7. RISK ANALYSIS IN CAPITAL BUDGETING

NO. OF PROBLEMS IN 40E OF CA INTER: CLASSROOM - 19, ASSIGNMENT - 14

NO. OF PROBLEMS IN 41E OF CA INTER: CLASSROOM - 20, ASSIGNMENT - 22

MODEL WISE ANALYSIS OF PAST EXAM PAPERS OF CA INTER (PROBLEMS)

MODEL NO.	M-18 (N)	N-18 (N)	RTP M18 (N)	RTP N18 (N)	RTP M19 (N)	MTP1 M18 (N)	MTP2 M18 (N)	MTP1 N18 (N)	MTP2 N18 (N)	MTP1 M19 (N)
1. Probability and Expected Cash Flow	-	-	-	-	-	-	-	-	-	-
2. Expected NPV	-	-	-	-	-	-	-	-	-	-
3. S.D, Variance & Co-efficient of Variance	-	-	-	-	-	-	-	-	-	-
4. Risk Adjusted Discount Rate (RADR)	-	-	-	-	5	-	5	5	-	5
5. Certainty Equivalent (CE) Method for Risk Analysis	-	-	-	5	-	-	-	-	-	-
6. Sensitivity Analysis	-	5	5	-	-	-	-	-	-	-
7. Scenario Analysis	-	-	-	-	-	-	-	-	-	-
8. Decision Tree Analysis	-	-	-	-	-	-	-	-	-	-
9. Monte Carlo Simulation	-	-	-	-	-	-	-	-	-	-

INTRODUCTION TO RISK ANALYSIS IN CAPITAL BUDGETING:

- In capital budgeting techniques, we assumed that the investment proposals do not involve any risk and cash flows of the project are known with certainty.
- This assumption was taken to simplify the understanding of the capital budgeting techniques. However, in practice, this assumption is not correct. In fact, investment projects are exposed to various degrees and types of risks.

RISK AND UNCERTAINTY:

- A decision to take up or leave out a project depends on expectations of future cash flows from the project. Such expectations are based on information that is currently available.
- The 'future' by definition is uncertain. Therefore, cash flows when they occur are likely to differ from what were expected. This uncertainty about future cash flows gives rise to risk.
- But risk is not the same as uncertainty. Risk can be measured but uncertainty cannot be measured. Risk applies where the decision maker is willing to act on probabilities. There can be three types of decision making:
  - i) **Decision making under certainty:** When cash flows are certain
  - ii) **Decision making involving risk:** When cash flows involve risk and probability can be assigned.
  - iii) **Decision making under uncertainty:** When the cash flows are uncertain and probability cannot be assigned.

Risk analysis

- **Conventional Techniques**
  - i) RADR
  - ii) Certainty Equivalent factor
- **Statistical Techniques**
  - **Expected NPV**
    - STATISTICAL TOOLS TO BE APPLIED:
      - i) Probability
      - ii) Variance or standard deviation
      - iii) Co-efficient of variation
- **Other Techniques**
  - i) Sensitivity Analysis
  - ii) Scenario Analysis
  - iii) Simulation
  - iv) Decision Tree

PROBLEMS FOR CLASSROOM DISCUSSION

MODEL 1: PROBABILITY & EXPECTED CASH FLOW

- Probability is the chance of occurrence or non-occurrence of an outcome.
- The aggregate of probabilities of all possible outcomes associated with an event is 1.
- For example, if there is a 70% chance that it would rain today, the probability associated with rain is 0.7. Since the only two possible outcomes are “Rain “and “No rain”, the probability associated with “No rain” is 0.3.

Probability distribution:

- Suppose a range of different outcomes is possible. Suppose that the chance of occurrence of each such outcome is different.
- We can express this position meaningfully by assigning appropriate numerical values to chances of occurrence.
- The resulting representation of all the possible outcomes is known as ‘Probability distribution’.

PROBLEM 1:

Assumption	Cash Flows (Rs.)	Probability
Best guess	3,00,000	0.3
High guess	2,00,000	0.6
Low guess	1,20,000	0.1

Compute expected cash flow based on above probability? *(C) (NEW SM)*

(ANS.: EXPECTED NET CASH FLOWS (ENCF): RS. 2,22,000) (SOLVE PROBLEM NO. 1 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ______________________________

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PROBLEM 2: From the following information, Find out Expected Investment.

Likely investment	
Amount (in lakhs)	**Probability**
30.00	0.25
40.00	0.50
50.00	0.25

(C) (ANS.: EXPECTED INVESTMENT: RS. 40 LAKHS) (SOLVE PROBLEM NO. 2 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ______________________________

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PROBLEM 3: From the following information, Find out Expected CFAT.

Likely investment	
Sales (in Units)	**Probability**
40,000	0.35
50,000	0.35
60,000	0.30

Expected Selling Price = Rs. 20

Expected Variable Cost = Rs. 10

Expected Fixed Cost (p.a.) = Rs.2,95,000

Annual depreciation = Rs.1,00,000

Tax Rate @ 50%.

(C) (ANS.: EXPECTED CFAT: RS. 1,50,000) (SOLVE PROBLEM NO. 3 OF ASSIGNMENT PROBLEMS AS REWORK)

MODEL 2: EXPECTED NPV

HOW TO COMPUTE EXPECTED NPV:

Step 1: Find out Expected Cash Flows (Cash Flow x Respective Probability)

Step 2: Find out Present Value of Expected Cash Flows using Cost of Capital

Step 3: Find out Expected NPV of the Project $(\sum \text{Step 2} - \text{Investment})$

PROBLEM 4: Possible net cash flows of Projects A and B (Assume life of 1 year) and their probabilities are given as below. Discount rate is 10%. For both the projects, Initial Investment is Rs. 10,000. Calculate the expected Net Present Value for each project. Which project is preferable?

