

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

NO. OF PROBLEMS IN 42E OF CA INTER: CLASSROOM - 17, ASSIGNMENT - 18

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

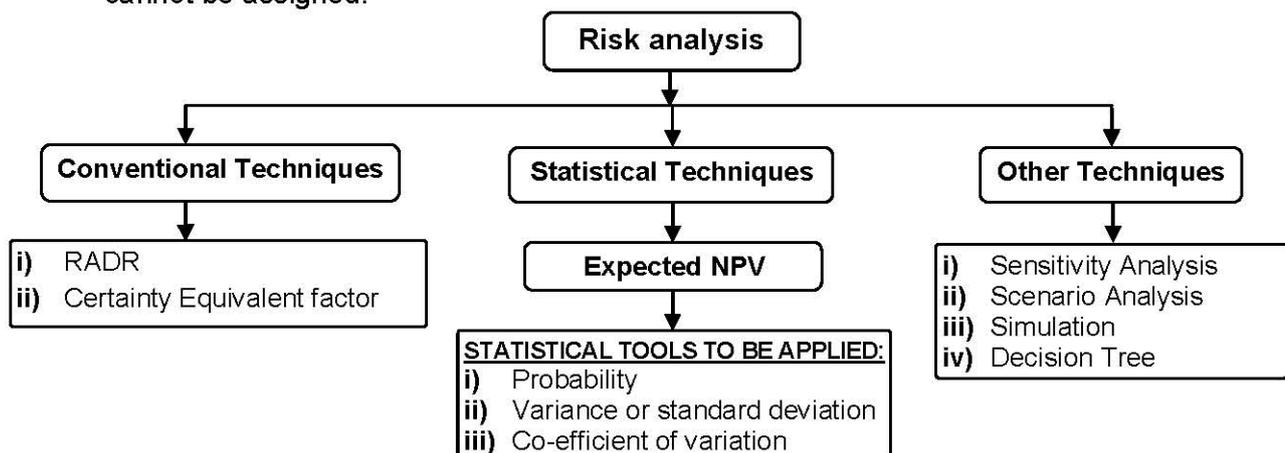
MODEL NO.	M-18 (N)	N-18 (N)	RTP M18 (N)	RTP N18 (N)	RTP M19 (N)	MTP1 M18 (N)	MTP2 M18 (N)	MTP1 N18 (N)	MTP2 N18 (N)	MTP1 M19 (N)
1. Probability and Expected Cash Flow	-	-	-	-	-	-	-	-	-	-
2. Expected NPV	-	-	-	-	-	-	-	-	-	-
3. S.D, Variance & Co-efficient of Variance	-	-	-	-	-	-	-	-	-	-
4. Risk Adjusted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

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.



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)

Concept question: What would be the impact of expected cash flows, when probabilities are 0.4, 0.5, 0.1 respectively.

Note: _____

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)

Concept question: what would be the impact on expected cash flows when cash flows are 90, 40, 30 lakhs respectively.

Note: _____

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)

Concept question: what will be the CFAT, when selling price is 40.

Note: _____

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 (Σ Step 2 – 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)

Concept question: If discount rate increases by 5%, investment increases 10%, what will be the expected NPV of each of the project.

Note: _____

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)

Concept question: If discount rate is 12%, initial investment is 8,000, then what would be the impact of each of the projects.

MODEL NO 3: STANDARD DEVIATION, VARIANCE & COEFFICIENT 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:

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

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

PROBLEM 6:

Possible Event	Project A		Project B	
	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)

Concept question: If probability for project A: 0.1, 0.10, 0.15, 0.20, 0.40, then estimate variance, standard deviation and coefficient of variance.

PROBLEM 7: The RST and Co. is engaged in evaluating the following two mutually exclusive proposals P₁ and P₂, 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.: SD₁: 41,530, COV₁: 0.2; SD₂: 3,42,930; COV₂: 1.56) (SOLVE PROBLEM NO. 7 OF ASSIGNMENT PROBLEMS AS REWORK)

Concept question: If probability for P₁: 0.2, 0.6, 0.2 & for P₂ 0.20, 0.30, 0.35, then evaluate standard deviation and coefficient of variation.

