



# CAIIB PAPER-3

# Module-C Unit-5

## ADVANCED BUSINESS & FINANCIAL MANAGEMENT (ABFM)



## CAIIB Paper 3 Module B Unit 5: Adjustment Of Risk And Uncertainty In Capital Budgeting Decision

### Introduction

- Capital budgeting is required for project implementation which generally takes long time.
- Budgeting means estimating cost and revenue to be incurred and earned in the future period whether it is a project to be established or is a running enterprise.
- The word capital budgeting is for new projects generally.
- Cost = land, plant, labour, materials and engagement of working capital.
- Capital or cash has its own cost depending on time, volume, source including foreign sourcing.
- Revenue estimating exercise is also not simple where it is dependent on many factors including market behaviour and competition.
- Each element of cost and revenue, therefore, poses many questions and uncertainty.

### Sensitivity Analysis

- The uncertainty of future movements of certain variables can move either way, that puts all our present estimates and the project or investments to jeopardy.
- We need to safeguard against this.
- The variables and important components of capital budget are cost, revenue and net profits.
- Taking all possible variables into account will be a difficult task, making calculations complex.
- Sensitivity analysis aims to assess the impact of changes in each of these important variables on our projections or estimates.

**The steps that need to be taken in order to perform a sensitivity analysis are as follows:**

- ✓ Identifying the factors that have an impact on the NPV (or IRR) of the project.
- ✓ Developing a mathematical understanding of the connections between the different variables.
- ✓ Conducting an analysis to determine how the changes in each of the variables will affect the net present value (or internal rate of return) of the project.

	Particulars	NPV
<b>A</b>	<b>SP (I)</b>	<b>NPV (I)</b>
<b>B</b>	<b>VC (I)</b>	<b>NPV (D)</b>
<b>C</b>	<b>FC (I)</b>	<b>NPV (D)</b>
<b>D</b>	<b>Volume (I)</b>	<b>NPV (I)</b>
<b>E</b>	<b>Initial Investment (I)</b>	<b>NPV (D)</b>
<b>F</b>	<b>Life of Project (I)</b>	<b>NPV (I)</b>
<b>G</b>	<b>Cost of Capital (I)</b>	<b>NPV (D)</b>

**ILLUSTRATION 1**

A Ltd. is considering its new project with the following details:

Particulars	Figure
<b>Initial Capital Cost</b>	<b>400 cr</b>
<b>Annual Unit Sales</b>	<b>5 cr</b>
<b>SP per unit</b>	<b>100</b>
<b>VC per unit</b>	<b>50</b>
<b>FC per year</b>	<b>50 cr</b>
<b>Discount rat</b>	<b>6%</b>

Required:

1. Calculate the Net Present Value (NPV) of the project. Assume that the tax rate is zero.
2. Compute the impact on the project's NPV considering a 2.5 per cent adverse variance in each variable. Which variable shall have the maximum effect? Consider Life of the project as 3 years.

Particulars	Amount
SP per unit	100
Less: VC	50
Contribution	50
Units sold	5 cr
Total contribution	250 cr
Less : FC	50 cr
Net cash flow per year	200 cr

Year	Cash flow (in cr)	PV Factor	PV
0	400	1	(400)
1	200	0.943	188.60
2	200	0.890	178
3	200	0.840	168
<b>NPV</b>			<b>134.60</b>

Sensitivity Analysis considering 2.5% Adverse Variance in each variable The table that follows demonstrates how to determine the impact on the NPV of the project in terms of percentages by adjusting one variable at a time by 2.5% (in a negative direction) while maintaining the other variables in their original states. As a result, it is clear that the change in selling price has the greatest impact on the NPV, accounting for 24.82 percent of the total change.

