Chapter 6: Risk Analysis

- 12 marks

- Risk is a condition where there is a possibility of deviation between desired and expected outcome.
- The term project risk means variability in project net PW.

Sources of risk:

i) Nature of business involved.
ii) Length of study period.
iii) Rate of interest.
iv) Type of physical plants and equipments used.
v) Cash flow estimate.
vi) Social risk & unclear specification.

Method of describing project risk

Imp: ⓐ Sensitivity Analysis

It reflects how much net PW will change in response to given change in and input parameter.

Steps for Sensitivity Graph Analysis:

a. Plot: PW/AW/FW/IRR/BCR along Y-axis
b. Plot % error in the estimate of parameter. % value is plotted in x-axis.
c. The slope of line shows the level of sensitivity.
d. The more the steep, more sensitive

Perform sensitivity analysis for the following project: over the range of ±30% in the parameter

Initial Investment

b) Annual Revenue
c) Life year.

Initial Cost = Rs. 5,00,000
Annual Revenue = Rs. 1,20,000
Salvage Value = Rs. 80,000
Life year = 6 year
MARR = 10%.

Solution,

Prime Equation

$$PW = -5,00,000 + 120000\left(\frac{P}{A}, i\%, n\right) + 80000\left(\frac{P}{F}, i\%, n\right)$$

$$= -5,00,000 + 1,20,000\left(\frac{1.1^6 - 1}{1.1^6 * 0.1}\right) + 80,000 * 1.1^{-6}$$

$$= 67789.19$$

ⓐ When the capital investment I varies with the increment of ±30%

At +10%

$$PW(10\%) = -500000(1+0.1) + 120000\left(\frac{P}{A}, i\%, n\right) + 80000\left(\frac{P}{F}, i\%, n\right)$$

$$= 17789.19$$

20% $PW(20\%) = -500000(1+0.2) + 120000\left(P/A, i\%, n\right) + 80000\left(P/F, i\%, n\right)$

$$= -32210.80$$

At 30%

$$PW(30\%) = -500000(1+0.3) + 120000\left(P/A, i\%, n\right) + 80000\left(P/F, i\%, n\right)$$

$$= -82210.80$$

PW(−10%) = 117789.19
PW(−20%) = 167789.19
PW(−30%) = 217789.19

When the annual revenue varies with the increment of ±30%

At +10%

PW (10%) = −500000 + 120000 (1+0.1) $\left(\frac{P}{A}, i\%, n\right)$ + 80000 $\left(\frac{P}{F}, i\%, n\right)$

= 120052.32

PW(20%) = −500000 + 120000 (1+0.2) $\left(\frac{P}{A}, i\%, n\right)$ + 80000 $\left(\frac{P}{F}, i\%, n\right)$

= 172315.455

PW(30%) = 224578.58
PW(−10%) = 15526.06
PW(−20%) = −36737.05
PW(−30%) = −89000.18

Useful life

At 10%, n = 6(1+0.1) = 6.6

PW (10%) = −500000 + 120000 $\left(\frac{P}{A}, i\%, n\right)$ + 80000 $\left(\frac{P}{F}, i\%, n\right)$

= 102928.55

At 20%, n = 6(1+0.2) = 7.2

PW(20%) = 136114.80

At 30%, n = 6(1+0.3) = 167456.512

∴ PW(30%) = 167456.512

PW(−10%) = 30581.78
PW(−20%) = −8815.38
PW(−30%) = −50531.19

Calculation Table: Present Worth

	−10%	−20%	−30%	0%	10%	20%	30%
Initial Investment	117789.19	167789.19	217789.19	67789.19	17789.19	-32210.80	-82210.80
Annual Revenue	11526.06	-36737.05	-89000.18	67789.19	120052.32	172315.455	224578
Useful Life	30581.78	-8815.38	-50531.19	67789.19	102928.5	136114.8	167456.512

