STATISTICAL TECHNIQUES TO HANDLE RISK IN CAPITAL BUDGETING

OBJECTIVES

After studying this lesson, you should be able to :

- Explain the use of probability technique in handling risk
- Explain the concepts of standard deviation and coefficient of variation in measuring risk
- Explain the steps involved in constructing decision tree

STRUCTURE

12.1INTRODUCTION

In the previous lesson you have studied the meaning and sources of risk. In addition to this, conventional techniques to handle risk in capital expenditure projects are also explained. The purpose of this lesson is to explain the use of statistical techniques such as probability, standard deviation, coefficient of variation ad decision tree in handling risk in capital budgeting projects.

12.2 PROBABILITY ASSIGNMENT

The concept of probability is one of the statistical techniques to handle risk in capital budgeting projects. It may be described as a "measure of someones opinion about the likelihood that an event will occur". If an event is certain to occur, we say that it has a probability of occuring. If an event is certain not to occur, we say that its probability of occuring is zero. Thus, probability of all events to occur lies between 0 and 1.

A probability distribution may consist of number of estimates. But in simple form it may consist of a few estimates. One commonly used form are "high, low and best guess estimates, or - the optimistic, most likely and pessimistic" estimates. For example, the annual cash flows expected from a project could be:

Assumption	Annual Cash flows (Rs)
Best Guess	1,00,000
High Guess	85,000
Low Guess	40,000

It can be seen that this is an improvement over the single forecast. But this is not sufficient. The forecast should describe more accurately his degree of confidence in his forecasts, i.e., he should describe his feelings as to the probability of these estimates occuring. For example, he may assign the following probabilities to his estimates:

Assumption	Annual Cash Flow (Rs)	Probability
Best Guess	1,00,000	.20
High Guess	85,000	.60
Low Guess	40,000	.20

Once the probability assignments are given to the future cashflows the next step is to find out the expected net present value. The expected net present value can be found out by multiplying the monetary values of the cash flows by their probabilities and discount rate. Consider the above example (assume investment as 60,000).

Assumption	Annual Cash flow (Rs)	Probability	Expected cash flow
Best Guess	1,00,000	.20	20,000
High Guess	85,000	.60	51,000
Low Guess	40,000	.20	8,000

		Expected Cash Flow	79,000

ILLUSTRATION 1

X Co. ltd., has given the following possible cash inflows for two of their projects X and Y. Both projects will require an equal investment of Rs. 5,000/- you are required to suggest which project should be accepted 10% discount rate.

Possible event	Project : X		Project: Y	
	Cashflow	Probability (Rs)	Cashflow (Rs)	Probability
A	4,000	.10	12,000	.10
B	5,000	.20	10,000	.15
C	6,000	.40	8,000	.50
D	7,000	.20	6,000	.15
E	8,000	.10	4,000	.10

SOLUTION

Calculation of expected cashflows for project X and Y

Project : X Project : Y

	Cash Inflows (Rs)	Proba-bility	Expected Cashflow	Cash Flow	Proba-bility	Expected Cashflow
A	4,000	.10	400	12,000	.10	1,200
B	5,000	.20	1,000	10,000	.15	1,500
C	6,000	.40	2,400	8,000	.50	4,000
D	7,000	.20	1,400	6,000	.15	900
E	8,000	.10	800	4,000	.10	400
		Total	6,000		Total	8,000

The above calculations show that project Y has higher expected cash flow as compared to project X. If expected cashflows are discounted @ 10% the net present value for project X will be : Rs. (6,000 X . 909)- 5,000/- Rs. 454/-. The net present value of project Y will be (8,000 X .909) - 5,000 = Rs. 2272/-. From the calculations it can be seen that NPV of project Y is more than project X. It is advisable to accept project Y.

12.3 STANDERED DEVIATION

The probability assignment approach to risk analysis in capital budgeting does not provide the decision maker about the variability of cash flows and therefore, the risk. To overcome this limitation standard deviation technique is used. Standard deviation is an absolute measure of risk. It may be defined as the square root of squared deviations calculated from the mean. In case of capital budgeting this measure is used to compare the variability of possible cash flows of different projects from their respective mean. A project having larger standard deviation will be more risky as compared to a project having smaller standard deviation.

The following steps are involved in calculating standard deviation :

(1) Mean value of possible cash flows is computed

(2) Deviation between the mean value and the possible cash flows are found out

(3) Deviation are squared

(4) Squared deviations are multiplied by the assigned probabilities which give weighted squared deviation.

(5) The weighted squared deviations are totalled and their square root is found out. The resulting figure is the standerd deviation.

Standard deviation is calculated by using the following formula.

$$\sigma = \sqrt{\sum_{t=1}^{n} (R-\bar{R})^2 \quad pi}$$

Where : σ = Standard deviation

n = No. of years

r = Expected cash flows

$\bar{R}$ = Mean value of cash flows

P = Probability assignments

ILLUSTRATION : 2

Consider the data given in illustration 1 and calculate standard deviation .