	Particulars	Base	Initial cost capital (I) to Rs.410 cr	SP p.u (D) to Rs. 97.5	VC p.u. (I) to 51.25	FC per year (I) to 51.25 cr	Units sold p.a. (D) to 4.875 cr
<b>A</b>	SP p.u	100	100	97.5	100	100	100
<b>B</b>	VC p.u	50	50	50	51.25	50	50
<b>C</b>	Contribution p.u	50	50	47.5	48.75	50	50
<b>D</b>	No. of units sold p.a. (in cr)	5	5	5	5	5	4.875
<b>E</b>	Total Contribution	250	250	237.5	243.75	250	243.75
<b>F</b>	FC p.a	50	50	50	50	51.25	50
<b>G</b>	Net Cash Inflow (E-F)	200	200	187.5	193.75	198.75	193.75
<b>H</b>	PV of Net Cash Inflow p.a (G * 2.673) [1- 1/ (1+i) <sup>n</sup> / i]	534.60	534.60	501.19	517.89	531.26	517.89

	Particulars	Base	Initial cost capital (I) to Rs.410 cr	SP p.u (D) to Rs. 97.5	VC p.u. (I) to 51.25	FC per year (I) to 51.25 cr	Units sold p.a. (D) to 4.875 cr
<b>I</b>	<b>Initial Capital cost</b>	<b>400</b>	<b>410</b>	<b>400</b>	<b>400</b>	<b>400</b>	<b>400</b>
<b>J</b>	<b>NPV (H-I)</b>	<b>134.60</b>	<b>124.60</b>	<b>101.19</b>	<b>117.89</b>	<b>131.26</b>	<b>117.89</b>
<b>K</b>	<b>% Change in NPV</b>	<b>-</b>	<b>-7.43%</b>	<b>-24.82%</b>	<b>-12.41%</b>	<b>-2.48%</b>	<b>12.41%</b>

### Scenario Analysis

- This method is an extension of or a step forward compared to the sensitivity analysis where only one variable was changed at a time.
- In this method, one plans for say, three scenarios namely, normal or the expected, optimistic and the pessimistic scenario.
- In the normal scenario, all the variables show expected values and the best values are taken for the optimistic scenario.
- It is in the pessimistic scenario the worst values are placed.
- Thus, all the variables move in the same directions at the same time.
- To explain the analysis in figures, the following table is presented.

Example:

Particulars	Figure
<b>Cost of the Project</b>	<b>35,00,000</b>
<b>Annual Cash Inflows</b>	<b>12,00,000</b>
<b>Project Life (Years)</b>	<b>6</b>
<b>Discounting rate</b>	<b>10%</b>

Determine NPV under the following scenario

Best Case Scenario 1: All variable remain unchanged

Scenario 2: Most likely case scenario:

Initial Project cost (I) by 20%, life remain same, decrease in annual cash inflow by 10% & increase in cost of capital to 12%

Scenario 3 : Worst case

Initial Project cost (I) by 20%, life of the project (d) to 5 years, decrease in annual cash inflow by 20% & increase in cost of capital to 12%

Scenario 1	Rs
<b>Initial Project Cost</b>	<b>(35,00,000)</b>
<b>Life of the project</b>	<b>6 years</b>
<b>Annual Cash Inflow</b>	<b>12,00,000</b>
<b>PV @10%</b>	<b>4.355</b>
<b>PV of Cash inflows</b>	<b>52,26,000</b>
<b>NPV</b>	<b>17,26,000</b>
Scenario 3	Rs
<b>Initial Project Cost</b>	<b>(42,00,000)</b>
<b>Life of the project</b>	<b>6 years</b>
<b>Annual Cash Inflow</b>	<b>10.80,000</b>
<b>PV @12%</b>	<b>4.1114</b>
<b>PV of Cash inflows</b>	<b>44,40,312</b>
<b>NPV</b>	<b>2,40,312</b>

Initial Project cost (I) by 20%

$35,00,000 + 20\% = 42,00,000$

ACF (D) by 10% = 108000

Cost of Capital (I) to 12%

Scenario 3	Rs
<b>Initial Project Cost</b>	<b>(42,00,000)</b>
<b>Life of the project</b>	<b>5 years</b>
<b>Annual Cash Inflow</b>	<b>9,60,000</b>
<b>PV @12%</b>	<b>3.604</b>
<b>PV of Cash inflows</b>	<b>34,59,840</b>
<b>NPV</b>	<b>(7,40,160)</b>