	Project A		Project B	
Possible Event	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	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

(A) (NEW SM) (ANS.: NPV OF PROJECT A: RS. 908, NPV OF PROJECT B: RS. 4,544 SO PROJECT B IS PREFERABLE)

(SOLVE PROBLEM NO. 4 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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PROBLEM 5: Probabilities for Net cash flows for 3 years of a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability	Cash Flow (Rs.)	Probability
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 Net Present Value of the expected cash flow, using 10 per cent discount rate. Initial Investment is Rs. 10,000. ***(A) (NEW SM)***

(ANS.: EXPECTED NET PRESENT VALUE-RS. 2,573) (SOLVE PROBLEM NO. 5 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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MODEL NO 3: STANDARD DEVIATION, VARIANCE & COEFFECIENT OF VARIANCE

- Project cash flows are **forecasts**. A forecast **cannot be accurate** and there can be a **margin of error.**
- The risk associated with a project can be expressed, as the **extent to which the actual value of outcome will differ / deviate from the expected value.**
- This **risk is measured** with the help of a statistical tool known as **Standard Deviation.**
- Standard Deviation is a **standardized unit of deviation from mean**. This measure is denoted by the symbol σ. The **square of Standard Deviation** (σ^2) **is known as variance of distribution**.
- Higher the standard deviation (σ), Higher will be the risk involved in the project.

How to compute Standard Deviation:

Following Steps are involved in computation of Standard Deviation

Step 1: Compute Expected Value.

Step 2: Compute deviation from expected value (d_x)

Step 3: Add: Aggregate Result of Step (2). The resultant value is known as variance.

Step 4: Find out σ

$$\sigma = \sqrt{\text{Variance}} = \sqrt{\sum_{i=1}^{n} p \times dx^2}$$

COEFFICIENT OF VARIATION

- The standard deviation is a useful measure of calculating **the risk associated** with the estimated cash inflows from an Investment.
- However, in Capital Budgeting decisions, **the management in several times faced with choosing between many investments avenues.**
- Under such situations, it becomes difficult for the management to compare the risk associated with different projects using Standard Deviation as **each project has different estimated cash flow values. In such cases, the Coefficient of Variation becomes useful.**
- The Coefficient of Variation calculates the **risk borne for every percent of expected return. It is calculated as:**

  Coefficient of variation = $\dfrac{\text{Standard Deviation}}{\text{Expected Return / Expected Cash Flow}}$

- Higher the COV, Higher will be the risk involved in the project.

PROBLEM 6: (PRINTED SOLUTION AVAILABLE)

	Project A		Project B	
Possible Event	**Cash Flow (Rs.)**	**Probability**	**Cash Flow (Rs.)**	**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

Calculate variance, standard deviation (σ) and coefficient of variance for the projects based on the above information? Which project is more risky? ***(A) (NEW SM)***

(ANS.: VARIANCE & S.D. FOR PROJECT A AND PROJECT B ARE 48,00,000; 2190.9 AND 1,76,00,000; 4195.23 RESPECTIVELY, COEFFICIENT OF VARIANCE: 0.183, 0.262) (SOLVE PROBLEM NO. 6 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ______________________________

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PROBLEM 7: The RST and Co. is engaged in evaluating the following two mutually exclusive proposals P_1 and P_2, for which the relevant information is as follows:

Proposal P_1		Proposal P_2	
Cash flows	**Probability**	**Cash flows**	**Probability**
1,50,000	0.3	-4,00,000	0.2
2,00,000	0.3	3,00,000	0.6
2,50,000	0.4	4,00,000	0.1
		8,00,000	0.1

Evaluate the proposals in terms of the standard deviation and coefficient of variation. ***(A) (CA FINAL RST)***

(ANS.: SD_1: 41,530, COV_1: 0.2; SD_2: 3,42,930; COV_2: 1.56) (SOLVE PROBLEM NO. 7 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ______________________________

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PROBLEM 8: **(PRINTED SOLUTION AVAILABLE)** Shivam Ltd. is considering two mutually exclusive projects A and B. Project A costs Rs. 36,000 and project B Rs. 30,000. You have been given below the net present value probability distribution for each project.

Project A		Project B	
NPV estimates (Rs.)	**Probability**	**NPV estimates (Rs.)**	**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. ***(A) (NEW SM)***

(ANS.: (I) EV FOR PROJECT A & B ARE 9,000 AND 9,000 RESPECTIVELY, (II) S.D. FOR A IS 4,450 AND B IS 3,795, (III) PROJECT A IS 1.25, B IS 1.30 (IV) PROJECT B IS PREFERABLE) (SOLVE PROBLEM NO. 8 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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PROBLEM 9: A company is considering Projects X and Y with following information:

Project	Expected NPV (Rs.)	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? ***(A) (CA FINAL OLD PM)***

(ANS.: (I) ON THE BASIS OF STANDARD DEVIATION PROJECT X BE CHOSEN, (II) ON THE BASIS OF CO-EFFICIENT OF PROJECT Y SHOULD BE ACCEPTED, (III) NPV METHOD) (SOLVE PROBLEM NO. 9 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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MODEL 4: RISK ADJUSTED DISCOUNT RATE (RADR)

- The discount- rates in capital budgeting represents the expected rate of return from the project.
- Projects with higher risk are generally expected to provide a higher return. And projects with relatively lower risk are expected to provide a lower rate of return, consequently all projects should not be discounted at the same rate, namely the company's cost of capital.
- Hence the cut-off discount rate should be adjusted upwards or downward to take care of the additional (or lower) risk element. This is referred to as **risk adjusted discount rate**.

How to compute NPV under RADR approach:

Step 1: Identify cash flows.

Step 2: Compute RADR, **(RADR = Cost of capital $\pm$ Premium for risk)**

Step 3: Discount the cash flows at RADR and find out NPV

Decision Rule: If the project yields a positive NPV, it can be accepted otherwise reject.

