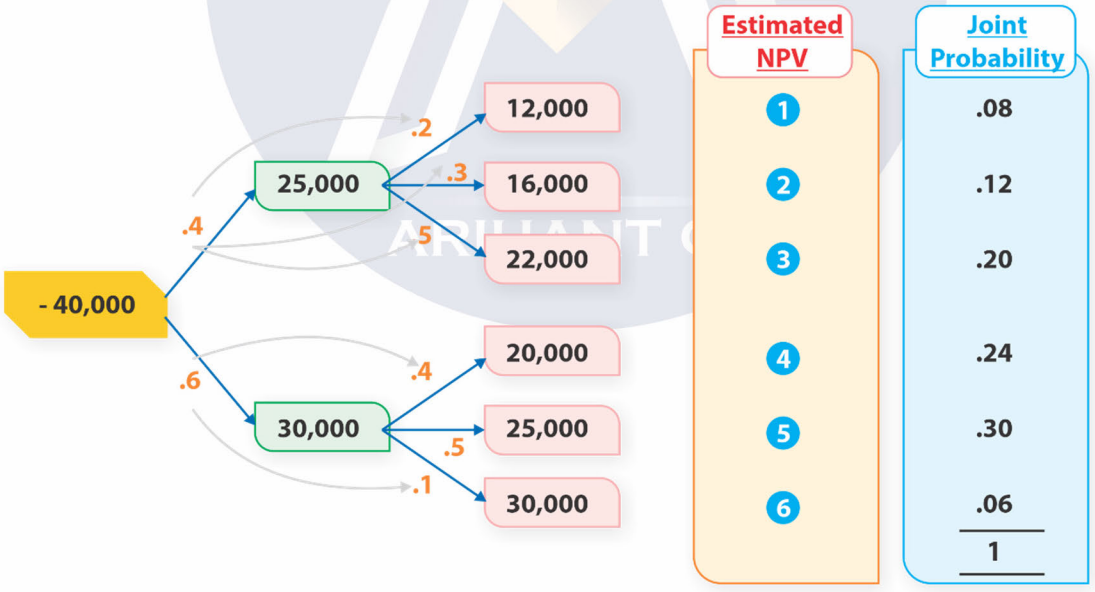
Project K		Project S	
Cash Flow (in ₹)	Probability	Cash Flow (in ₹)	Probability
11	0.10	09	0.10
13	0.20	13	0.25
15	0.40	17	0.30
17	0.20	21	0.25
19	0.10	25	0.10

Required:

(i) Calculate variance, standard deviation and co-efficient of variance for both the projects.
(ii) Which of the two projects is riskier?

LOS 3: Decision Tree Approach & Joint Probability

Type 1 : Moderately Correlated Cash Flows



- Decision Tree is a graphical representation of two or more than 2 years cash flows, which are dependent to each other.
- Joint probability is the product of two or more than two dependent probabilities.
- The total of joint probabilities is always equal to 1.
- Joint probability is applicable in case of dependent cash flows.

Steps Involved:

Step 1: Identify the various paths or outcomes

Step 2: Compute joint probability.

Step 3: Compute NPV of each path.

Step 4: Compute Expected NPV.

QUESTION NO. 3A :

A firm has an investment proposal, requiring an outlay of ₹ 40,000. The investment proposal is expected to have 2 years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹ 25,000 and 0.6 probability that cash inflow after tax will be ₹ 30,000. The probabilities assigned to cash inflows after tax for the year 1 are as follows:

The cash inflow year I	₹ 25,000		₹ 30,000	
The Cash inflow year II		**Probability**		**Probability**
	₹ 12,000	0.2	₹ 20,000	0.4
	₹ 16,000	0.3	₹ 25,000	0.5
	₹ 22,000	0.5	₹ 30,000	0.1

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

Required:

(a) Construct a decision tree for the proposed investment project.

(b) What net present value will the project yield if worst outcome is realized? What is the probability of occurrence of this NPV?

(c) What will be the best and the probability of that occurrence?

(d) Will the project be accepted?

QUESTION NO. 3B :

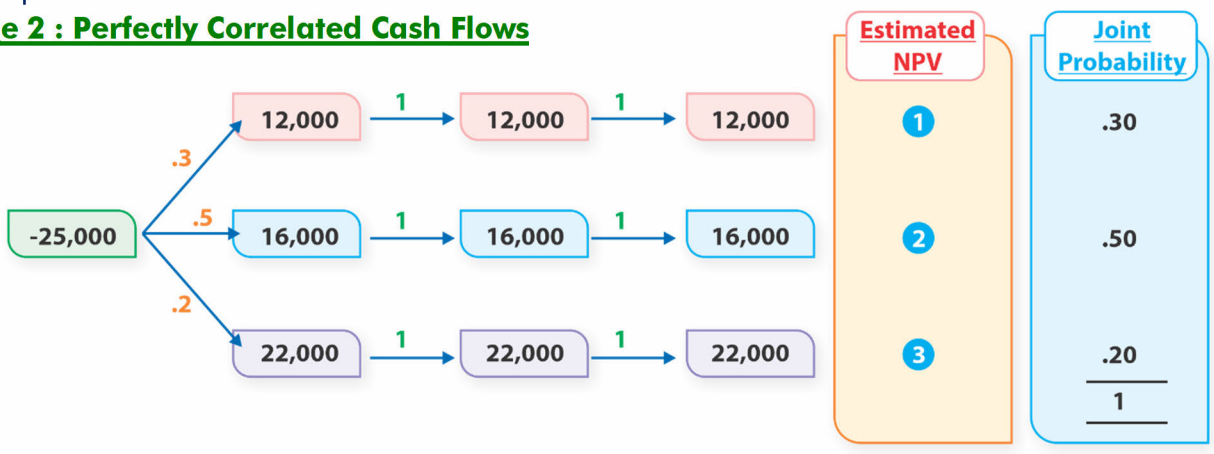
A Ltd. are purchasing a machine at a cost of ₹ 3,000. Life is two years The CFAT for two years is as follows:

Year ₹		**Year 2**	
Cash Flow (₹)	**Initial Probability**	**Cash Flow (₹)**	**Conditional Probability**
1,500	0.4	2,200	0.5
		1,800	0.5
2,500	0.6	1,800	0.7
		2,000	0.3

(a) What are the various joint probabilities of occurrences/arising of various branches?