Note: _____

PROBLEM 8: 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

- Compute the expected net present values of projects A and B.
- Compute the risk attached to each project i.e. standard deviation of each probability distribution.
- Compute the profitability index of each project.
- 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)

Concept question: If probability for Project A is 0.10, 0.30, 0.15 & for project B 0.15, 0.25, 0.20, 0.40, then compute the expected NPV for each of the projects.

Note: _____

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

- Which project will you recommend based on the above data?
- Explain whether your opinion will change, if you use coefficient of variation as a measure of risk.
- 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)

Concept question: what would be the impact on risk element for project x & project Y if Standard deviation is 1,00,000 and 80,000 respectively.

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), similar Nov- 19, MTP2 M18 (N) - 5M, MTP1 N18 (N) Nov-19) - 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)

Concept question: What would be the NPV when risk premium is 10%.

PROBLEM 11: 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)

Concept question: If risk index P-I: 1, P-II: 1.50, P- III: 0.50, then which project should be selected?

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)

Concept question: Estimate Risk adjusted NPV, when C.V is 0.4, 1.6, 1.2 for the given projects respectively.

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: Gauv 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)

Concept question: Whether the project should accept, if certainty equivalent quotient are: 0.90, 0.50, 0.70, 0.50, 0.50.

Note: _____

PROBLEM 14: 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:

- Which project should be accepted?
- 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)

Concept question: If the C.E factors for project M : 0.70, 0.80, 0.90. whereas for Project N: 0.70, 0.80, 0.90 respectively, then which project should be accepted.

Note: _____

MODEL 6: SENSITIVITY ANALYSIS**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.

METHOD OF COMPUTATION: 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: 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)

Concept question: Estimate NPV, when investment increases by 10%, variable cost reduced by 20%, & the discount rate is 5%.

Note: _____

PROBLEM 16: 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 OF ASSIGNMENT PROBLEMS AS REWORK)

Concept question: Identify the factor which is most sensitive if cost of capital is 12%.

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. 18 OF ASSIGNMENT PROBLEMS AS REWORK)

Concept question: What would be the impact on probable NPV, if probabilities are 0.20, 0.10, 0.70 respectively.

Note: _____

PRINTED SOLUTIONS TO CLASS ROOM PROBLEMS

PROBLEM NO: 1

Assumption (1)	Cash Flows (RS) (2)	Probability (3)	Expected cash flow(2*3)(Rs)
Best guess	3,00,000	0.3	$3,00,000 \times .3 = 90,000$
High guess	2,00,000	0.6	$2,00,000 \times .6 = 1,20,000$
Low guess	1,20,000	0.1	$1,20,000 \times .1 = 12,000$
Expected Net cash flow (ENCF)			2,32,000

PROBLEM NO: 2

Likely investment		Expected Investment.
Amount (in lakhs)	Probability	
30.00	0.25	= 30 x 0.25= 7.5
40.00	0.50	= 40 x 0.50= 20
50.00	0.25	= 50 x 0.25= 12.5
		40

PROBLEM NO: 3CALCULATION OF CFAT:

Particulars	Amount(Rs)
Sales(units)(W.N1)	49,500
Contribution (per unit)(W.N 2)	10
Total	4,95,000
Less: Fixed cost	(2,95,000)
PBDT	2,00,000
Less: Depreciation:	(1,00,000)
PBT	1,00,000
Less: Tax@ 50%	(50,000)
PAT	50,000
Add: Depreciation	1,00,000
CFAT	1,50,000

Working note:

- Sales (units) = 40,000 x 0.35 + 50,000 x 0.35 + 60,000 x 0.30
= 49500 units
- Contribution = selling price- variable cost
= 20- 10 = 10 per unit.

PROBLEM NO: 4

Project A				Project B		
Possible Event	Net Cash Flow (Rs)	Probability	Expected Value (Rs)	Cash Flow (Rs)	Probability	Expected Value (Rs)
A	8,000	0.10	800	4,000	0.10	400
B	10,000	0.20	2,000	20,000	0.15	3,000
C	12,000	0.40	4,800	16,000	0.50	8,000
D	14,000	0.20	2,800	12,000	0.15	1,800
E	16,000	0.10	1,600	80,000	0.10	800
ENCF			12,000			16,000

The net present value for Project A is $(0.909 \times 12,000 - 10,000) = \text{RS } 908$