SOLUTION :

Project : X

Events	Cash inflows (R)	$(R-\bar{R})$ R=6000	$(R-\bar{R})^2$	Pi	$(R-\bar{R})^2$ Pi
A	4000	2000	4000000	.10	400000
B	5000	1000	1000000	.20	200000
C	6000	0	0	.40	0
D	7000	1000	1000000	.20	200000
E	8000	2000	4000000	.10	400000
ER	30000				1200000

$$\bar{R} = \frac{\Sigma R}{N} = \frac{30000}{5} = 6000$$

$$x = \sqrt{(1200000)}$$

$$= \text{Rs } 1.095$$

Project : y

Events	Cash inflows (R)	$(R-\bar{R})$ R=6000	$(R-\bar{R})$	Pi	$(R-\bar{R})^2$ Pi
A	12000	4000	16000000	.10	1600000
B	10000	2000	4000000	.15	600000
C	8000	0	0	.50	0
D	6000	-2000	4000000	.15	600000
E	4000	-4000	16000000	.10	1600000
ER	40000				4400000

$$\bar{R} \quad \frac{\Sigma R}{N} = \frac{40000}{5} = 8000$$

$$Y = \sqrt{(4400000)}$$

$$= \text{Rs } 2.098$$

The standard deviation of project X is Rs. 1.095 where as for the project Y it is Rs. 2.098. Thus variability of cash flows is more in case of project Y as compared to project X. Hence, project Y is more risky.

: COEFFICIENT OF VARIATION

Coefficient of variation is a relative measure of risk. It is defined as the standard deviation of probability distribution devided by its expected value. It is calculated as follows

$$\text{Coefficient of variation} = \frac{\text{Standard Deviation}}{\text{Expected (mean) Value}}$$

Consider the above example and calculate the coefficient of variation.

Project X $\quad \frac{1095}{6000} = .1825$

Project Y $\quad \frac{2098}{8000} = .2623$

The coefficient of variation of project Y is more as compared to project X. Hence project Y is more risky. Whether project X or Project Y should be accepted will depend upon the investors attitude towards risk. He would prefer project Y if he is ready to bear more risk in order to get higher monetary value. In case he has great aversion to risk, he would accept project X as it is less risky.

12.5 DECISION TREE ANALYSIS :

Decision tree analysis is another technique of analysing the risk involved in capital budgeting proposals. Decision tree is a " Grapic display of relationship between present decision and possible future events, future decisions and their consequences. The sequence of event is mapped out over time in a format similar to the branches of tree ". In otherwords, it is a pictorial representation in tree form which indicates the magnitude, probability and interrelationship of all possible outcomes.

The following steps are taken for constructing a decision tree.

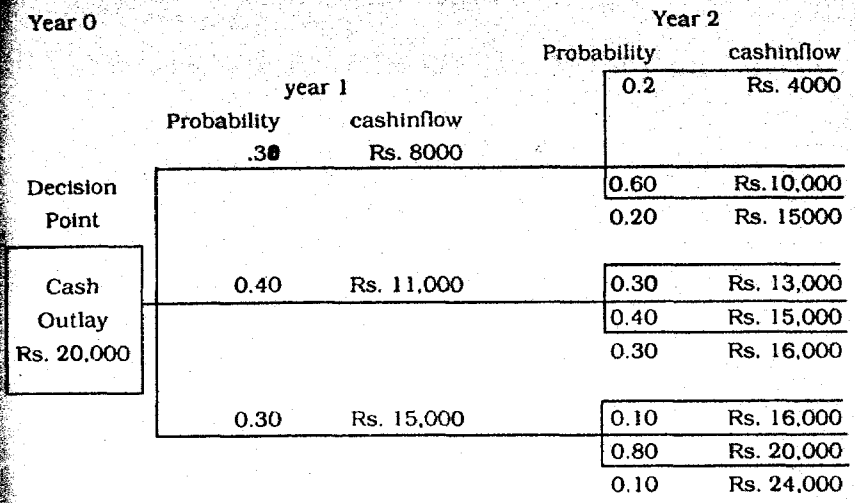
1. Defination of the proposal : The first stept in constructing decision tree is to define the proposal. For example, entering a new market or introducing new product line.

2. Identify decision alternatives : The decision alternatives should be clearly identified. For example, a firm may be considering the purchase of new plant for manufacturing a new product. It may have three alternatives (a) Purchase a small plant (b) Purchase a large plant (c) Purchase a medium size plant.

3. Draw a decision tree : The decision tree is than laid down showing decision points and decision branches.

4. Analysis of Data : The results should be analysed and the best alternative should be selected.

An illustrative decision tree can be presented as follows :



Decision Tree

The technique of decision tree analysis has the advantage of giving an overall view of all possibilities associated with the project. The management can take a decision keeping entire picture in mind. However, it has one big disadvantage. Its format may become unwidely and complex if the project has a long life with different probabilities of cash flows.

12.6 SUMMARY

In order to analyse the risk involved in capital budgeting statistical techniques also can be used. Statistical techniques include probability assignments standard deviation coefficient of variation and decision tree analysis

12.7 SELF EXAMINATION QUESTIONS :

(a) Explain the use of probability assignments in estimating the risk involved in capital investment proposals.

(b) "Standard deviation in an absolute measure of risk" explain

(c) What is coefficient of variation and how do you compute

(d) Define decision tree. What are the steps involved in constructing decision tree.

(e) Explain the statistical techniques to handle risk in capital budgeting projects.

12.8 GLOSSORY

Probability : It is someones openion about the likelihood that an event will occur.

Standard Deviation : It is the square root of squared deviations calculated from the mean

Coefficient of Variation : It is the product of standerd deviation of probability distrubution devided by its expected value (Mean)