(b) If the risk free rate is 12%, what are the Mean and Standard Deviation of the probability distribution of possible NPVs?

Type 2 : Perfectly Correlated Cash Flows



QUESTION NO. 3C :

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 in flows 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.

(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.?

QUESTION NO. 3D :

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 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.

QUESTION NO. 3E :

A firm has an investment proposal, requiring an outlay of ₹ 80,000. The investment proposal is expected to have two years economic life with no salvage value. In year 1, there is a 0.4 probability that cash inflow after tax will be ₹ 50,000 and 0.6 probability that cash inflow after tax will be ₹ 60,000. The probabilities assigned to cash inflow after tax for the year 2 are as follows:

The cash inflow year I	₹ 50,000		₹ 60,000	
The Cash inflow year II		**Probability**		**Probability**
	₹ 24,000	0.2	₹ 40,000	0.4
	₹ 32,000	0.3	₹ 50,000	0.5
	₹ 44,000	0.5	₹ 60,000	0.1

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

Required:

(i) Construct a decision tree for the proposed investment project and calculate the expected Net Present Value (NPV) ?

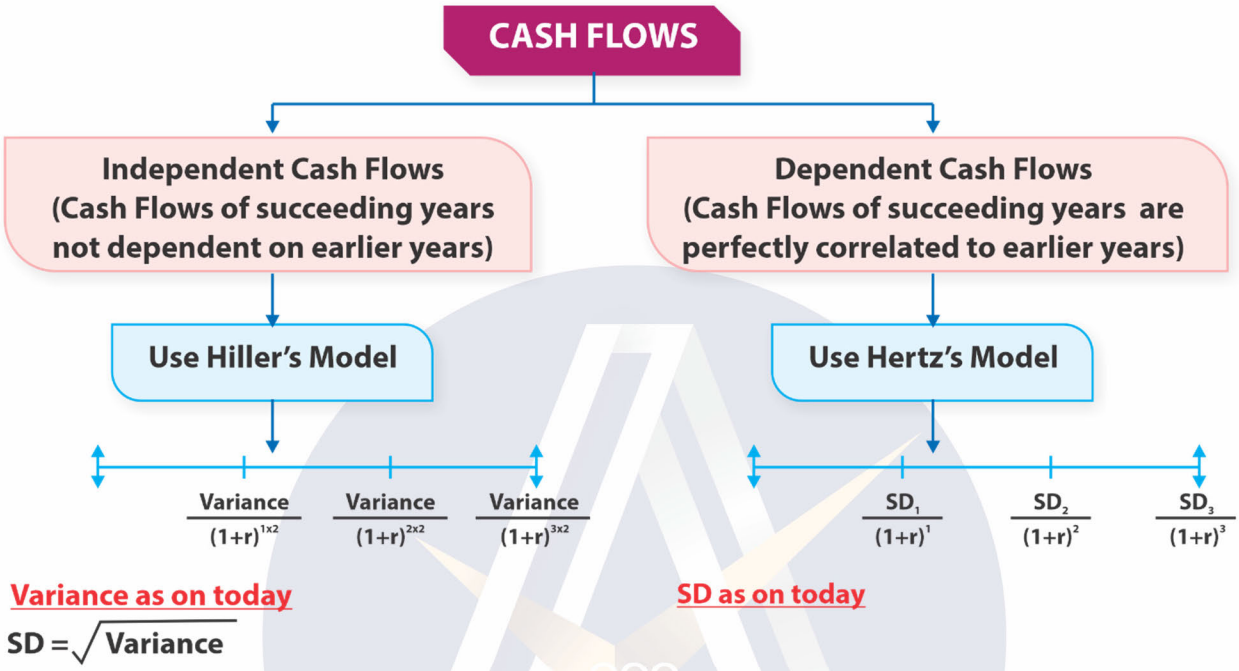
(ii) What net present value will the project yield, if worst outcome is realized? What is the probability of occurrence of this NPV?

(iii) What will be the best outcome and the probability of that occurrence?

(iv) Will the project be accepted?

(10% Discount factor 1 year - 0.909 - 2 year - 0.826)

Type 3 : Hiller's and Hertz's Model



QUESTION NO. 3F :

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 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.

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

QUESTION NO. 3G :

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 (year 0) ₹ 70 lakhs

Probability weights	0.30	0.40	0.30
Years	₹ lakhs	₹ lakhs	₹ lakhs
1	30	50	65
2	30	40	55
3	30	40	45

Project Y: Investment (year 0) ₹ 80 lakhs.

Probability weighted	Annual cash flows through life
	₹ lakhs
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.

QUESTION NO. 3H :

a) 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:

(i) The expected NPV of this proposal assuming independent probability distribution with 7% risk free rate of interest.

(ii) The possible deviations on expected values.

b) Assume that the cash flow streams are perfectly correlated. Compute Standard Deviation of the project.

LOS 4 : Scenario Analysis

- Scenario Analysis is an analysis of the NPV of a project under a series of specific scenarios (worst, most likely and best scenario) based on macro-economics, industry and firm-specific factor.
- Under this, all inputs are set at their most optimistic or pessimistic or most likely levels and NPV is computed.
- Decision is based on the NPV under all scenarios.

QUESTION NO. 4 :

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)
Particular	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%, determine NPV in each scenario. If XYZ Ltd is certain about the most likely result but uncertain about the third year's cash flow, what will be the NPV expecting worst scenario in the third year.

LOS 5 : Sensitivity Analysis

- Also known as "What if" Analysis.
- Sensitivity Analysis is one of the methods of analyzing the risk surrounding the capital expenditure Decision and enables an assessment to be made of how responsive the project's NPV is to changes in those variables based on which NPV is computed.
- Sensitivity Analysis is a tool in the hand of firms to analyze change in the project's NPV for a given change in one of the variables.
- Under this analysis we try to measure risk of each factor taking NPV=0.
- Key factors which are used to calculate NPV are as follows:

	Inverse Effect
Cash Inflows	Decrease
Cash Outflows	Increase
Discount Rate	Increase
Life of the project	Decrease

- Decision Rule
- Management should pay maximum attention towards the factor where minimum percentage of adverse changes causes maximum adverse effect.

Example:

- If NPV is to become Zero with 5% change in initial investment relative to 10% change in cash inflows, project is said to be more sensitive to initial investment then to cash inflows.

Note:

Sensitivity Analysis is calculated for each factor separately, keeping other factors constant.