The net present value for Project B is $(0.909 \times 16,000 - 10,000) = \text{RS } 4,544$

PROBLEM NO: 5

Year 1			Year 2			Year 3		
Cash Flow	Probability	Expected Value	Cash Flow	Probability	Expected Value	Cash Flow	Probability	Expected Value
2,000	0.1	200	2,000	0.2	400	2,000	0.3	600

4,000	0.2	800	4,000	0.3	1200	4,000	0.4	1,600
6,000	0.3	1,800	6,000	0.4	2400	6,000	0.2	1,200
8,000	0.4	3,200	8,000	0.1	800	8,000	0.1	800
ENCF		6,000			4,800			4,200

The present value of the expected value of cash flow at 10 per cent discount rate has been determined as follows:

$$\text{Present Value of cash flow} = \frac{\text{ENCF}_1}{(1+k)^1} + \frac{\text{ENCF}_2}{(1+k)^2} + \frac{\text{ENCF}_3}{(1+k)^3}$$

$$\frac{6000}{(1.1)^1} + \frac{4,800}{(1.1)^2} + \frac{4,200}{(1.1)^3}$$

$$= (6,000 \times 0.909) + (4,800 \times 0.826) + (4,200 \times 0.751) = 12,573$$

Expected Net Present value = Present Value of cash flow - Initial Investment

$$= 12,573 - 10,000 = \text{Rs } 2,573.$$

PROBLEM NO: 6

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

Project A:

$$\text{Variance } (\sigma^2) = (8,000 - 12,000)^2 (0.1) + (10,000 - 12,000)^2 (0.2) + (12,000 - 12,000)^2 (0.4) + (14,000 - 12,000)^2 (0.2) + (16,000 - 12,000)^2 (0.1) = 48,00,000$$

$$\text{Standard Deviation(s)} = \sqrt{48,00,000} = 2190.90 = 2190.90$$

Project B:

$$\text{Variance } (\sigma^2) = (24,000 - 16,000)^2 (0.1) + (20,000 - 16,000)^2 (0.15) + (16,000 - 16,000)^2 (0.5) + (12,000 - 16,000)^2 (0.15) + (8,000 - 16,000)^2 (0.1) = 44,00,000$$

$$\text{Standard Deviation (s)} = \sqrt{44,00,000} = 4195.23 = 4195.23$$

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: 7

The expected value of cash flows (EVCF) may be calculated as follows:

Proposal 1:

$$= (1,50,000 \times 0.30) + (2,00,000 \times 0.30) + (2,50,000 \times 0.40) = 2,05,000.$$

Proposal 2:

$$= (-4,00,000 \times 0.20) + (3,00,000 \times 0.60) + (4,00,000 \times 0.10) + (8,00,000 \times 0.10) = 2,20,000.$$

Evaluation of proposals

Proposal 1			Proposal 2		
CF(Rs)	Prob	P(CF-EVCF) ²	CF(Rs)	Prob	P(CF- EVCF) ²
150	0.30	907.5	-400	0.20	76,880
200	0.30	7.5	300	0.60	3,840
250	0.40	810.0	400	0.10	3,240
			800	0.10	33,640
		1,725.0			1,17,600
Expected value (EVCF)		205			205

Now, the standard deviation and CV of the two proposals are:

Proposal 1:

$$(1,725)^{1/2} = 41.53$$

Or Rs. 41,530

Proposal 2:

$$(1,17,600)^{1/2} = 342.93$$

or Rs. 3,42,930

CV (SD/EVCF):

$$= 0.20$$

$$= 1.56$$

The expected value of cash flows of project 2 is higher at 2,20,000, therefore, it may be preferred. But the standard deviation of project 1 is lower signifying lesser variability. However, the difference in size of the standard deviation of two proposals may be different because of the size. The CV tells that the project 2 is more risky than the project 1. Therefore, a risk averse management should prefer project 1 as it is subject to less variations as depicted by the CV of 0.2 against the project 2. Which is having the CV of 1.56. so, it may be concluded, at this point that the coefficient of variation is a better measure of uncertainty of returns than is the standard deviation. This is because the coefficient of variation adjusts for the size of cash flows (adjusts for scale for the projects), whereas the standard deviation does not.

