8. RISK ANALYSIS IN CAPITAL BUDGETING

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

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

NO. OF PROBLEMS IN 43E OF CA INTER: CLASSROOM - 17, ASSIGNMENT - 17

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

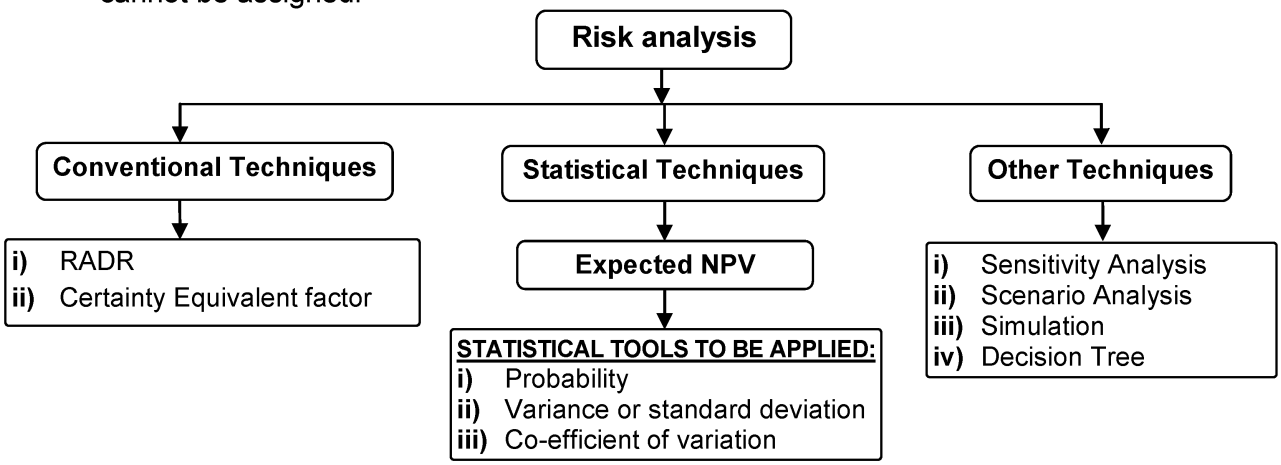
MODEL NAME	M-18 (N)	N-18 (N)	M-19 (N)	N-19 (N)
1. Probability and Expected Cash Flow	-	-	-	-
2. Expected NPV	-	-	-	-
3. S.D, Variance & Co-efficient of Variance	-	-	-	-
4. Risk Adjusted Discount Rate (RADR)	-	-	-	-
5. Certainty Equivalent (CE) Method for Risk Analysis	-	-	-	-
6. Sensitivity Analysis	-	5	-	-
7. Scenario Analysis	-	-	5	5

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 QUESTIONS:

i) What would be the impact on expected cash flows, when probabilities are 0.4, 0.5, 0.1 respectively?

ii) What is the significance of probability with respect to risk analysis?

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)

CONCEPT QUESTIONS:

i) What would be the impact on expected cash flows when cash flows are 90, 40, 30 lakhs respectively.

ii) Does the change in probability without any change in cash flows would have any impact on Expected cash flow?

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 60,000	0.35 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 QUESTIONS:

i) What will be impact on Expected CFAT, when the selling price is taken as Rs.40?

ii) What would be the impact on Expected CFAT, if Variable cost P.U is taken as Rs.15?

Note: _____

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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)

CONCEPT QUESTIONS:

i) If discount rate increases by 5%, what will be the expected NPV of each of the project?

ii) If investment increases by 10%, what will be the expected NPV of each of the project?

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)

CONCEPT QUESTIONS:

i) What would be the impact on NPV, If discount rate is 12%?

ii) What would be the impact on NPV, If initial investment is Rs.8,000?

Note: _____

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

- Project cash flows are f**orecasts**. 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:

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)

CONCEPT QUESTIONS:

i) "Standard deviation and co-efficient of variance prefers concludes same decisions in all situations". Comment.

ii) When does standard deviation and co-efficient of variance differs in decision making?

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)

CONCEPT QUESTIONS:

i) What is the interlink between expected cash flow and standard deviation?

ii) What is the interlink between expected cash flow and co-efficient of variance?

Note: _____

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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

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)

CONCEPT QUESTIONS:

i) 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.

ii) Why do you compute the profitability index in the above case?

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 Standard deviation?