Method 1 : Margin of Safety Approach (MOS)

Set NPV = 0 & Calculate the Break Even Values and Margin of Safety for Each Factor

$$\text{Sensitivity (\%)} = \frac{\text{Change}}{\text{Base}} \times 100$$

Decision : Most critical / Sensitive Factor is that Factor for which MOS is least.

Method 2 : Shock Approach

Shock each Risk Factor in the adverse direction like 10% / 20% & Find out the Revised NPV or %age fall in NPV

$$\text{\% Fall In NPV} = \frac{\text{Revised NPV} - \text{Original NPV}}{\text{Original NPV}} \times 100$$

Decision : Most critical / Sensitive Factor is that Factor for which results in Maximum Fall in NPV.

QUESTION NO. 5A :

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 size of investment, cash flow, life and discount factor.

QUESTION NO. 5B :

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 I	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) Sales Price/unit
(ii) Unit cost
(iii) Sales volume
(iv) Initial outlay and
(v) Project lifetime.
(vi) Taxation may be ignored.

QUESTION NO. 5C :

From the following details relating to a 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 (Years)	4
Cost of Capital	10%

To which of the three factors, the project is most sensitive if the variable is adversely affected by 10%? (Use annuity factors: for 10% 3.169 and 11% ... 3.103).

QUESTION NO. 5D :

The Easy going Company Ltd. 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 is:

Profit Volume ratio is	70 %
Variable Cost is	₹ 60/- per unit.
Annual Cash Flow	₹ 57,500

Ignore depreciation on initial investment and impact of taxation.

Calculate:

(i) Initial Investment
(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	3.505	3.517	3.433	3.352	3.274	3.199	3.127

QUESTION NO. 5E :

Red Ltd. is considering a project with the following Cash flows:₹

Year	Cost of Plant	Recurring Cost	Savings
0	10,000	—	—
1	—	4,000	12,000
2	—	5,000	14,000

The cost of capital is 9%. Measure the sensitivity of the project to changes in the levels of plant value, running cost and savings (considering each factor at a time) such that the NPV becomes zero. The P.V. factor at 9% is as under:

Year	Factor
0	1
1	0.917
2	0.842

Which factor is the most sensitive to affect the acceptability of the project?

QUESTION NO. 5F :

X Ltd is considering its New Project 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	No. of years	3

Required:

1) Calculate the NPV of the project.
2) Find the impact on the project's NPV considering a 2.5 per cent adverse variance in each variable. Which variable is having maximum effect.

QUESTION NO. 5G :

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;
(iv) 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 which 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.

QUESTION NO. 5H :

From the following details relating to a project, analyse the sensitivity of the project to changes in the Initial Project Cost, Annual Cash Inflow and Cost of Capital :

Particulars	
Initial Project Cost	₹2,00,00,000
Annual Cash Inflow	₹60,00,000
Project Life	5 years
Cost of Capital	10%

To which of the 3 factors, the project is most sensitive if the variable is adversely affected by 10 ?
Cumulative Present Value Factor for 5 years for 10% is 3.791 and for 11% is 3.696.

LOS 6 : Simulation

The main problem with sensitivity analysis is that it only allows us to assess the impact of one variable changing at a time. Simulation addresses this problem by considering how the NPV will be impacted by a number of variables changing at once.

Simulation employs random numbers to select specimen values for each variable in order to estimate a 'trial value' for the project NPV. This is repeated a large number of times until a distribution of net present values emerge. By analysing this distribution, the firm can decide whether to proceed with the project. For example, if 95% of the generated NPVs are positive, this might reassure the firm that the chances of suffering a negative NPV are small. Monte Carlo simulation assumes that the input variables are uncorrelated. However, more sophisticated modelling can incorporate estimates of the correlation between variables.

Steps for Simulation Analysis:

1. Modelling the project: The model shows the relationship of NPV with parameters and exogenous variables. (Parameters are input variables specified by decision maker and held constant over all simulation runs. Exogenous variables are input variables, which are stochastic in nature and outside the control of the decision maker).
2. Specify values of parameters and probability distributions of exogenous variables.
3. Select a value at random from probability distribution of each of the exogenous variables.
4. Determine NPV corresponding to the randomly generated value of exogenous variables and pre-specified parameter 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 and compute a mean and Standard Deviation of returns to gauge the project's level of risk.

Example: Uncertainty associated with two aspects of the project: Annual Net Cash Flow & Life of the project.
Where i=Risk free interest rate, I= initial investment are parameters, CF = Annual Cash Flow
With i = 10%, I = ₹ 1,30,000, CFt & n stochastic exogenous variables with the following distribution will be as under:

Annual Cash Flow		Project Life	
Value (₹)	Probability	Value (Year)	Probability
10,000	0.02	3	0.05
15,000	0.03	4	0.10
20,000	0.15	5	0.30
25,000	0.15	6	0.25
30,000	0.30	7	0.15
35,000	0.20	8	0.10
40,000	0.15	9	0.03
		10	0.02

Ten manual simulation runs are performed for the project. To perform this operation, values are generated at random for the two exogenous variables viz., Annual Cash Flow and Project Life. For this purpose, we take following steps

(1) set up correspondence between values of exogenous variables and random numbers

(2) choose some random number generating device.

Correspondence between Values of Exogenous Variables and two Digit Random Numbers:

Annual Cash Flow				Project Life			
Value (₹)	Probability	Cumulative Probability	Two Digit Random No.	Value (Year)	Probability	Cumulative Probability	Two Digit Random No.
10,000	0.02	0.02	00 – 01	3	0.05	0.05	00 – 04
15,000	0.03	0.05	02 – 04	4	0.10	0.15	05 – 14
20,000	0.15	0.20	05 – 19	5	0.30	0.45	15 – 44
25,000	0.15	0.35	20 – 34	6	0.25	0.70	45 – 69
30,000	0.30	0.65	35 – 64	7	0.15	0.85	70 – 84
35,000	0.20	0.85	65 – 84	8	0.10	0.95	85 – 94
40,000	0.15	1.00	85 - 99	9	0.03	0.98	95 – 97
				10	0.02	1.00	98 - 99