PROBLEM 10: An enterprise is investing Rs. 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 (Rs. 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. ***(A) (NEW SM, RTP M19 (N), MTP2 M18 (N) - 5M, MTP1 N18 (N) - 5M)***

(ANS.: NPV BASED ON RISK FREE RATE IS 144.34 AND ON THE BASIS OF RISK ADJUSTED RATE IS 99.79)

(SOLVE PROBLEM NO. 10 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

PROBLEM 11: (PRINTED SOLUTION AVAILABLE) New Projects Ltd. is evaluating 3 projects, P-I, P-II, P-III. Following information is available in respect of these projects:

Particulars	P-I	P-II	P-III
Cost	Rs. 15,00,000	Rs. 11,00,000	Rs. 19,00,000
Inflows: Year 1	6,00,000	6,00,000	4,00,000
Year 2	6,00,000	4,00,000	Rs. 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? ***(B) (CA FINAL OLD PM)***

(ANS.: (I) FOR P-I: RADR IS 19%, FOR P-II: RADR IS 15%, FOR P-III: RADR IS 13%; NPV: 83,400 PROJECT-I; 1,67,800 PROJECT-II; 2,13,800 PROJECT-III) (SOLVE PROBLEM NO. 11 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

PROBLEM 12: Determine the risk adjusted net present value of the following projects:

Particulars	X	Y	Z
Net cash outlays (Rs.)	2,10,000	1,20,000	1,00,000
Project life	5 years	5 years	5 years
Annual Cash inflow (Rs.)	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

(A) (NEW SM – TYK, MTP1 M19 (N) - 5M) (NPV: X: RS. 19,180, Y: RS. 24,186, Z: RS. 8,150)

(SOLVE PROBLEM NO. 12 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

MODEL 5: CERTAINTY EQUIVALENT (CE) METHOD FOR RISK ANALYSIS

- Certainty Equivalent Factor (CEF) is **the ratio of assured (or certain) cash flows to uncertain cash flows.**
- Under this approach, the cash flows expected in a project are converted into **risk- less equivalent** amounts. The adjustment factor used is called Certainty Equivalent Co-efficient factor.
- While employing this method, the decision maker estimates the sum he must be assured of receiving, in order that he is indifferent between as **"assured sum"** and **expected values of "risky sum".**
- **This varies between 0 and 1**. A coefficient of 1 indicates that the cash flows are certain.
- The greater the risk in a cash flow the smaller will be the CE factor for 'receipts' and Larger will be the CE factor for 'payments'.
- Since the risk involved in cash flows is already incorporated, the **appropriate discount rate** for project evaluation will **be the risk free rate.** **(M18 (N) - 4M)**

How to compute NPV under CE approach

Step 1: Convert uncertain cash flows to certain cash flows by multiplying it with the certainty equivalent factor.

Step 2: Discount the certain cash flows at the risk free rate to arrive at NPV.

Step 3: If the resultant NPV is positive, the project can be accepted.

DIFFERENCE BETWEEN RADR AND CEF APPROACHES

Point	Certainty Equivalent Method	Risk Adjusted Discount Rate Method
a) Factor Adjusted	This method adjusts the cash flows of a project for risk.	This method adjusts the discount rate (WACC) for risk.
b) Time effect	Cash flows are adjusted for Risk over time under this method.	This method assumes that risk increases with at a constant rate.
c) Ease	It is difficult to specify a series of CE Co- efficient.	It is comparatively easier to adjust discount rates.
d) Accuracy	This is superior to the RADR Approach, as it can measure risk more accurately.	Risk is adjusted only in the discount rates and is not recognised in the cash flows. However, cash flows are more uncertain than the cost of capital.

PROBLEM 13: 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? *(A) (RTP N18 (N)) (ANS.: NPV: RS. 2,58,776; NPV IS +VE AND PROJECT SHOULD BE ACCEPTED)*

(SOLVE PROBLEM NO. 13, 14 OF ASSIGNMENT PROBLEMS AS REWORK)

<u>PROBLEM 14:</u> The Textile Manufacturing Company Ltd., is considering one of two mutually exclusive proposals, Projects M and N, which require cash outlays of Rs. 8,50,000 and Rs. 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:

Year-end	Project M		Project N	
	Cash Flow (Rs.)	C.E.	Cash Flow (Rs.)	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 Rs. 1 discounted at 6% at the end of year 1, 2 and 3 are 0.943, 0.890 and 0.840 respectively.

Required:

i) Which project should be accepted?

ii) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why? ***(A) (NEW SM - TYK)***

(ANS.: I. PROJECT N SHOULD BE ACCEPTED; RISK ADJUSTED NPV: 10,980; 1,71,315, II. PROJECT M, SINCE "HIGHER THE RISKINESS OF A CASH FLOWS THE LOWER WILL BE THE C.E FACTOR")

(SOLVE PROBLEM NO. 15 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

<u>MODEL 6: SENSITIVITY ANALYSIS</u>

Meaning:

- Sensitivity analysis is one of the **methods of analysing the risk surrounding the capital expenditure** decision, and **enables the firm to assess** how responsive the project's NPV is to changes in those variables based on which NPV is computed.
- We know that NPV is **computed based on set of critical variables (**like: selling price, sales volume, discount rate, initial cost, operating costs, or estimated Benefits). During a project's life, **any one or more of these input parameters may undergo a change.**
- Such changes are **natural because each of these elements is only an** estimate. **An adverse change** can result in originally computed **NPV turning zero.**
- If this happens, the decision - maker would be hit hard. Hence the decision-maker is keen to ensure that **estimates contain a reasonable buffer to absorb unforeseen changes in the critical variables of the project.**

<u>Method of computation:</u> Sensitivity is computed as the ratio of downside change in input parameter to the value of initial parameter.

- Each input variable is considered separately and all other assumptions are held constant.
- The extent of change in an input parameter that would result in zero NPV is computed.
- The extent of change so determined is expressed as a percentage.
- The process is repeated for all critical variables to test their sensitivity.