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

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

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

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

iii) Computation of profitability of each project

$$\text{Profitability index} = \text{Discount cash inflow} / \text{Initial outlay}$$

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

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

- 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:9

- (i) On the basis of standard deviation project X be chosen because it is less risky than Project Y having higher standard deviation.

$$(ii) CV_x = \frac{SD}{ENPV} = \frac{90,000}{1,22,000} = 0.738$$

$$CV_y = \frac{1,20,000}{2,25,000} = 0.533$$

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

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

PROBLEM NO:10

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

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

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

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

Year	Cash flows Rs. in Lakhs	Discounting Factor @14%	Present Value of Cash Flows Rs. in lakhs
1	25	0.877	21.93
2	60	0.769	46.14
3	75	0.675	50.63
4	80	0.592	47.36
5	65	0.519	33.74
Total of present value of Cash flow			199.80
Initial investment			100
Net present value (NPV)			99.80

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 = $I_{RF} + (k_e - I_{RF}) \text{ Risk Factor}$

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: 12

Statement showing the determination of the risk adjusted net present value

Projects	Net cash outlays	Co-efficient of variation	Risk adjusted discount rate	Annual cash inflow	PV factor 1-5 years	Dis-counted cash inflow	Net present value
	(Rs)			(Rs)		(Rs)	(Rs)
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii) = (v) × (vi)	(viii) = (vii) - (ii)
X	2,10,000	1.20	16%	70,000	3.274	2,29,180	19,180

Y	1,20,000	0.80	14%	42,000	3.433	1,44,186	24,186
Z	1,00,000	0.40	12%	30,000	3.605	1,08,150	8,150

PROBLEM NO: 13

Determination of Net Present Value (NPV)

Year	Expected Cash flow (Rs)	Certainty-equivalent (CE)	Adjusted Cash flow (Cash flow × CE) (Rs)	PV factor (at 0.06)	Total PV (Rs)
0	(4,00,000)	1.0	(4,00,000)	1.000	(4,00,000)
1	3,20,000	0.8	2,56,000	0.943	2,41,408
2	2,80,000	0.7	1,96,000	0.890	1,74,440
3	2,60,000	0.6	1,56,000	0.840	1,31,040
4	2,40,000	0.4	96,000	0.792	76,032
5	1,60,000	0.3	48,000	0.747	35,856
NPV = (6,58,776 – 4,00,000)					2,58,776

As the Net Present Value is positive the project should be accepted

PROBLEM NO: 14

Year end	CashFlow (Rs) (a)	C.E. (b)	Adjusted Cash flow (Rs) (c) = (a) × (b)	Present value factor at 6%(d)	Total Present value (Rs) (e) = (c) ×(d)
1	4,50,000	0.8	3,60,000	0.943	3,39,480
2	5,00,000	0.7	3,50,000	0.890	3,11,500
3	5,00,000	0.5	2,50,000	0.840	2,10,000
					8,60,980
Less: Initial Investment					8,50,000
Net Present Value					10,980

Statement Showing the Net Present Value of Project N

Year end	CashFlow (Rs) (a)	C.E. (b)	Adjusted Cash flow (Rs) (c) = (a) × (b)	Present value factor (d)	Total Present value (RS) (e) = (c) ×(d)
1	4,50,000	0.9	4,05,000	0.943	3,81,915
2	5,00,000	0.8	3,60,000	0.890	3,20,400
3	5,00,000	0.7	3,50,000	0.840	2,94,000
					9,96,000
Less: Initial Investment					8,25,000
Net Present Value					1,71,315

Decision : Since the net present value of Project N is higher, so the project N should be accepted.

(ii) Certainty - Equivalent (C.E.) Co-efficient of Project M (2.0) is lower than Project N (2.4). This means Project M is riskier than Project N as "higher the riskiness of a cash flow, the lower will be the CE factor". If risk adjusted discount rate (RADR) method is used, Project M would be analysed with a higher rate

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 x D)	250	250	237.5	243.75	250	243.75
F	Fixed Cost Per Year (in Crores)	50	50	50	50	51.25	50
G	Net Cash Inflow Per Year (G =E - F)	200	200	187.5	193.75	198.75	193.75
H	(G x 2.673)	534.60	534.60	501.19	517.89	531.26	517.89
I	Initial Cash Flow	400	410	400	400	400	400
J	NPV	134.60	124.60	101.19	117.89	131.26	117.89
K	Percentage Change in NPV		-7.43%	-24.82%	-12.41%	-2.48%	-12.41%