Random Number

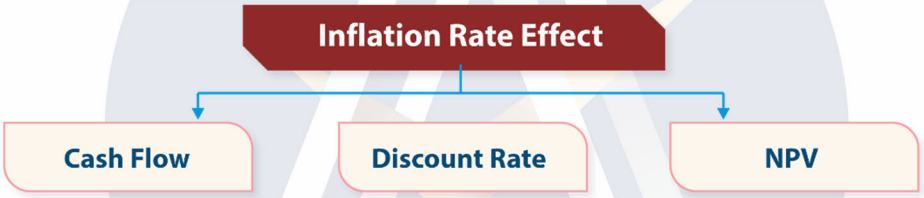
53479	81115	98036	12217	59526
97344	70328	58116	91964	26240
66023	38277	74523	71118	84892
99776	75723	03172	43112	83086
30176	48979	92153	38416	42436
81874	83339	14988	99937	13213
19839	90630	71863	95053	55532
09337	33435	53869	52769	18801
31151	58295	40823	41330	21093
67619	52515	03037	81699	17106

For random numbers, we can begin from any-where taking at random from the table and read any pair of adjacent columns, column/row wise. For the first simulation run we need two digit random numbers (1) For Annual Cash Flow (2) For Project Life. The numbers are 53 & 97 and corresponding value of Annual Cash Flow and Project Life are ₹ 30,000 and 9 years respectively.

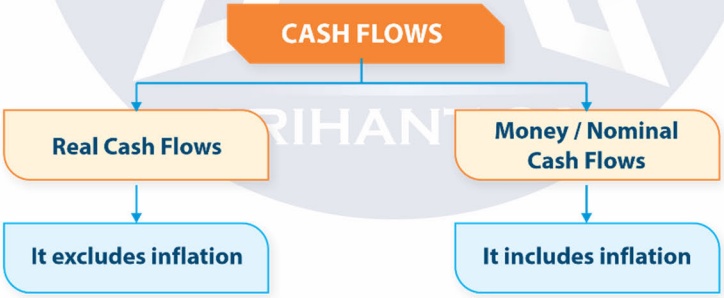
Simulation Results :

Annual Cash Flow			Project Life			
Run	Random No.	Corres. Value of Annual Cash Flow (1)	Random No.	Corres. Value of Project Life	PVAF @ 10% (2)	NPV (1)x(2) – 1,30,000
1	53	30,000	97	9	5.759	42,770
2	66	35,000	99	10	6.145	85,075
3	30	25,000	81	7	4.868	(8,300)
4	19	20,000	9	4	3.17	(66,600)
5	31	25,000	67	6	4.355	(21,125)
6	81	35,000	70	7	4.868	40,380
7	38	30,000	75	7	4.868	16,040
8	48	30,000	83	7	4.868	16,040
9	90	40,000	33	5	3.791	21,640
10	58	30,000	52	6	4.355	650

LOS 7 : Inflation under Capital Budgeting



Cash Flow:



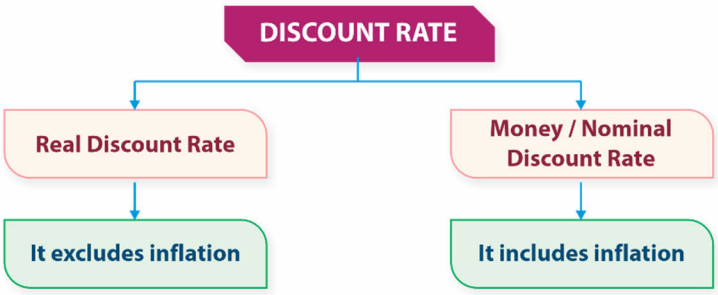
Conversion of Real Cash Flow into Money Cash Flow & Vice-versa

$$\text{Money Cash Flow} = \text{Real Cash Flow}\,(1 + \text{Inflation Rate})^{n}$$

Or

$$\text{Real Cash Flow} = \frac{\text{Money Cash Flow}}{(1+\text{Inflation Rate})^{n}}$$

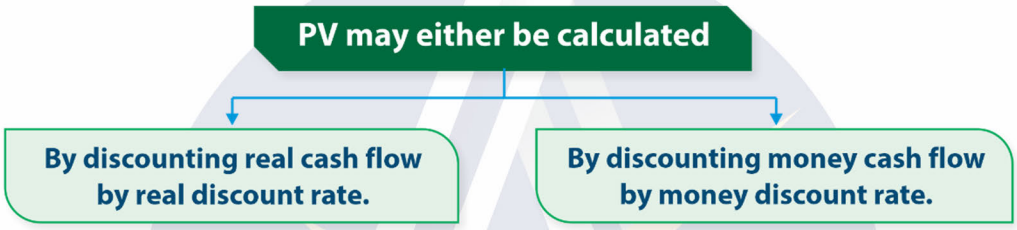
Discount Rate:



Conversion of Real Discount Rate into Money Discount Rate & Vice-versa

(1 + Money Discount Rate) = (1+ Real Discount Rate) (1+Inflation Rate)

NPV:



Note:

- Answer in both the case will be same.
- Depreciation is not affected by inflation rate as depreciation is changed on the book value of the asset & not market value.

Note:

When discount rate is silent in question and inflation rate is given in the question:

Assumption:

- If Cash Flow is Real Cash Flow, then assume Discount Rate to be Money Discount Rate.
- If Cash Flow is Money Cash Flow, then assume Discount Rate to be Real Discount Rate.

QUESTION NO. 6A :

The following are the sales and cost figures for the three years The initial investment is ₹ 5 lacs.

Details	Year 1	Year 2	Year 3
Sales (in lacs)	5	9	15
Costs (in lacs)	3	6	9

Compute NPV under each of the following situations. Each situation is to be considered separately.

(i) Inflation is zero. The discount rate is 5%

(ii) All cash flows are in money terms. Inflation is 10%. Money discount rate is 15%

(iii) All cash inflows are in money terms. Inflation is 10%. RDR is 8%

(iv) All cash flows are in real terms. Inflation is 10%. Real discount rate is 6%.

(v) All cash inflows are in real terms. Sales inflation is 10%. Cost inflation is 5%. MDR is 15%

QUESTION NO. 6B :

A firm usually forecast cash flows in nominal terms and discounts at a 20 per cent nominal rate. The firm is considering a project at present involving an immediate cash outflow of ₹ 1,00,000 and has forecasted cash flows in real terms i.e. in terms of current purchasing power of rupees, as follows:

Year	1st	2nd	3rd	4th	5th	Total
₹	24,176	24,953	25,820	26,764	27,780	129493

Calculate NPV assuming inflation rate to be 15 %.