Decision Rule: The lower the change percentage the higher is the sensitivity of the project to the input parameter. This is because a small change in input parameter leads to a reversal of investment decision.

PROBLEM 15: (PRINTED SOLUTION AVAILABLE) X Ltd is considering its New Product with the following details.

S.No.	Particulars	Figures (in Rs.)
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%

a) Calculate the NPV of the project.

b) Find the impact on the project's NPV of a 2.5 per cent adverse variance in each variable. Which variable is having maximum effect? ***(A) (NEW SM)***

(ANS.: A) NPV: RS. 134.60, B) -7.43%, -24.82%, - 12.41%, - 2.48%, -12.41%)

(SOLVE PROBLEM NO. 16 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

PROBLEM 16: (PRINTED SOLUTION AVAILABLE) 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 (Rs.)	1,20,000
Annual Cash Inflow (Rs.)	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)

(A) (NEW SM, RTP M18 (N)) (ANS.: NPV: RS. 22,605, PROJECT IS MORE SENSITIVE TO ANNUAL CASH INFLOW)

(SOLVE PROBLEM NO. 17, 18 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

MODEL 7: SCENARIO ANALYSIS

- Although sensitivity analysis is probably the most widely used risk analysis technique, it does have limitations. Therefore, we need to extend sensitivity analysis to deal with the probability distributions of the inputs.
- In addition, it would be useful to vary more than one variable at a time so we could see the combined effects of changes in the variables.
- Scenario analysis provides answer to these situations of extensions. This analysis brings in the probabilities of changes in key variables and also allows us to change more than one variable at a time.
- This analysis begins with base case or most likely set of values for the input variables. Then, go for worst case scenario (low unit sales, low sale price, high variable cost and so on) and best case scenario.
- So, in a nutshell Scenario analysis examines the risk of investment, so as to analyse the impact of alternative combinations of variables, on the project's NPV (or IRR)

PROBLEM 17: XY Ltd. has under its consideration a project with an initial investment of Rs.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 the three probability alternatives, respectively, are Rs. 0, 20,000 and 30,000

You are required to:

i) Find the probable NPV

ii) Find the worst-case NPV and the best-case NPV. ***(A) (CA FINAL OLD PM, M10)***

(ANS.: I) PROBABLE NPV: RS. 761; II) WORST CASE: RS. (40,187.76); BEST CASE: RS. 31,680.81)

(SOLVE PROBLEM NO. 19 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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MODEL 8: DECISION TREE ANALYSIS

a) In a capital budgeting exercise, decision-maker has to identify and evaluate various alternative courses of action leading to the investment decision.

b) A decision tree captures these alternatives in the form of a diagram and is useful for clarifying the range of alternative courses of action, assessing possible outcomes, i.e. multiplicity of choices and outcomes.

c) There are two stages in preparing a decision tree.

i) The first step is drawing the decision tree itself, in a manner that reflects all the choices and outcomes.

ii) The second step is to incorporate probabilities, relevant values and derive expected monetary values.

Rules for drawing a decision tree diagram:

Some basic rules in drawing the decision tree are:

Rule 1: A decision tree begins with a decision point. A decision point (also known as decision node) is represented by a rectangle. An outcomes point (also known as chance node) is denoted by a circle.

Rule 2: Decision alternatives are shown by a straight line originating from the decision node.

Rule 3: A decision tree diagram is drawn from left to right. The rectangles and the circles are sequentially numbered.

Rule 4: Values and probabilities for each branch are then incorporated.

Evaluation and decision rules: A decision tree is analyzed and evaluated using toll-back method. That is, the value of each circle and each square is computed by evaluating from right to left this technique proceeds from the last decision in the sequence, and works back to the first, for each of the possible decisions. There are two rules in this evaluation.

Rule 1: The expected monetary value (EMV) at a change node (branches emanating from a circle) is the aggregate of the expected values of the various branches that emanate from the chance node.

Rule 2: The expected value at a decision node (branches emanating from a square) is the highest amongst the expected values of the various branches that emanate from the decision node.

PROBLEM 18: A firm has an investment proposal, requiring an outlay of Rs. 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 Rs. 50,000 and 0.6 Probability that cash inflow after tax will be Rs. 60,000. The probability assigned to cash inflow after tax for the year 2 is as follows:

Year	Cash Flows (Rs.)	Probability	Cash Flows (Rs.)	Probability
Year - 1	50,000	0.4	60,000	0.6
Year - 2	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? **(Note:** 10% discount factor 1 year 0.909; 2 years 0.826)

(C) (NEW SM) (ANS.: I) EXPECTED NPV IS 6,223.76, II) WORST OUTCOME REALIZED, PROJECT YIELD NPV-14,726 PROFITABILITY OF OCCURRENCE OF THIS NPV IS 8%, III) BEST OUTCOME IS PATH 6 WHEN NPV IS 24,100, PROBABILITY OF OCCURRENCE IS 6%, IV) YES, SINCE NPV IS POSITIVE AT RS.6223.76)

(SOLVE PROBLEM NO. 20 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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PROBLEM 19: A firm is required to choose between constructing a large or small factory to produce a new line of products. The large plant would be needed if the future brings a high demand for new products. But the large plant would have cash outflow of Rs. 10,00,000. The present value of cash inflows are Rs. 14,00,000 with high demand, Rs. 9,00,000 with medium demand, and Rs. 6,00,000 with low demand. The smaller plant produces a lower return if demand is high but has positive net present values at medium demand. It would cost Rs. 2,00,000 as a cash outlay and would return a present value inflow of Rs. 3,20,000 with high demand, Rs. 2,70,000 with medium demand and Rs. 1,80,000 with low demand.

What is the net present value of each alternative if there is a 40% chance of high demand, 40% chance of medium demand and a 20% chance of low demand?