Initial Project cost (I) by 20%

$35,00,000 + 20\% = 42,00,000$

ACF (D) by 20% = 9,60,000

Cost of Capital (I) to 12%

	Pessimistic Scenario	Expected Scenario	Optimistic Scenario
<b>Investment</b>	<b>48000</b>	<b>40000</b>	<b>36000</b>
<b>Sales</b>	<b>30000</b>	<b>36000</b>	<b>42000</b>
<b>Variable Cost</b>	<b>21000 (70%)</b>	<b>24000 (66.67%)</b>	<b>27300 (65%)</b>
<b>Fixed Costs</b>	<b>2600</b>	<b>2000</b>	<b>1600</b>
<b>Depreciation</b>	<b>4800</b>	<b>4000</b>	<b>3600</b>
<b>Pre- Tax Profit</b>	<b>1600</b>	<b>6000</b>	<b>9500</b>
<b>Tax</b>	<b>540</b>	<b>2000</b>	<b>3160</b>
<b>Profit after Tax</b>	<b>1060</b>	<b>4000</b>	<b>6340</b>
<b>Annual Cash flow from operation</b>	<b>5860</b>	<b>8000</b>	<b>9940</b>
<b>Net PV (Cash flow * PVIFA) 12%, 10 year</b>	<b>(14900)</b>	<b>5200</b>	<b>10080</b>

### ILLUSTRATION 3

XYZ Ltd. is considering a project "A" with an initial outlay of Rs. 14,00,000 and the possible three cash inflow attached with the project as follows:

Particulars	Year 1	Year 2	Year 3
<b>Worst Case</b>	<b>450</b>	<b>400</b>	<b>700</b>
<b>Most likely</b>	<b>550</b>	<b>450</b>	<b>800</b>
<b>Best Case</b>	<b>650</b>	<b>500</b>	<b>900</b>

Determine the net present value of each scenario based on the assumption that the cost of capital is 9%. If XYZ Ltd is sure about the most likely result in the first two years but uncertain about the cash flow in the third year, then analyse what the NPV will be assuming the worst case scenario in the third year.

Year	PVF @9%	Worst Case		Most Likely		Best Case	
		Cash Flow	PV	Cash Flow	PV	Cash Flow	PV
		'000	'000	'000	'000	'000	'000
<b>0</b>	<b>1</b>	<b>(1400)</b>	<b>(1400)</b>	<b>(14000)</b>	<b>(14000)</b>	<b>(1400)</b>	<b>(1400)</b>
<b>1</b>	<b>0.917</b>	<b>450</b>	<b>412.65</b>	<b>550</b>	<b>504.35</b>	<b>650</b>	<b>596.05</b>
<b>2</b>	<b>0.842</b>	<b>400</b>	<b>336.80</b>	<b>450</b>	<b>378.90</b>	<b>500</b>	<b>421</b>
<b>3</b>	<b>0.772</b>	<b>700</b>	<b>540.40</b>	<b>800</b>	<b>617.60</b>	<b>900</b>	<b>694.80</b>
<b>NPV</b>			<b>-110.15</b>		<b>100.85</b>		<b>311.85</b>

**Most likely result in the first two years but uncertain about the cash flow in the third year, then analyse what the NPV will be assuming the worst case scenario in the third year.**

$$\begin{aligned}
 &= 550000 * 1/1.09 + 450000 * (1/1.09)^2 + 700000 * (1/1.09)^3 \\
 &= 504587 + 378756 + 540528 = 1423871 \\
 &= (14,00,000) + 1423871 = 23871
 \end{aligned}$$