QUESTION NO. 6C :

A Firm has projected the following cash flows from a project under evaluation:

Year	₹ lakhs
0	(70)
1	30
2	40
3	30

The above cash flows have been made at expected prices after recognizing inflation. The firms cost of capital is 10%. The expected annual rate of inflation is 5%.
Show how the viability of the project is to be evaluated.

QUESTION NO. 6D :

Today is 1st Jan. A company's PBDT on 31st Dec would be ₹ 10,000. Inflation is 10%. Annual depreciation is ₹ 2,000 under straight-line method. The real discount rate is 4%. Assume tax rate as 40%. Compute money cash flows for three years Compute present value.

QUESTION NO. 6E :

Determine NPV of the project with the following information:

Initial Outlay of project	₹ 40,000
Annual revenues (Without inflation)	₹ 30,000
Annual costs excluding depreciation (Without inflation)	₹ 10,000
Useful life	4 years
Salvage value	Nil
Tax Rate	50%

Cost of Capital (Including inflation premium of 10%) 12%

QUESTION NO. 6F :

XYZ Ltd. requires ₹ 8,00,000 for an unit.

Useful life of project	4 years
Salvage Value	Nil
Depreciation Charge	₹ 2,00,000 p.a.
Tax Rate	60%
Cost of Capital	10%

Expected Revenues & Costs (excluding depreciation) ignoring inflation.

Year	1	2	3	4
Revenues	₹ 6,00,000	₹ 7,00,000	₹ 8,00,000	₹ 8,00,000
Cost	₹ 3,00,000	₹ 4,00,000	₹ 4,00,000	₹ 4,00,000

Calculate NPV of the project if inflation rates for revenues & costs are:

Year	Revenues	Costs
1	10%	12%
2	9%	10%

3	8%	9%
4	7%	8%

QUESTION NO. 6G :

PQR Company is examining an investment proposal requiring an initial outflow of ₹ 8 lacs and expected inflow in real terms (i.e. today's purchasing power) is ₹ 2,80,000 per year for the next 4 years The company's out of pocket monetary cost of capital is 9% and inflation is expected to be 3.2% p.a. over the next four years

(i) Compute the company's real (net of inflation) cost of capital.

(ii) What is the present value of cash inflows and its NPV if real cost of capital is taken into consideration?

(iii) Compute nominal cash inflow from real cash inflows and also calculate present value on the basis of nominal cash inflows.

QUESTION NO. 6H :

An investment proposal for ₹ 100 lacs is under evaluation. At the current cost and selling prices with no inflation expected, the cash inflows during years 1 to 5 useful life of the proposal are respectively 20,40, 70, 70 and 30 (lacs rupees). The discount rate is 10%. You are required to calculate

(i) Net Present Value assuming no inflation and

(ii) Net Present Value assuming annual inflation of 5%.

QUESTION NO. 6I :

Shashi Co. Ltd has projected the following cash flows from a project under evaluation:

Year	0	1	2	3
₹ (in lakhs)	(72)	30	40	30

The above cash flows have been made at expected prices after recognizing inflation. The firm's cost of capital is 10%. The expected annual rate of inflation is 5%. Show how the viability of the project is to be evaluated. PVF at 10% for 1 -3 years are 0.909, 0.826 and 0.751.

QUESTION NO. 6J :

KLM Ltd. requires ₹ 15,00,000 for a new project.

Useful life of project	3 years
Salvage value	NIL
Depreciation	₹ 5,00,000 p.a.

Given below are projected revenues and costs (excluding depreciation) ignoring inflation:

Year	1	2	3
Revenues in ₹	10,00,000	13,00,000	14,00,000
Costs in ₹	5,00,000	6,00,000	6,50,000

Applicable tax rate is 35%. Assume cost of capital to be 14% (after tax). The inflation rates for revenues and costs are as under:

Year	Revenues %	Costs %
1	9	10
2	8	9
3	6	7

PVF at 14%, for 3 years =0.877, 0.769 and 0.675

Show amount to the nearest rupee in calculations.

You are required to calculate net present value of the project.

LOS 8 : Replacement Decision

"Whether to repair existing machine"

Or

"Whether to replace the existing machine and buy new machine"

Case 1 : Life of new machine = Remaining Life of Old Machine

(We can apply incremental principle i.e. New – Old)

Initial Investment = Cost of New Machine – SV of Old Machine

Operating CF's = CFAT from New Machine – CFAT from Old Machine

Terminal CF's = SV from New Machine – SV from Old Machine

Case 2 : Life of new machine ≠ Remaining Life of Old Machine

We can't apply incremental principle

Use equated Annual Annuity Approach (EAA)

Steps Involved:

Step 1: Calculate NPV **or** PV of cash inflow **or** PV of cash outflow of each project.

Step 2: Calculate equated annual amount by using this formulae:

$$= \frac{\text{NPV or PV of cash out flow or PV value of cash Inflow}}{\text{PVAF (k\%,n years)}}$$

QUESTION NO. 7A :

A Company named Roby 's cube decided to replace the existing Computer system of their organization. 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 over 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 ₹ 100000. Company follows straight line method of depreciation. Cost of capital of the company is 10% whereas tax rate is 30%.Decide?

QUESTION NO. 7B :

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 have 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%. The company follows straight line method of depreciation.

Assume cost of capital to be 15%, P.V.F. of 15%, 5 = 0.870, 0756, 0.658, 0.572 and 0.497. You are required to advise the company as to which alternative is to be adopted.

QUESTION NO. 7C :

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.

LOS 9 : Evaluation Between Two Proposals

QUESTION NO. 8A :

Company X is forced to choose between two machines A and B. The two machines are designed differently, but have identical capacity and do exactly the same job. Machine A costs ₹ 1,50,000 and will last for 3 years It costs ₹ 40,000 per year to run. Machine B is an 'economy' model costing only ₹ 1,00,000, but will last only for 2 years, and costs ₹ 60,000 per year to run. These are real cash flows. The costs are forecasted in rupees of constant purchasing power. Ignore tax. Opportunity cost of capital is 10 per cent. Which machine company X should buy?

QUESTION NO. 8B :

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:

Particulars	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:

Particulars	Plant A	Plant B
Running hours per annum	2,500	2,500
Costs:	(In ₹)	(In ₹)
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 Costs	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:

Note: 10 percent interest tables

	20 Years	15 Years
Present value of ₹ 1	0.1486	0.2394
Annuity of ₹ 1 (capital recovery factor with 10% interest)	0.1175	0.1315

QUESTION NO. 8C :

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?