(C) (ANS.: NPV LARGE = RS. 40,000, SMALL = RS. 72,000) (SOLVE PROBLEM NO. 21 OF ASSIGNMENT PROBLEMS AS REWORK)

Note: ____

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MODEL 9: MONTE CARLO SIMULATION

- Simulation is a mathematical model that represents actual decision making under conditions of uncertainty, for evaluating alternative courses of action.
- Such a model involves conducting a series of organized experiments to predict the probable outcome of the process in a given period of time.
- Simulation provides a trial and error movement towards an optimal solution.

Simulation Method:

Step 1: Define the problem and lay down the model.

Step 2: Identify the key variables.

Step 3: Specify Rupee value and probability.

Step 4: Generate random number class intervals.

Step 5: Assign random numbers.

Step 6: Solve the Model.

PROBLEM 20: **(PRINTED SOLUTION AVAILABLE)** You are the CFO of Dynamite Ltd., Your company proposes to buy equipment costing Rs.1,00,000. The equipment will last 5 years. Your Cost of Capital is 10%. Your analysts have suggested that the expected revenues per annum can be Rs.1,00,000 or Rs.1,25,000 or Rs.1,37,500 or Rs.1,50,000. Similarly, the costs could be Rs.62,500 or Rs.75,000 or Rs.87,500 or Rs.1,00,000. The probability distribution for these variables is:

Revenues	0.15	0.40	0.30	0.15
Costs	0.10	0.25	0.35	0.30

You wish to run a simulation model and have picked the random numbers 81, 02, 60, 04, 46, 31, 67, 25. In that order, alternatively for revenues and costs. Decide whether the project can be undertaken.

(C) (PTB) (ANS.: NPV: RS. 1,48,784) (SOLVE PROBLEM NO. 22 OF ASSIGNMENT PROBLEMS AS REWORK)

Note:____

ASSIGNMENT PROBLEMS

MODEL 1: PROBABILITY & EXPECTED CASHFLOW

PROBLEM 1:

Assumption	Cash Flows (Rs.)	Probability
Best case	9,00,000	0.3
Most likely	5,00,000	0.4
worst case	2,00,000	0.3

Compute Expected cash flow based on above probability. ***(C) (ANS.: EXPECTED CF: RS. 5,30,000)***

PROBLEM 2: From the following information, Find out Expected Investment.

Likely Investment	
Amount (in lakhs)	**Probability**
70.00	0.20
80.00	0.40
90.00	0.40

(C) (ANS.: EXPECTED INVESTMENT: RS. 82 LAKHS)

PROBLEM 3: From the following information, Find out Expected CFAT.

Selling Price (P.u)	Probability	Variable Cost (P.u)	Probability
10	0.3	5	0.25
20	0.4	10	0.35
30	0.3	15	0.40

Expected Sales Volume = 40,000 units

Expected Fixed Cost (p.a.) = Rs. 1,20,000

Annual depreciation = Rs. 50,000

Tax Rate @ 50%. ***(C) (ANS.: EXPECTED CFAT: RS. 1,80,000)***

MODEL 2: EXPECTED NPV

PROBLEM 4: Possible net cash flows of Projects X and Y (Assume life of 1 year) and their probabilities are given as below. Discount rate is 12%. For both the projects, Initial Investment is Rs. 9,000. Calculate the expected Net Present Value for each project. Which project is preferable?

	Project X		Project Y	
Possible Event	**Cash Flow (Rs.)**	**Probability**	**Cash Flow (Rs.)**	**Probability**
A	5,000	0.20	15,000	0.10
B	8,000	0.10	19,000	0.15

C	10,000	0.50	16,000	0.50
D	13,000	0.10	12,000	0.15
E	15,000	0.10	10,000	0.10

(A) (ANS.: NPV OF PROJECT X: RS. (429), NPV OF PROJECT Y: RS. 4,527 SO PROJECT Y IS PREFERABLE)

PROBLEM 5: Probabilities for Net cash flows for 3 years of a project are as follows:

Year 1		Year 2		Year 3	
Cash Flow (Rs.)	**Probability**	**Cash Flow (Rs.)**	**Probability**	**Cash Flow (Rs.)**	**Probability**
3,000	0.1	4,000	0.3	5,000	0.4
6,000	0.2	6,000	0.4	10,000	0.2
9,000	0.3	9,000	0.2	13,000	0.1
12,000	0.4	12,000	0.1	16,000	0.3

Calculate the expected net cash flows. Also calculate the Net Present Value of the expected cash flow, using 12 per cent discount rate. Initial Investment is Rs. 15,000.

(A) (ANS.: EXPECTED NET PRESENT VALUE: RS. 5,488)

MODEL 3: STANDARD DEVIATION, VARIANCE & COFFECIENT OF VARIANCE

PROBLEM 6:

	Project M		Project N	
Possible Event	**Cash Flow (Rs.)**	**Probability**	**Cash Flow (Rs.)**	**Probability**
P	12,000	0.10	14,000	0.30
Q	15,000	0.30	16,000	0.20
R	18,000	0.20	18,000	0.20
S	21,000	0.30	20,000	0.10
T	24,000	0.10	22,000	0.20

Calculate variance, standard deviation (σ) and coefficient of variance for the projects based on the above information? Which project is more risky?

(A) (ANS.: VARIANCE & S.D. FOR PROJECT A AND PROJECT B ARE 1,26,00,000; 3,549.64 AND 92,00,000; 3,033.15 RESPECTIVELY, COEFFICIENT OF VARIANCE: 0.1972, 0.1685)

PROBLEM 7: XYZ Ltd. is evaluating two equal size mutually exclusive proposals A and B for which the respective cash flows together with associated probabilities are as follows:

Project X		Project Y	
Cash flows	**Prob.**	**Cash flows**	**Prob.**
2,000	0.3	1,000	0.1
4,000	0.4	3,000	0.1
6,000	0.3	5,000	0.4
		7,000	0.3
		9,000	0.1

Find out the risks of the proposals in terms of the standard deviation and coefficient of variation.