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) CO EFFICIENT OF VARIATION IS RIGHT MEASURE)

(SOLVE PROBLEM NO. 9 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS:

i) What would be the impact on risk element for project x & project Y if Standard deviation is 1,00,000 and 80,000 respectively.

ii) "Higher the co-efficient of variance lower will be the risk of a project." Comment.

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 + 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: Invest Corporation Ltd. adjusts risk through discount rates by adding various risk premiums to the risk free rate. Depending on the resultant rate, the proposed project is judged to be a low, medium or high risk project.

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

The cash flows of the project considered are as following:

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

DEMONSTRATE the acceptability of the project on the basis of Risk Adjusted rate. *(MTP2 M19 (N))*

(ANS.: NPV @ LOW RISK: RS.3.96 CRORES; MEDIUM RISK: RS.(0.38) CRORES; HIGH RISK: RS.(4.41))

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

CONCEPT QUESTIONS:

i) What would be the NPV when risk premium is 10%?

ii) What would be the impact on RADR, when risk premium increases (or) decreases by 1%?

PROBLEM 11: DLF is evaluating a New Project 'X'. The following information is available:

Particulars	Project 'X'
Cost	Rs. 15,00,000
Inflows: Year 1	6,00,000
Year 2	6,00,000
Year 3	6,00,000
Year 4	6,00,000
Risk Index	1.80

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)

ii) Compute Risk Adjusted NPV? ***(B) (CA FINAL OLD PM)***

(ANS.: (I) RADR: 19%; RISK ADJUSTED NPV: 83,400) (SOLVE PROBLEM NO. 11 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS:

i) Does it make any difference if minimum required return is 17%?

ii) "Risk index increases, risk decreases in the project." Comment

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)

CONCEPT QUESTIONS:

i) "If COV increases, risk increases in the project." comment

ii) "If COV increases, RADR decreases for a given project." comment

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 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS:

i) "If certainty equivalent coefficient increases, Risk of a cash flow decreases." Comment

ii) "Certainty equivalent coefficient decreases over the life of the project." Comment

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:

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. 14 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS:

i) Why does risk-free rate is used as discounting factor instead of cost of capital?

ii) If risk-free rate is taken as 8%, how it effects the risk-adjusted NPV?

Note:_____

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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. 15 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS:

i) What would be the impact on NPV, If Selling price per unit increases (or) decreases by 10%?

ii) What would be the impact on NPV, If Fixed Cost increases (or) decreases by 10%?

Note:_____

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

Required: Project's NPV and show how sensitive (Which makes NPV is zero) the results are to various input factors like SPU, Cost of Project, Discount Rate, Fixed Cost and Life of Project.

(A) (CA FINAL OLD SM) (ANS.: PROJECTS NPV IS RS. 26,640 AND SELLING PRICE FALL OF 3.51%, , INITIAL COST - 21.28%, DISCOUNT RATE 80%, FIXED COST - 7.03%, LIFE: 20%)(SOLVE PROBLEM NO. 16 OF ASSIGNMENT PROBLEMS AS REWORK)

CONCEPT QUESTIONS: What would be the impact on NPV, If -

i) Variable Cost per unit increases (or) decreases by 10%? ***ii) Life of the Project increases (or) decreases by 10%?***

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: Kanoria Enterprises wishes to evaluate two mutually exclusive projects X and Y.

The particulars are as under:

Particulars	Project X (Rs.)	Project Y (Rs.)
Initial Investment	1,20,000	1,20,000
Estimated cash inflows (per annum for 8 years)		
Pessimistic	26,000	12,000
Most Likely	28,000	28,000
Optimistic	36,000	52,000

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

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

Advise management about the acceptability of projects X and Y. ***(A) (M19 (N) - 5M)***

(ANS.: PESSIMISTIC: NPV: X: 614, Y: (64,332); MOST LIKELY: X: 9,892, Y: 9,892; OPTIMISTIC: X: 47,004, Y: 1,21,228)

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

CONCEPT QUESTIONS:

i) Will be it be any change in decision, if pessimistic cash flow of project Y is taken Rs.28000 instead of Rs 12000?

ii) Will be it be any change in decision, if most-likely cash flow of project X is taken Rs.30,000 instead of Rs 28,000?