### **Hillier Model**

- An investor applies various techniques of analyzing the risk involved in any particular investment decision.
- Hillier's Model is one amongst many of these risk analysis techniques.
- This model is also based on NPV like earlier methods.
- Prof. Fredrick. S. Hillier of Stanford University suggested this model. Hillier's view was that the risk associated with the cash inflows is reflected in the standard deviation of the cash inflows.
- Lesser the deviation of cash flows from the mean value, the lesser would be the risk and vice versa.
- He argued that for risk analysis, value of standard deviation of net present value may be obtained through analytical deviation of the cash inflows.
- Two cases can be considered for such analysis viz. no correlation among cash flows and perfect correlation among cash flows.
- When cash flows for different years are perfectly correlated, the behaviour of cash flows in all years is alike.
- But, if they are not correlated, it implies that cash inflow in any particular year will be independent of the cash inflow in any other year during the life of the project.
- The formulae, though bit complicated, are presented below. Perfectly Correlated Cash

#### *Uncorrelated Cash Flows*

$$\overline{\text{NPV}} = \sum_{t=1}^n \frac{\overline{C}_t}{(1+i)^t} - I$$

$$\sigma(\text{NPV}) = \sum_{t=1}^n \left( \frac{\sigma_t^2}{(1+i)^{2t}} \right)^{1/2}$$

### *Perfectly Correlated Cash Flows*

$$\overline{\text{NPV}} = \sum_{t=1}^n \frac{\overline{C_t}}{(1+i)^t} - I$$

$$\sigma(\text{NPV}) = \sum_{t=1}^n \frac{\sigma_t}{(1+i)^t}$$

Where  $C_t$  = expected cash flow for year  $t$ ,

$\sigma$  = standard deviation of cash flow for year  $t$ ,  $i$  is the risk-free rate, and  $I$  is the initial investment.

### **Simulation Analysis**

- Simulation means not real, imitation or deception.
- It is a process of creating a similar but artificial situation.
- What we do here is that firstly, we conduct analysis by finding out sensitivity of certain criteria of merit such as NPV, IRR, or any such criterion, to variation in basic factors.
- Then as a next step, we do simulations to find out likelihood under various scenarios to enable us to take the best suited decision.

*The steps involved can be briefly stated as under:*

- ✓ Prepare model project report on expected lines.
- ✓ Calculate NPV. (it can be IRR too)
- ✓ Find out how the NPV is influenced by or related to the parameters and the exogenous variables.
- ✓ Parameters are input variables specified by the decision maker who is in charge of the project.
- ✓ Exogenous variables are those whose value is determined outside the model and imposed on the model.
- ✓ These are not in control of the decision maker. This may probably depend on random event.
- ✓ For example, if we use seeds, fertilisers and water and then depend on rains to give us say 100 tons of a crop; the seeds, fertilisers, water and yield are endogenous and the rainfall is the exogenous factor which is not influenced by other variables.
- ✓ Fix the values of the parameters and also estimate the probability of distributions of exogenous variables.
- ✓ Select a value at random from the probability distributions of each of the exogenous variables.

- ✓ Determine the NPV with relation to the randomly generated values of exogenous variables and the predetermined or specified parameter values.
- ✓ Simulate the above exercise to any number of times to generate large number of simulated NPV.
- ✓ Plot the frequency distribution of the NPV and then consider which simulation is most probable or suitable.
- Most of the simulations are done using computers because of computational tedium and the multiplicity.
- Manual calculations become lengthy and bit difficult.
- This tool is versatile. Its capacity to handle multi factor project is a great scoring point.
- It can deal with complex inter relationships among parameters and exogenous variables, which are otherwise difficult to deal with manually.
- Despite heavily relying on computer computations, it does not replace skilled judgement which is required in selecting variables and combinations.
- Although this is a powerful tool, the treatment of correlations between variables remains a major problem. If correlations are not handled properly, it can give misleading conclusions.

### **Decision Tree Analysis**

Like scenario analysis, another method to help in corporate decision making is Decision Tree method, which a graphical representation of possible outcomes (with their associated probability), attached to each decision.