The PVIF @ 15% for the six years are as below:

Year	1	2	3	4	5	6
PVIF	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323

LOS 10: Replacement Cycle

QUESTION NO. 9A :

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)	0	1	2	3	4
Purchase price (in ₹)	60,000				
Maintenance (in ₹)		16,000	18,000	20,000	20,000
Repair (in ₹)		0	4,000	8,000	16,000
Scrap Value (in ₹)		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.

QUESTION NO. 9B :

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
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 the machine?

(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).

QUESTION NO. 9C :

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%.

QUESTION NO. 9D :

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 40000 kms per annum. 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:

Period	₹
1 Year old	35,000
2 Year old	21,000
3 Year old	9,000

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

Year	Road Taxes Insurance etc. (₹)	Petrol Repair Maintenance etc. (₹)
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.

LOS 11: Calculation of Expected utility

QUESTION NO. 10 :

Jumble Consultancy Group has determined relative utilities of cash flows of two forthcoming projects of its client company as follows :

Cash Flow in ₹	-15000	-10000	-4000	15000	10000	5000	1000
Utilities	-100	-60	-3	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 ?

LOS 12: Backward Decision Tree

In Capital Budgeting, the decision taker has to identify and find out the various alternatives available to an investment decision. By drawing a decision tree, the alternatives are highlighted through a diagram, giving the range of possible outcomes. The stages set for drawing a decision tree is based on the following rules.

1. It begins with a decision point, also known as decision node, represented by a rectangle while the outcome point, also known as chance node, denoted by a circle.
2. Decision alternatives are shown by a straight line starting from the decision node.
3. The Decision Tree Diagram is drawn from left to right. Rectangles and circles have to be sequentially numbered.
4. Values and Probabilities for each branch are to be incorporated next.

The Value of each circle and each rectangle is computed by evaluating from right to left. This procedure is carried out from the last decision in the sequence and goes on working back to the first for each of the possible decisions. The following rules have been set for such evaluation.

(a) The expected monetary value (EMV) at the chance node with branches emanating from a circle is the aggregate of the expected values of the various branches that emanate from the chance node.

(b) The expected value at a decision node with branches emanating from a rectangle is the highest amongst the expected values of the various branches that emanate from the decision node.

- It is a graphical presentation of a decision making situation. We have branches coming out of nodes.

Decision Nodes → From which this alternative will come out.

Choice Nodes → Certain outcome like High Demand or Low Demand or success or failure will come out.

- The tree is drawn from left to right. However, calculation can be done from right to left.
- At Every  Calculate expected value
- At Every  Move towards best alternative.

QUESTION NO. 11 :

L& R Limited wants 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 rated at 50%.

In case it does succeed L & R can invest a 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 a smaller amount of ₹ 12 lacs with the hope of gaining perpetually a sum of ₹ 1 lac.

Evaluate the proposal, adopting a decision tree approach.

The discount rate is 10%.

LOS 13: REAL OPTIONS

Real options are a right but not an obligation to make a business decision. The concept of a real option is crucial to the success of a business as the ability to choose the right business opportunity bears a significant effect on the company's profitability and growth. A real option allows the management team to analyze and evaluate business opportunities and choose the right one.

Different types of real option

There are many different classifications of real options. For the purposes of the AFM syllabus, we use the following four generic headings:

1) **Options to delay/defer**
The key here is to be able to delay investment without losing the opportunity, creating a call option on the future investment.
2) **Options to switch/redeploy**
It may be possible to switch the use of assets should market conditions change.
3) **Options to expand/follow-on**
It may be possible to adjust the scale of an investment depending on the market conditions.
4) **Options to abandon**
If a project has clearly identifiable stages such that investment can be staggered, then management have to decide whether to abandon or continue at the end of each stage.

Valuing real options:

Method 1: Using the Black-Scholes model to value real options
Method 2: Using the Binomial model to value real options

QUESTION NO. 12A :

ABC Ltd. is a pharmaceutical company possessing a patent of a drug called 'Aidrex', a medicine for aids patient. Being an approach drug ABC Ltd. holds the right of production of drugs and its marketing. The period of patent is 15 years after which any other pharmaceutical company produce the drug with same formula. It is estimated that company shall require to incur $ 12.5 million for development and market of the drug. As per a survey conducted the expected present value of cashflows from the sale of drug during the period of 15 years shall be $ 16.7 million. Cash flow from the previous similar type of drug have exhibited a variance of 26.8% of the present value of cashflows. The current yield on Treasury Bonds of similar duration (15 years) is 7.8%.
Determine the value of the patent.
Given
ln(1.336) =0.2897
$e^{1.0005} = 0.3677$ and $e^{-1.17} = 0.3104$

QUESTION NO. 12B :

IPL already in production of Fertilizer is considering a proposal of building a new plant to produce pesticides. Suppose the PV of proposal is ₹ 100 crore without the abandonment option. However, if market conditions for pesticide turns out to be favourable the PV of proposal shall increase by 30%. On the other hand, market conditions remain sluggish the PV of the proposal shall be reduced by 40%. In case company is not interested in continuation of the project it can be disposed of for ₹ 80 crore.
If the risk-free rate of interest is 8% then what will be value of abandonment option.

QUESTION NO. 12C :

Suppose MIS Ltd. is considering installation of solar electricity generating plant for light the staff quarters. The plant shall cost ₹ 2.50 crore and shall lead to saving in electricity expenses at the current tariff by ₹ 21 lakh per year forever.
However, with change in Government in state, the rate of electricity is subject to change. Accordingly, the saving in electricity can be of ₹ 12 lakh or ₹ 35 lakh per year and forever.
Assuming WACC of MIS Ltd. is 10% and risk-free rate of rate of return is 8%.
Decide whether MIS Ltd. should accept the project or wait and see.

QUESTION NO. 12D :

Ram Chemical is in production Line of Chemicals and considering a proposal of building new plant to produce pesticides. The Present Value (PV) of new proposal is ₹ 150 crores (After considering scrap value at the end of life of project). Since this is a new product market, survey indicates following variation in Present Value (PV):

Condition Favourable in first year	PV will increase 30% from original estimate
Condition sluggish in first year	PV will decrease by 40% from original Figures.