(A) (CA FINAL RST) (ANS.: SD_X: 1549, COV_X: 0.387; SD_Y: 2154; COV_Y: 0.398)

PROBLEM 8: Below is given for the two cement projects in south and north in India.

NPV (Rs. in Lacs)	Probability	NPV (Rs. in Lacs)	Probability
3	0.05	3	0.15
5	0.30	5	0.25
6	0.30	6	0.25
12	0.30	12	0.25
15	0.05	16	0.10

i) Compute the expected net present value of Projects.

ii) Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.

iii) Which project do you consider riskier and why?

(A) (ANS.: I) EXPECTED NPV: 7.80, SD:3.516; II) EXPECTED NPV: 7.80, SD: 3.977; III) NORTH PROJECT IS RISKIEST PROJECT)

PROBLEM 9: A company is considering projects X and Y with the following information:

	Project X	Project Y
Expected NPV	Rs. 60,000	Rs. 2,27,000
Standard Deviation	40,000	1,35,000

a) Which project will you recommend based on standard deviation?

b) Will your answer change if you use different use coefficient of variation as a measure of a risk instead of standard deviation?

c) Which measure is more appropriate? ***(A) (ANS.: A) PROJECT X; B) PROJECT Y (COV): 0.595; C) PROJECT Y)***

MODEL 4: RISK ADJUSTED DISCOUNT RATE (RADR)

PROBLEM 10: An investment will have an initial outlay of Rs. 1,00,000. It is excepted to generate cash inflows as under:

Year	1	2	3	4
Cash in flows	40,000	50,000	15,000	30,000

Risk free rate of interest is 10%. Risk premium is 10% (the risk characterizing the project)

a) Compute the NPV using risk free rate

b) Compute NPV using risk - adjusted discount rate ***(C) (RM) (ANS.: A) RS. 9,415; B) RS. (8,835))***

PROBLEM 11: Salvations and Solutions have been in IT business for six years and enjoy a favorable market reputation. Corporate tax is 30%. They anticipate that the demand for IT solutions would increase sizably since many foreign firms are setting up their BPO shops in India. For an expansion project, they propose to invest Rs. 22 crores to be funded by new debt and equity on 50/50 basis. Enquiries with merchant bankers reveal that funds can be raised as under:

Debt	**Rate %**
First Rs. 5 Crores	10 %
Next Rs. 5 Crores	12 %
All additional funds	15.72 %
Equity	12 %
Risk gradation by company	2 % over WMCC

Compute the appropriate risk adjusted discount rate. ***(A) (ANS.: RADR: 12%)***

PROBLEM 12: Determine the Risk Adjusted Net Present Value of the following projects:

Particulars	P	Q	R
Net cash outlays (Rs.)	4,00,000	1,80,000	2,50,000
Project life	3 years	3 years	3 years
Annual Cash inflow (Rs.)	2,00,000	80,000	1,25,000
Coefficient of variation	1.6	2.0	1.2

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

(A) (NEW SM - TYK, MTP1 M19 (N) - 5M) (NPV: P: RS. 2,25,400; Q: RS. 49,120; R: RS. 1,59,250)

MODEL 5: CERTAINTY EQUIVALENT (CE) METHOD FOR RISK ANALYSIS

PROBLEM 13: 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 (in Rs.)	Certainty-equivalent quotient
0 (Initial Outlays)	(2,00,000)	1.0
1	1,60,000	0.8
2	1,40,000	0.7
3	1,30,000	0.6
4	1,20,000	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? ***(A) (PTB)***

(ANS.: NPV: RS. 1,29,388; YES, PROJECT CAN BE ACCEPTED)

PROBLEM 14: If Investment Proposal is Rs. 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

(B) (NEW SM) (ANS.: NPV: RS. 5,34,570)

PROBLEM 15: The globe manufacturing company ltd. Is considering an investment in one of the two mutually exclusive proposals-project X and Y, which require cash outlays of Rs.3,40,000 and Rs.3,30,000 respectively. The certainty-equivalent (C.E.) approach is used in incorporating risk in capital budgeting decisions. Risk free rate is 8%, and risk adjusted rate is 10%. The expected net cash flows and their certainty equivalents are as follows:

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

Present value factor of Rs.1 discounted at 8% at the end of year 1, 2 and 3 are 0.926, 0.857 and 0.794 respectively.

a) Which project should be accepted under CE approach?

b) If risk adjusted discount rate method is used, which project would be appraised with a higher rate and why? ***(A) (CA FINAL OLD PM) (ANS.: NPV: PROJECT X: RS. (7,276), PROJECT Y: RS. 54,580; B. PROJECT X)***

MODEL 6: SENSITIVITY ANALYSIS

PROBLEM 16: The following information applies to a new project:

Initial Investment	1,25,000
Selling price per Unit	100
Variable costs per unit	30
Fixed costs for the period	100,000
Sales volume	2,000 units

Life	5 years
Discount rate	10%

Required: Project's NPV and show how sensitive the results are to various input factors.

(A) (CA FINAL OLD SM) (ANS.: PROJECTS NPV IS RS. 26,640 AND SELLING PRICE FALL OF 3.51%, VARIABLE COST - 11.71%, VOLUME FALL OF 5%, INITIAL COST - 21.31% AND FIXED COST - 7.03%, DISCOUNT RATE 80%, LIFE: 10%)

PROBLEM 17: 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	Rs. 2,00,00,000
Annual Cash Inflow	Rs. 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. *(A) (N18 (N) - 5M)*

(ANS.: PROJECT NPV: RS.27,46,000; INITIAL PROJECT COST (72.83%), ANNUAL CASH FLOW 82.83%, COST OF CAPITAL: 20.76%; PROJECT IS MOST SENSITIVE TO ANNUAL CASH INFLOW)

PROBLEM 18: Red Ltd. is considering a project with the following Cash flows:

Years	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?