**So, there are two elements in a decision tree:**

- Branch, which represents a decision (which is an alternative course of action) and
- Node, at the end of the branch, which represents the reward of the decision along with the probability attached to that reward.

**Example:** A finance manager has to select either project A or project B. The reward of project A (NPV) is Rs. 5 lakh and the probability attached to it is 40%. The reward of project B (NPV) is Rs. 4 lakh and the probability attached to it is 40%.

- It is graphically represented by a simple decision tree which has only two branches.
- First branch represents the decision to go for project A and the second branch represents the decision to go for project B.
- The nodes at the end of each branch represent the outcome (NPV) and the probability.
- This decision tree will further grow, i.e. there will be more branches emanating from node of first and/or second branch, if there are further uncertainties associated with each decision (represented by branch).

- For example, project A can be executed either by the company itself or it may be executed by a contractor on turnkey basis.
- The cost associated with each decision, and the probability of its completion in time, are different in both the cases.
- So, graphic representation will be through two more branches out of the node of first branch, one representing decision of internal execution and the other turnkey contract.
- The nodes at the end of each of these additional branches will show the probability and cost of each decision.
- As further uncertainties are taken into account, the decision tree will grow bigger and bigger.
- The management has to decide the factors to be taken into account depending upon the size and importance of the project.
- The above process of preparing the tree is called “Drawing (or delineating) the decision tree”.
- This is first of the two steps involved in the whole process of “Decision Tree Analysis”.
- The other step is “Evaluating the outcome”.
- This process of evaluation starts from the last branch of the tree till we come to the starting point of the tree.
- We have already learnt in Scenario Analysis, the way to evaluate a situation.
- For example, if the probability associated with NPV of Rs. 5 lakh is 40% and that associated with NPV of Rs. 4 lakh is 60%,
- the estimated NPV is:  $(5 * 0.4) + (4 * 0.6) = \text{Rs. } 4.4 \text{ lakh}$ .
- We can continue to move backward in the decision tree, calculating the estimated NPV at each node, selecting the decision of higher value and discarding the other, till we come to the starting point.

### **Corporate Risk Analysis**

- Every existing business firm has its own unique risk profile for its cash flows.
- When a new project/ investment is envisaged, which has its own risk profile, the combined risk profile of the firm is likely to undergo a change.
- Corporate Risk Analysis is the evaluation of this impact of the new project/investment on the combined risk profile of the firm.
- A corporate faces variety of risks like economic, competition, financial, reputation, operational, compliance, security etc.
- It is to be evaluated what type of corporate risk analysis one has to do while embarking up on a project and preparing capital budget.

- The project may have impact, good or bad, on the corporate.
- For example, in a portfolio of securities, when a new security is to be added, it may impact the overall profile of the portfolio due to a different standard deviation of its returns and the correlation of its returns with the returns on the other securities in the portfolio.
- Similarly, we may analyse what the risk connected with a project will mean in terms of corporate risk?
- A project is like a product in a bouquet of other projects carried out by the corporate.
- A project on a standalone basis or by itself may look risky or not so profitable.
- However, if you look in conjunction with the overall product or project profile of the corporate, it may be a complimentary one.
- Diversification, backward integration or a captive power plant cannot be viewed or reviewed independently.

### **Managing Risk**

- The cost
- Financial Leverage
- Pricing
- Sequential Investment
- Information Intelligence
- Strategic Alliance
- Insurance
- Supply chain management
- Shorter time to market
- Derivatives
- Contingency planning

### **Project Selection Under Risk**

- Evaluation using our judgemental capabilities
- How quickly we become risk free
- Risk adjusted discount rate
- Certainty Expectations

### **Risk Analysis In Practice**

We have several methods of risk analysis. These contain various ways and complicated mathematical formulae, some of which are quite complex. However, while applying any such method, what we keep common in our mind is certain features of compilation. We will now cover some of these in the paragraphs to follow.

- Revenue Estimation
- Cost Estimates
- Flexibility in investing
- Sensitivity Analysis