In addition Rama Chemical has a option to abandon the project at the end of Year and dispose it at ₹ 100 crores. If risk free rate of interest is 8%, what will be present value of put option?

QUESTION NO. 12E :

Ramesh owns a plot of land on which he intends to construct apartment units for sale. No. of apartment units to be constructed may be either 10 or 15. Total construction costs for these alternatives are estimated to be ₹ 600 lakhs or ₹ 1025 lakhs respectively. Current market price for each apartment unit is ₹ 80 lakhs. The market price after a year for apartment units will depend upon the conditions of market. If the market is buoyant, each apartment unit will be sold for ₹ 91 lakhs, if it is sluggish, the sale price for the same will be ₹ 75 lakhs. Determine the value of vacant plot of land. Assuming that the construction cost will remain same in year 1 should Ramesh start construction now or keep the land vacant? The yearly rental per apartment unit is ₹ 7 lakhs and the risk free interest rate is 10% p.a.

Assume that the construction cost will remain unchanged.

LOS 14: ADJUSTED PRESENT VALUE TECHNIQUE

The APV method of investment appraisal has been introduced in this chapter in the context of domestic investments. There are essentially three steps to the technique:

Step 1: Estimate the base case NPV assuming that the project is financed entirely by equity.

Step 2: Estimate the financial 'side effects' of the actual method of financing.

Step 3: Add the values from steps 1 and 2 to give the APV.

If the APV is positive, accept the project.

Basic principle

The APV method evaluates the project and the impact of financing separately.

Hence, it can be used if a new project has a different financial risk (debt-equity ratio) from the company, i.e. the overall capital structure of the company changes.

APV consists of two different elements:

APV = Base case NPV + Financing impact

Value of a geared project	=	(1) Value of an all equity financed project	+	(2)	Present value of financing side effects

The investment element (base case NPV)

The project is evaluated as though it were being undertaken by an all equity company with all financing side effects ignored. The financial risk is quantified later in the second part of the APV analysis.

Therefore:

- ignore the financial risk in the investment decision process
- use a beta that reflects just the business risk, i.e. ß asset.

Once the base case NPV is identified, the PV of the financing package is evaluated.

The financing impact

Financing cash flows consist of:

- issue costs
- tax reliefs.

As all financing cash flows are low risk they are discounted at either:

- the kd or
- the risk free rate.

QUESTION NO. 13A :

XYZ Ltd. is presently all equity financed. The directors of the company have been evaluating investment in a project which will require ₹ 270 lakhs capital expenditure on new machinery. They expect the capital investment to provide annual cash flows of ₹ 42 lakhs indefinitely which is net of all tax adjustments. The discount rate which it applies to such investment decisions is 14% net.

The directors of the company believe that the current capital structure fails to take advantage of tax benefits of debt, and propose to finance the new project with undated perpetual debt secured on the company's assets. The company intends to issue sufficient debt to cover the cost of capital expenditure and the after tax cost of issue.

The current annual gross rate of interest required by the market on corporate undated debt of similar risk is 10%. The after tax costs of issue are expected to be ₹ 10 lakhs. Company's tax rate is 30%.

You are required to calculate:

(i) The adjusted present value of the investment,

(ii) The adjusted discount rate and

(iii) Explain the circumstances under which this adjusted discount rate may be used to evaluate future investments.

QUESTION NO. 13B :

The Management of a multinational company TL Ltd. is engaged in construction of Infrastructure Project. A proposal to construct a Toll Road in Nepal is under consideration of the Management.

The following information is available:

The initial investment will be in purchase of equipment costing USD 250 lakhs. The economic life of the equipment is 10 years. The depreciation on the equipment will be charged on straight line method.

EBIDTA to be collected from the Toll Road is projected to be USD 33 lakhs per annum for a period of 20 years.

To encourage investment Nepalese government is offering a 15 year term loan of USD 150 lakhs at an interest rate of 6 per cent per annum. The interest is to be paid annually. The loan will be repaid at the end of 15 year in one tranche.

The required rate of return for the project under all equity financing is 12 per cent per annum.

Post tax cost of debt is 5.6 per cent per annum.

Corporate Tax Rate is 30 per cent.

All cash Flows will be in USD.

Ignore inflation.

You are required to advise the management on the viability of the proposal by using Adjusted Net Present Value method.

Given

PVIFA (12%, 10) = 5.650, PVIFA (12%, 20) = 7.469, PVIFA (8%,15) = 8.559, PVIF (8%, 15) = 0.315.

PRACTICE QUESTIONS

QUESTION NO. 14 :

If Investment proposal costs ₹ 45,00,000 and risk free rate is 5%, CALCULATE net present value under certainty equivalent technique.

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

QUESTION NO. 15 :

X Ltd is considering installation of new machine with the following details:

Sr. No.	Particulars	Figures
1	Initial Investment	₹ 1400 Crore
2	Annual unit sales	100 Crore
3	Selling price per unit	₹ 40
4	Variable cost per unit	₹ 20
5	Annual Fixed costs	₹ 500 Crore
6	Depreciation	₹ 200 Crore
7	Discount Rate	12%
8	Tax rate	30%

Consider Life of the project as 4 years with no salvage value. Required:

(i) CALCULATE the expected NPV of the project.

(ii) COMPUTE the impact on the project's NPV if change in variables is as under and also compute which variable is having maximum impact on NPV.

Sr. No.	Variable	Figures
1	Unit sold per year	85 Crore
2	Selling price per unit	₹ 39
3	Variable cost per unit	₹ 22
4	Annual Fixed costs	₹ 575 Crore

PV factor at 12% are as follows:

Year	1	2	3	4
PV factor	0.893	0.797	0.712	0.636

QUESTION NO. 16 :

Giri Ltd. is 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?

QUESTION NO. 17 :

Following information have been retrieved from the finance department of Corp Finance Ltd. relating to Project X, Y and Z:

Particulars	X	Y	Z
Net cash outlays (₹)	42,00,000	24,00,000	20,00,000
Project life	5 years	5 years	5 years
Annual Cash inflow (₹)	14,00,000	8,40,000	6,00,000
Coefficient of variation	2.0	0.8	1.6

You are required to DETERMINE the risk adjusted net present value of the projects considering that the Company selects risk adjusted rate of discount on the basis of the coefficient of variation:

Coefficient of Variation	Risk Adjusted discount rate	P.V. Factor for 1 to 5 years at risk adjusted discount rate
0.0	8%	3.992
0.4	10%	3.790
0.8	12%	3.604
1.2	14%	3.433
1.6	16%	3.274
2.0	20%	2.990
More than 2.0	22%	2.863

QUESTION NO. 18 :

A&R Ltd. has under its consideration a project with an initial investment of ₹ 90,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow (₹)	20,00,000	30,00,000	40,00,000
Probability	0.2	0.7	0.1

The project life is 5 years and the desired rate of return is 18%. The estimated terminal values for the project assessed under the three probability alternatives, respectively, are ₹ 0, ₹ 20,00,000 and ₹ 30,00,000.