(CA FINAL OLD PM) (ANS.: SAVINGS FACTOR IS MOST SENSITIVE TO AFFECT ACCEPTABILITY)

MODEL 7: SCENARIO ANALYSIS

PROBLEM 19: AB Ltd. has under its consideration a project with an initial investment of Rs.5,00,000. Three probable cash inflow scenarios with their probabilities of occurrence have been estimated as below:

Annual cash inflow	1,50,000	2,00,000	2,50,000
Probability	0.2	0.6	0.2

The Project life is 4 years and the desired rate of return is 25%. The estimated terminal values for the project assets under the three probability alternatives, respectively, are Rs. 50,000; 1,00,000 and 1,50,000.

Given that PVAF (25%, 4 yrs.) = 2.3616, PVF @ 25% at 4^{th} year = 0.4096

You are required to:

i) Find the probable NPV

ii) Find the worst-case NPV and the best-case NPV.

(A) (ANS.: I) PROBABLE NPV: RS. 13,280; II) WORST CASE: RS. (1,25,280); BEST CASE: RS. 1,51,840)

MODEL 8: DECISION TREE ANALYSIS

PROBLEM 20: A firm has an investment proposal, requiring an outlay of Rs. 2,00,000. The investment proposal is expected to have two years' economic life with no salvage value. In year 1, there is a 0.7 probability that cash inflow after tax will be Rs. 1,80,000 and 0.3 Probability that cash inflow after tax will be Rs. 1,40,000. The probability assigned to cash inflow after tax for the year 2 is as follows:

Year	Cash Flows (Rs.)	Probability	Cash Flows (Rs.)	Probability
Year - 1	1,80,000	0.7	1,40,000	0.3
Year - 2	1,40,000	0.3	90,000	0.2
	1,10,000	0.4	1,00,000	0.6
	1,00,000	0.3	1,20,000	0.2

The firm uses a 15% 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? **(Note:** 15% discount factor 1 year 0.870; 2 years 0.756)

(C) (ANS.: I) EXPECTED NPV IS (21,587.2); II) WORST OUTCOME REALIZED, PROJECT YIELD NPV: (60,160) PROFITABILITY OF OCCURRENCE OF THIS NPV IS 6%, III) BEST OUTCOME IS PATH 1 WHEN NPV IS RS.12,440; PROBABILITY OF OCCURRENCE IS 21%, IV) PROJECT SHOULD BE REJECTED)

PROBLEM 21: ABC & Co. has funds of Rs.2,00,000 which expectedly are not required for next few years. These funds can be deposited in a bank @ 15% interest payable annually. Alternatively, the funds can be used to install a new machine for the production of a new item. For this, the firm has two options before it: Machine 1 costing Rs.1,80,000 which is expected to give annual cash inflows of Rs.1,00,000, Rs.1,20,000 ad Rs. 40,000 respectively for next three years. Machine 2 costing Rs.1,90,000 which is expected to give annual cash inflows of Rs. 1,00,000 and Rs. 50,000 respectively for next three years. Present the decision situation in a decision tree and evaluate the options. ***(C) (ANS.: NPV OF BANK DEPOSIT IS RS. 120, M.1 IS RS.24,040 & M.2 IS RS. 5,500)***

MODEL 9: MONTE CARLO SIMULATION

PROBLEM 22: A company manufactures 3,000 units of product P per day. The sale of this product depends upon which has the following distribution.

Sales (units)	2,700	2,800	2,900	3,000	3,100	3,200
Probability	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and sale price of each unit are Rs.4 and Rs.5 respectively. Any unsold product is to be disposed off at a loss of Rs.1.50 per unit. There is a penalty of Rs.0.50 per unit if demand is not met.

Using the following random numbers estimate total profit /loss for the company for next 10 days: 11,98,66,97,95,01,79,12,17,21.

If the company decides to produce 2,900 items per day, what is profit / loss position of the company?

(C) (CA FINAL RTP M12) (ANS.: PROFIT/LOSS FOR THE COMPANY FOR NEXT 10 DAYS IS 26,950 AND IF THE COMPANY DECIDES TO PRODUCE 2,900 UNITS, THEN IT IS 26,950)

PRINTED SOLUTIONS TO SOME SELECTIVE PROBLEMS

PROBLEM NUMBERS TO WHICH SOLUTIONS ARE PROVIDED: 6, 8, 11, 15, 16, 20

PROBLEM NO: 6

Estimation of Variance, Standard Deviation(s) & Co -efficient of variation of each of the projects:

Project A:

Variance (σ^2) = $(8,000 - 12,000)^2$ (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(s) = $\sqrt{48,00,000} = 2190.90$ = 2190.90

Project B:

Variance (σ^2) = $(24,000 - 16,000)^2$ (0.1) + $(20,000 - 16,000)^2$(0.15) + $(16,000 - 16,000)^2$ (0.5) + $(12,000 - 16,000)^2$ (0.15) + $(8,000 - 16,000)^2$ (0.1) = 44,00,000

Standard Deviation (s) = $\sqrt{1,76,00,000} = 4195.23$ = 4195.23

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

PROBLEM NO: 8

i) Statement showing computation of Expected Net Present Value of Projects A and B:

Project A			Project B		
NPV Estimate (Rs.)	**Probability**	**Expected Value**	**NPV Estimate (Rs.)**	**Probability**	**Expected Value**
15,000	0.2	3,000	15,000	0.1	15,000
12,000	0.3	3,600	12,000	0.4	4,800
6,000	0.3	1,800	6,000	0.4	2,400
3,000	0.2	600	3,000	0.1	300
	10	EV = 9,000		10	EV = 9,000

ii) Computation of Standard Deviation of each project:

Project A

P	X	(X - EV)	P (X- EV)²
0.2	15,000	6,000	72,00,000
0.3	12,000	3,000	27,00,000
0.3	6,000	- 3,000	27,00,000
0.2	3,000	- 6,000	72,00,000
			Variance = 1,98,00,000

Standard Deviation of Project A = $\sqrt{1,98,00,000}$ = Rs.4,450

Project B

P	X	(X - EV)	P (X- EV)²
0.1	15,000	6,000	36,00,000
0.4	12,000	3,000	36,00,000
0.4	6,000	-3,000	36,00,000
0.1	3,000	- 6,000	36,00,000
		Variance = 1,44,00,000	

Standard Deviation of Project B = $\sqrt{1,44,00,000}$ = Rs. 3,795

iii) Computation of profitability of each project

Profitability index = Discount cash inflow / Initial outlay

In case of Project A: PI = $\frac{9,000 + 36,000}{36,000} = \frac{45,000}{36,000} = 1.25$

In case of Project B: PI = $\frac{9,000 + 30,000}{30,000} = \frac{39,000}{30,000} = 1.30$

iv) 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 A and B, Project B is preferable because the possible profit which may occur is subject to less variation (or dispersion). Much higher risk is lying with project A.