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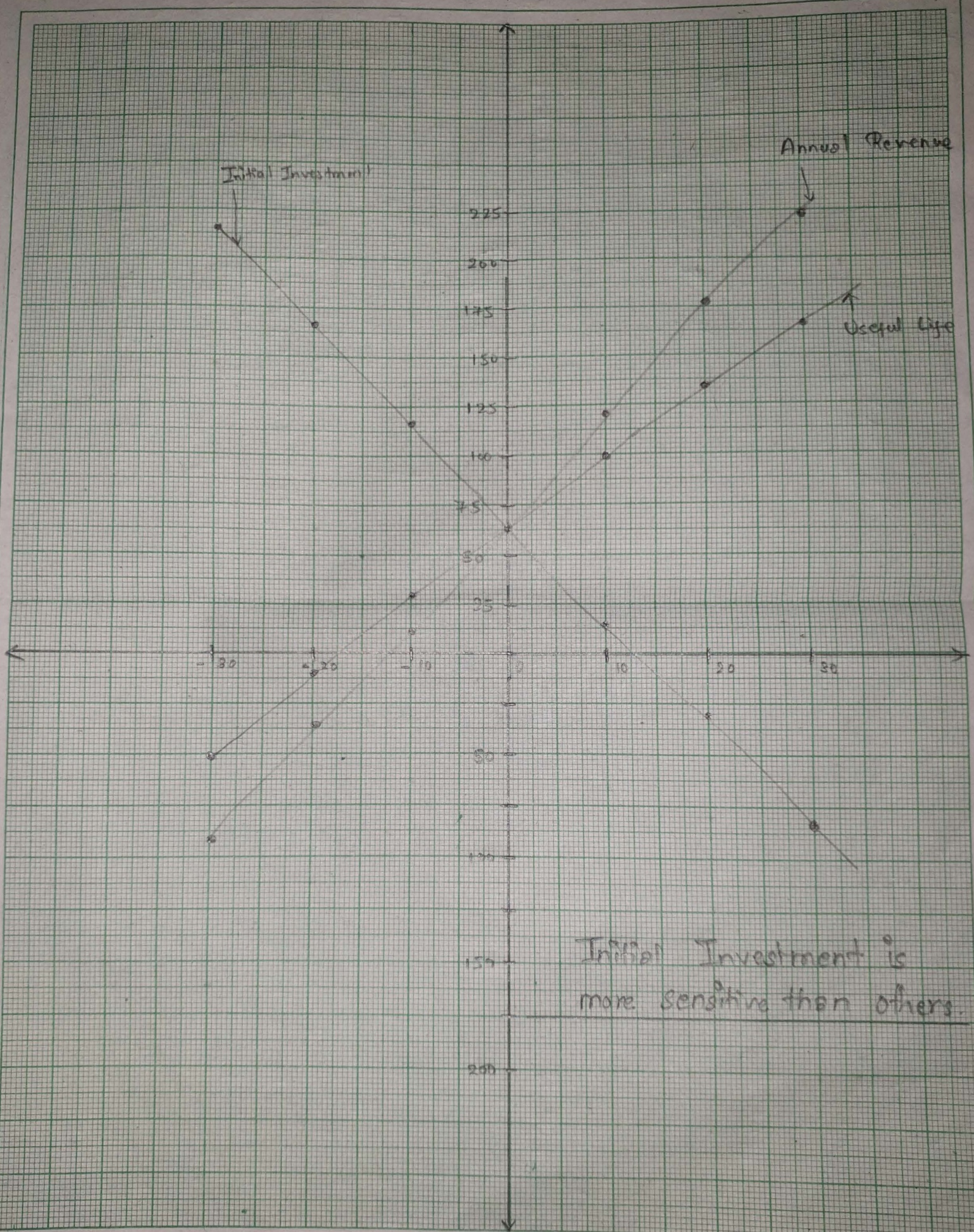
Sensitivity Graph Analysis



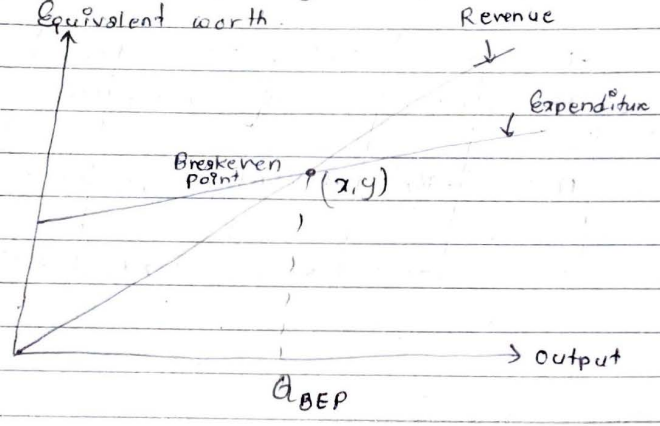
Initial Investment is more sensitive than others.

(b) Breakeven Analysis:

Breakeven point is the point at which revenue is exactly equal to cost.

The main objective of breakeven analysis is to find out the condition of no loss & no gain.

Let S be the selling price per unit, V be the variable cost per unit and F.C. is fixed cost, Q be the quantity of production.



At Breakeven point,

Total cost = Total sales

$F.C. + V.C. = S \times Q$; V.C. = Variable Cost

$F.C + V \times Q = S \times Q$

$Q(S - V) = F.C.$

$Q_{BEP} = \frac{F.C.}{S-V}$ units

Q. Calculate breakeven value volume of a cable manufacturing company from the following data

Total cost : Rs. 12,00,000

Variable cost : Rs. 4,00,000

Income from sales : Rs. 15,00,000 at the production of 5000 units.