Note: _____

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PRINTED SOLUTIONS TO CLASS ROOM PROBLEMS

PROBLEM NO: 1

Assumption (1)	Cash Flows (Rs) (2)	Probability (3)	Expected cash Flow (2x3) (Rs)
Best guess	3,00,000	0.3	3,00,000 × 0.3= 90,000
High guess	2,00,000	0.6	2,00,000 × 0.6 = 1,20,000
Low guess	1,20,000	0.1	1,20,000 × 0.1 = 12,000
Expected Net cash flow (ENCF)			2,22,000

PROBLEM NO: 2

Likely investment		Expected Investment.
Amount (in lakhs)	Probability	
30.00	0.25	= 30 x 0.25 = 7.50
40.00	0.50	= 40 x 0.50 = 20.00
50.00	0.25	= 50 x 0.25 = 12.50
		40 Lacs

PROBLEM NO: 3

Calculation of CFAT:

Particulars	Amount (Rs.)
Sales (units) (W.N.1)	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:

1. Sales (units) = (40,000 x 0.35) + (50,000 x 0.35) + (60,000 x 0.30) = 49,500 units
2. 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 × 12,000 - 10,000) =RS 908

The Net Present Value for Project B is (0.909 × 16,000 -10,000) =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:

$$\text{Present Value of cash flow} = \frac{ENCF1}{(1+k)1} + \frac{ENCF2}{(1+k)2} + \frac{ENCF3}{(1+k)3} = \frac{6000}{(1.1)1} + \frac{4,800}{(1.1)2} + \frac{4,200}{(1.1)3}$$

= (6,000 × 0.909) + (4,800 × 0.826) + (4,200 + 0.751 = 12,573

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

= 12,573 - 10,000 =Rs 2,573.

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) = 1,76,00,000

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: 7

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

Proposal 1 = (1,50,000 x 0.30) + (2,00,000 x 0.30) +(2,50,000 x 0.40) =2,05,000.

Proposal 2 = (-4,00,000 x 0.20) + (3,00,000 x 0.60) +(4,00,000 x 0.10) + (8,00,000 x 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

CV (SD/EVCF):

= 0.20

Proposal 2:

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

or Rs. 3,42,930

= 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 lessor 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 project1. Therefore, a risk averse management should prefer project1 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

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: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) We can measure risk of projects with standard deviation and with coefficient of variation; Standard Deviation fails to measure the risk of two mutual exclusive projects having different standard deviation and NPV. In this case two projects are mutual exclusive and having different standard deviation and NPV. Co-efficient of Variation (COV) is the most appropriate measure to quantify the risk of projects. It facilitates risk per rupee of return expected from the project; a project with higher COV is preferred as it helps to maximize the wealth of shareholders.

PROBLEM NO:10

If the project is judged to be Low risk:

Years	0	1	2
PV (Rs. in crore)	(100)	$\frac{45}{1+0.12}$ = 40.18	$\frac{80}{(1+0.12)^2}$ = 63.78

NPV = 40.18 + 63.78 -100 = 3.96: Accept

If the project is judged to be Medium risk

Years	0	1	2
PV (Rs. in crore)	(100)	$\frac{45}{1+0.15}$ = 39.13	$\frac{80}{(1+0.15)^2}$ = 60.49

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

If the project is judged to be High risk

Years	0	1	2
PV (Rs. in crore)	(100)	$\frac{45}{1+0.18}$ = 38.14	$\frac{80}{(1+0.18)^2}$ = 57.45

NPV = 38.14 + 57.45 -100 = (4.41): Reject

PROBLEM NO: 11

i) The risk free rate of interest and risk factor is given. The risk adjusted discount rate (RADR) can be found on the basis of CAPM as follows:

Required Rate of Return = I_{RF} + (k_e-I_{RF}) Risk Factor

For Project 'X'	= 0.10 + (0.15 - 0.10) 1.80 = 19%

ii) Risk Adjusted NPV of the Project 'X':

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**

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	Discounted 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	Cash Flow (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

	Cash Flow (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	100	100	97.5	100	100	100

	Unit (A)						
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

Computation of CFAT:

Particulars	Amount (Rs.)
Selling Price Unit	100
Variable Cost per unit	30
A. Contribution per unit	70
B. Output	2,000 units
C. Total Contribution (A x B)	1,40,000
Less: Fixed Cost	1,00,000
PBDT/CFAT	**40,000**

Computation of NPV:

Years	Cash Flows	PVF/AF	P.V of Cash Flows
0	1,25,000	1	(1,25,000)
1-5	40,000	3.79	1,51,600
NPV			**26,600**

Sensitivity Analysis:

1. **Selling price unit**

Let 'a' be the C.P.U, at which NPV = '0'

Total cost (2,000 x a) = 2,000a

Less: Fixed Cost = (1,00,000)

PBDT/CFAT = 2,000a - 1,00,000

AF = 3.79

PV of Cash inflow

3.79 (2,000a - 1,00,000) = 1,25,000

7580a - 3,79,000 = 1,25,000 (To make NPV = 0)

7580a = 5,04,000

a = 66.49

Maximum change in Selling price unit (66.49+30) = 3.51 (96.49-100)

Maximum permissible change = 3.51%

2. Cost of Project:

Maximum permissible change in NPV with respect to investment = $\frac{26,600}{1,25,000} \times 100 = 21.28\%$

3. Discount rate

Maximum permissible change in NPV with respect to Discount rate

1,25,000 = [(100-30) 2,000 - 1,00,000] x AF (5, a%)

3.125 = AF (5, a%)

From tables AF for 5 years at 18% is 3.127 so 'a' is approximately 18%

i.e. An increase of 80% (18-10/10) before NPV is zero.

4. Fixed cost

Maximum permissible change in NPV with respect to fixed cost

1,25,000 = [(100-30) x 2,000 - F.C] x 3.791

F.C = 1,07,027

Permissible change in Fixed cost = (1,07,027 - 1,00,000/1,00,000) x 100 = 7.03%

5. Life of the Project

Maximum permissible change in NPV with respect to life

1,25,000 = [(100-30) x 2,000 - F.C] x AF (10%, n)

3.125 = AF (10%, n)

AF for four years at 10% is 3.17

Change in life is = 5-4/5 x 100 = 20%

PROBLEM NO: 17

Estimates	Project X				Project Y			
	Annual cash flows	PVAF @14%	PV of Cash flows	NPV	Annual Cash flows	PVAF @14%	PV of Cash flows	NPV
Pessimistic	26,000	4.639	1,20,614	**614**	12,000	4.639	55,668	**(64,332)**
Most likely	28,000	4.639	1,29,892	**9,892**	28,000	4.639	1,29,892	**9,892**
Optimistic	36,000	4.639	2,41,228	**47,004**	52,000	4.639	2,41,228	**1,21,228**

In pessimistic situation project X will be better as it gives low but positive NPV whereas Project Y yield highly negative NPV under this situation. In most likely situation both the project will give same result. However, in optimistic situation Project Y will be better as it will gives very high NPV. So, project X is a risk less project as it gives positive NPV in all the situation whereas Y is a risky project as it will result into negative NPV in pessimistic situation and highly positive NPV in optimistic situation. So acceptability of project will largely depend on the risk taking capacity (Risk seeking/ Risk aversion) of the management.

ASSIGNMENT PROBLEMS

MODEL 1: PROBABILITY & EXPECTED CASH FLOW

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?

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. (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 & 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 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

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: 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

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 6%. Risk premium is 4% (Low Risk), 6% (Medium Risk), 8% (High Risk) (the risk characterizing the project). Compute NPV using risk - adjusted discount rate at various risk levels. *(C) (RM) (ANS.: LOW RISK: RS.9,415; MEDIUM RISK: RS.5,330; HIGH RISK: RS.(2,195))*

PROBLEM 11: 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: N19(N) - 5M, MTP2 M18 (N) - 5M, MTP1 N18 (N))*

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

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: 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 15: 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)

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

Initial Investment	6,47,750
Selling price per Unit	Rs.50
Variable costs per unit	Rs.25
Fixed costs for the period	Rs.7,50,000
Sales volume	40,000 units
Life	5 years
Discount rate	10%
PVAF (10%, 5Y)	3.791
PVAF (10%, 4Y)	3.170
PVAF (17%, 5Y)	3.199

Required: Project's NPV and show how sensitive (Which makes NPV is zero) the results are to various input factors like SPU, Cost of Project, Discount Rate and Fixed Cost.

(ANS.: PROJECTS NPV: RS.1,50,000 AND SELLING PRICE FALL OF 1.98%, , INITIAL COST: 18.80%, DISCOUNT RATE: 70%, FIXED COST: 5.28%

MODEL 7: SCENARIO ANALYSIS

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)

ADDITIONAL PROBLEMS FOR SELF PRACTICE

PROBLEM 1: 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 2: 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:

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)

PROBLEM 3: 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 4: 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)

THE END