PROBLEM NO: 11

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} + (k_e-I_{RF}) Risk Factor

For P-1 RADR	= 0.10 + (0.15 - 0.10) 1.80 = 19%
For P-II RADR	= 0.10 + (0.15 - 0.10) 1.00 = 15 %
For P- III RADR	= 0.10 + (0.15 - 0.10) 1.00 = 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 (Rs.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 (Rs)	PVF (15%)	PV(Rs)
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	1,14,000
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 (Rs.)	PVF (13%)	PV (Rs.)
1	4,00,000	0.885	3,54,000
2	6,00,000	0.783	4,69,800
3	8,00,000	0.693	5,54,400
4	12,00,000	0.613	7,35,600
Total Present Value			21,13,800
Less: Cost of Investment			19,00,000
Net Present Value			**2,13,800**

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

PROBLEM NO: 15

1. Calculation of Net Cash Inflow per year:

	Particulars	Amount (Rs.)
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)	Rs. 250 Cr.
F	Fixed Cost Per Year	Rs. 50 Cr.
G	Net Cash Inflow Per Year (G =E - F)	Rs. 200 Cr.

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

Year	Year Cash Flow (Rs. in Cr.)	Discounting @ 6%	Present Value (PV) (Rs. 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 in variable	Base	Initial Cash Flow increased to Rs. 410 crore	Selling Price per Unit Reduced to Rs. 97.5	Variable Cost Per Unit increased to Rs. 51.25	Fixed Cost Per Unit increased to Rs. 51.25	Units sold per year reduced to Rs. 4.875 crore
	Particulars	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**	**Amount Rs.**
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	4.875	50	50
D	Number of Units Sold Per Year (in Crores)	5	5	5	5	5	4.875
E	Total Contribution (E = C × 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 × 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 %.

PROBLEM NO: 16

Calculation of NPV through Sensitivity Analysis

Particulars	(Rs.)
PV of cash inflows (Rs. 45,000 × 3.169)	1,42,605
Initial Project Cost	(1,20,000)
NPV	22,605

Situation	NPV	Changes in NPV
Base (present)	Rs. 22,605	
If initial project cost is varied adversely by 10%	(Rs. 1,42,605 - Rs. 1,32,000) = Rs. 10,605	(Rs. 22,605 - Rs. 10,605)/ Rs. 22,605 = (53.08%)
If annual cash inflow is varied adversely by 10%	[Rs. 40,500(revised cash flow) × 3.169) - (Rs. 1,20,000)] = Rs. 8,345	(Rs. 22,605 - Rs. 8,345) / Rs. 22,605=63.08%
If cost of capital is varied adversely by 10% i.e. it becomes 11%	(Rs. 45,000 × 3.103) - Rs. 1,20,000 = Rs. 19,635	(Rs. 22,605 - Rs. 19,635) / Rs. 22,605 = 13.14%

Conclusion: Project is most sensitive to 'annual cash inflow'.

PROBLEM NO: 20

Step 1: Generate random number class intervals for exogenous variable

	Revenue			Cost		
	Probability	**Cum Prob.**	**Random digit allocation**	**Probability**	**Cum Prob.**	**Random digit allocation**
1	0.15	0.15	00 - 14*	0.10	0.10	00 - 09*
2	0.40	0.55	15 - 54*	0.25	0.35	10 - 34*
3	0.30	0.85	55 - 84*	0.35	0.70	35 - 69*
4	0.15	1.00	85 - 99*	0.30	1.00	70 - 99*

* **Note:** Probability is 15%. Random number digits should be 15% of the range between 00 and 99. Hence, UC CI = 0 to 14.

Step 2: assign random numbers and ascertain value

The random numbers 81, 02, 60, 04, 46, 31, 67, 25 are assigned alternatively for revenue and costs.

Random Numbers:

Revenue	Range	Revenues (Rs.)	Costs	Range	Costs (Rs.)
81	55 -84	1,37,500	02	00 - 09	62,500
60	55 - 84	1,37,500	04	00 - 09	62,500
46	15 - 84	1,25,000	31	10 - 34	75,000
67	55 - 84	1,37,500	25	10 - 34	75,00
	Total	5,37,000		Total	2,75,000
	Average	1,34,375		Average	68,750

* The RN 81 falls in the range 55 - 84. For this range the revenue value is 1,37,500. The RN 02 falls in the range 00 - 09. For this range cost is Rs. 62,500. Similar compositions are done for all random numbers.

Step 3: Solving for costs and revenue: The cash flow for the year would be randomly generated revenues less costs.

Revenues	Rs. 1,34,375
Costs	Rs. 68,750
Cash flow	Rs. 65,625

Evaluation of project for NPV @ 10%

Year	Cash flow (Rs.)	Discount Factor	PV Amount (Rs.)
0	1,00,000	1,000	1,00,000
1 - 5	65,625	3,791	2,48,784
		NPV	1,48,784

As the NPV is positive and the project is seen to be viable. Alternatively we could have computed the NPV for each of the exercise and arrived at its simple average. This would have also led to an NPV of Rs.1,48,784

THE END