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

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: 17

The expected cash flows of the project are as follows

Year	Pr = 0.1	Pr = 0.7	Pr = 0.2	Total
	Rs	Rs	Rs	Rs
0	-10,000	-70,000	-20,000	-1,00,000
1	2,000	21,000	8,000	31,000
2	2,000	21,000	8,000	31,000
3	2,000	21,000	8,000	31,000
4	2,000	21,000	8,000	31,000
5	2,000	21,000	8,000	31,000
5	0	14,000	6,000	20,000

i) NPV based on expected cash flows would be as follows:

$$= -1,00,000 + \frac{31,000}{(1+0.20)^1} + \frac{31,000}{(1+0.20)^2} + \frac{31,000}{(1+0.20)^3} + \frac{31,000}{(1+0.20)^4} + \frac{31,000}{(1+0.20)^5} + \frac{20,000}{(1+0.20)^5}$$

$$= -Rs 1,00,000 + Rs 25,833.33 + Rs 21,527.78 + Rs 17,939.81 + Rs 14,949.85 + Rs 12,458.20 + Rs 8,037.55$$

$$NPV = Rs 746.52$$

ii) For the worst case, the cash flows from the cash flow column farthest on the left are used to calculate NPV

$$= -1,00,000 + \frac{20,000}{(1+0.20)^1} + \frac{20,000}{(1+0.20)^2} + \frac{20,000}{(1+0.20)^3} + \frac{20,000}{(1+0.20)^4} + \frac{20,000}{(1+0.20)^5}$$

$$= -100,000 + 16,666.67 + 13,888.89 + 11,574.07 + 9,645.06 + 8,037.76$$

$$NPV = -Rs 40,187.76$$

For the best case, the cash flows from the cash flow column farthest on the right are used to calculate NPV

$$= 1,00,000 + \frac{40,000}{(1+0.20)^1} + \frac{40,000}{(1+0.20)^2} + \frac{40,000}{(1+0.20)^3} + \frac{40,000}{(1+0.20)^4} + \frac{40,000}{(1+0.20)^5} + \frac{30,000}{(1+0.20)^5}$$

$$= -1,00,000 + 33,333.33 + 27,777.78 + 23,148.15 + 19,290.12 + 16,075.10 + 12,056.33$$

NPV = Rs 31,680.81

- iii) If the cash flows are perfectly dependent, then the low cash flow in the first year will mean a low cash flow in every year. Thus the possibility of the worst case occurring is the probability of getting Rs 20,000 net cash flow in year 1 is 10%.

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. 1,55,000)

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?

Possible Event	Project X		Project Y	
	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. (427), NPV OF PROJECT Y: RS. 4,529 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 & COEFFICIENT OF VARIANCE

PROBLEM 6:

Possible Event	Project M		Project N	
	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 88,40,000; 2,973.21 RESPECTIVELY, COEFFICIENT OF VARIANCE: 0.1972, 0.1708)

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

- Compute the expected net present value of Projects.
- Compute the risk attached to each project i.e., Standard Deviation of each probability distribution.
- Which project do you consider riskier and why?

(A) (ANS.: I) EXPECTED NPV: 7.80, SD:3.516; II) EXPECTED NPV: 7.80, SD: 4.167; 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

- Which project will you recommend based on standard deviation?
- Will your answer change if you use different use coefficient of variation as a measure of a risk instead of standard deviation?
- 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 expected 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)

- Compute the NPV using risk free rate
- 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.

- Which project should be accepted under CE approach?
- 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%

PVAF(10%, 5)	3.791
PVAF(10%, 4)	3.170
PVAF(18%, 5)	3.127

Required: Project's NPV and show how sensitive (Which makes NPV is zero) 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 - 21.28% AND FIXED COST - 7.03%, DISCOUNT RATE 80%, LIFE: 20%)

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) (M18 (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)

MODEL 7: SCENARIO ANALYSIS

PROBLEM 18: 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 4th year = 0.4096

You are required to:

- Find the probable NPV
- 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)

Copyrights Reserved
To **MASTER MINDS**, Guntur

THE END