You are required to:

(i) CALCULATE the probable NPV.

(ii) CALCULATE the worst case NPV and the best case NPV.

(iii) STATE the probability occurrence of the worst case, if the cash flows are perfectly positively correlated over time.

QUESTION NO. 19 :

SG Ltd. is considering a project "Z" with an initial outlay of ₹ 7,50,000 and life of 5 years. The estimates of project are as follows:

	Lower Estimates	Base	Upper Estimates
Sales (units)	4,500	5,000	5,500
	(₹)	(₹)	(₹)
Selling Price p.u.	175	200	225
Variable cost p.u.	100	125	150
Fixed Cost	50,000	75,000	1,00,000

Depreciation included in Fixed cost is ₹ 35,000 and corporate tax is 25%.

Assuming the cost of capital as 15%, DETERMINE NPV in three scenarios i.e worst, base and best case scenario.

PV factor for 5 years at 15% are as follows:

Years	1	2	3	4	5
P.V. factor	0.870	0.756	0.658	0.572	0.497

QUESTION NO. 20 :

G 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	(8,00,000)	1.0
1	6,40,000	0.8
2	5,60,000	0.7
3	5,20,000	0.6
4	4,80,000	0.4
5	3,20,000	0.3

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

QUESTION NO. 21 :

A company is evaluating a project that requires initial investment of ₹ 60 lakhs in fixed assets and ₹12 lakhs towards additional working capital.

The project is expected to increase annual real cash inflow before taxes by ₹ 24,00,000 during its life. The fixed assets would have zero residual value at the end of life of 5 years. The company follows straight line method of depreciation which is expected for tax purposes also. Inflation is expected to be 6% per year. For evaluating similar projects, the company uses discounting rate of 12% in real terms. Company's tax rate is 30%.

Advise whether the company should accept the project, by calculating NPV in real terms.

PVIF (12%, 5 years)		PVIF (12%, 5 years)	
Year 1	0.893	Year 1	0.943
Year 2	0.797	Year 2	0.890
Year 3	0.712	Year 3	0.840
Year 4	0.636	Year 4	0.792
Year 5	0.567	Year 5	0.747

QUESTION NO. 22 :

A project requires an initial outlay of ₹ 3,00,000.

The company uses certainty equivalent method approach to evaluate the project. The risk free rate is 7%.

Following information is available:

Year	CFAT (Cash Flow After Tax) ₹	CE (Certainty Equivalent Coefficient)
1.	1,00,000	0.90
2.	1,50,000	0.80
3.	1,15,000	0.60
4.	1,00,000	0.55
5.	50,000	0.50

PV Factor at 7%

Year	1	2	3	4	5
PV Factor	0.935	0.873	0.816	0.763	0.713

Evaluate the above. Is investment in the project beneficial?

QUESTION NO. 23 :

K.P. Ltd. is investing ₹ 50 lakhs in a project. The life of the project is 4 years. Risk free rate of return is 6% and risk premium is 6%, other information is as under:

Sales of 1st year	₹ 50 lakhs
Sales of 2nd year	₹ 60 lakhs
Sales of 3rd year	₹ 70 lakhs
Sales of 4th year	₹ 80 lakhs
P/V Ratio (same in all the years)	50%
Fixed Cost (Excluding Depreciation) of 1st year	₹ 10 lakhs
Fixed Cost (Excluding Depreciation) of 2nd year	₹ 12 lakhs
Fixed Cost (Excluding Depreciation) of 3rd year	₹ 14 lakhs
Fixed Cost (Excluding Depreciation) of 4th year	₹ 16 lakhs

Ignoring interest and taxes.
You are required to calculate NPV of given project on the basis of Risk Adjusted Discount Rate.
Discount factor @ 6% and 12% are as under:

Year	1	2	3	4
Discount Factor @ 6%	0.943	0.890	0.840	0.792
Discount Factor@ 12%	0.893	0.797	0.712	0.636

QUESTION NO. 24 :

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.

QUESTION NO. 25 :

N&B Ltd. is considering one of two mutually exclusive proposals, Projects A and B, which require cash outlays of Rs. 34,00,000 and Rs. 33,00,000 respectively. The certainty- equivalent (C.E) approach is used in incorporating risk in capital budgeting decisions. The current yield on government bonds is 5% and this is used as the risk free rate. The expected net cash flows and their certainty equivalents are as follows:

Year-end	Project A		Project B	
	Cash Flow (Rs.)	C.E.	Cash Flow (Rs.)	C.E.
1	16,75,000	0.8	16,75,000	0.9
2	15,00,000	0.7	15,00,000	0.8
3	15,00,000	0.5	15,00,000	0.7
4	20,00,000	0.4	10,00,000	0.8
5	21,20,000	0.6	9,00,000	0.9

PV factor at 5% are as follows:

Year	1	2	3	4	5
PV factor	0.952	0.907	0.864	0.823	0.784

DETERMINE which project should be accepted

QUESTION NO. 26 :

PQR Ltd. has under its consideration a project with an initial investment of ₹ 2,25,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow (₹)	50,00,000	75,00,000	1,00,00,000
Probability	0.2	0.7	0.1

The project life is 5 years and the desired rate of return is 12%. The estimated terminal values for the project assets under the three probability alternatives are ₹ 0, ₹ 50,00,000 and ₹ 75,00,000 respectively.

You are required to:

(i) CALCULATE the probable NPV;

(ii) CALCULATE the worst-case NPV and the best-case NPV; and

STATE the probability occurrence of the worst case, if the cash flows are perfectly positively correlated over time.

QUESTION NO. 27 :

SL Ltd. has invested ₹1,000 lakhs in a project. The risk-free rate of return is 5%. Risk premium expected by the Management is 10%. 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	125
2	300
3	375
4	400
5	325

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

QUESTION NO. 28 :

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