Here,

Given, Total cost = 1200000

$F.C. + V.C. = 1200000$

$F.C. = 1200000 - 400000$

$= 800000$

~~F.C. =~~ $V.C. = 400000$

$V \times Q = 400000$

$V = \frac{400000}{Q} = 80$

$SQ = 1500000$

$\therefore S = \frac{1500000}{5000} = 300$

$\therefore Q_{BEP} = \frac{800000}{300 - 80}$

$\therefore$ Breakeven volume = 3636.36 units.

Q. Use of breakeven analysis for comparing two alternat

$EW_1 = f_1(y)$

EW_1 = Equivalent worth of alternative 1

$EW_2 = f_2(y)$ = E.W. of alternative & 2

y = Common factor on which both alternatives are dep ent.

At breakeven point
$EW_1 = EW_2$ and Solve for x.

Q. Suppose there are two alternatives electric motors that provides 100HP output.

Item	Motor A	Motor B
Purchase Cost	1,25,000	1,60,000
Efficiency	74%	92%
Maintaince cost	5000 per year	2500 per year
Life	10 years	10 years
Annual tax & insurance	1.5% of I	1.5% of I

MARR = 15%

a) How many hours per year would the motor have to be operated for full load for annual cost to be equal if the electricity cost is 5/Kwhr.

b) If annual operation is more than 55 hours which motor should be selected.

Solution:

For motor A,

$$A.W.A = -1,25,000\left(\frac{A}{P}, i\%, n\right) - 5000 - 1.5\% \text{ of } 125000$$

$$= -125000\left(\frac{1.15^{10} \times 0.15}{1.15^{10} - 1}\right) - 5000 - 1875$$

$$= -31781.50$$

For motor B,

$$A.W_B = -160000\left(\frac{A}{P}, i\%, n\right) - 2500 - 1.5\% \text{ of } 160000$$

$$= -36780.33$$

For motor A,

$$\eta = \frac{\text{Output}}{\text{Input}}$$

$$\text{Input}_A = \frac{\text{Output}}{\eta} = \frac{0.746 \times 100}{0.74} \text{ kW}$$

$$= 100.81 \text{ kW}$$

Operating cost = Input × rate × x hrs

$$= 100.81 \text{ kW} \times \frac{5}{\text{kWhr}} \times x \text{ hrs}$$

$$= 504.05x$$

Total annual cost A = $31781.57 + 504.05x$ --- (I)

For motor B,

$$\eta_B = \frac{\text{Output}}{\text{Input}}$$

$$\text{Input}_B = \frac{\text{Output}}{\eta_B} = \frac{100 \times 0.746 \text{ kW}}{0.92}$$

$$= 81.08$$

Operating cost: Input × rate × x hrs

$$= 81.08 \times 5 \times x$$

$$= 405.43x$$

Total annual cost B = $36780.33 + 405.43x$ --- (II)

At breakeven point, Equating (I) and (II)

Total annual cost A = Total annual cost B

$$31781.51 + 504.05x = 36780.33 + 405.43x$$

or $x = 50.69$

$= 51$ hrs.

(a) 51 hours per hours

1HP = 746 watt

(b) From equation (i),

Total annual cost A = 31781.57 + 504.05 x 55
= 59504.32

Total annual cost B = 36780.33 + 405.43 x 55
= 59077.33

Since, A.C. of B < A.C. of A. So, motor B is selected.

Q. If 20 watt CFL bulb price is Rs. 280 & 100 watt filament bulb price is Rs. 30 at market but their lighting power is equal. Which bulb do you prefer to use in your home when electricity cost is Rs. 12 per unit.

(c) Scenario analysis

A procedure of comparing base case to one or more additional scenario such as best and worst cases, to identify the extreme at most likely project outcome.

- Best scenario:
  High demand, high selling price, low variable cost & so on.
- Normal scenario:
  Average demand, Average selling price, average variable cost & so on.
- Worst scenario:
  Low demand, low selling price, high variable cost & so on.

Breakdown Analysis

Q. A company produces a product whose F.C. and T.C. are Rs. 40,000 & Rs. 85,000 respectively. The total sale is Rs. 1,05,000 and sale volume Q is 15,000 for this situation. Find

i. ~~BPE~~ & BEP in no. of units.

ii. What should be the output if profit desired is Rs. 50,00

Soln:

F.C. = 40,000

T.C. = 85,000

T.S. = 1,05,000

Q = 15000

Q_{BEP} = ?

We have,

$S = \frac{T.S.}{Q} = \frac{105000}{15000} = 7$

T.C. = F.C + V.C.

= FC + V x Q.

$\therefore V = \frac{TC - FC}{Q} = 3$

(a) $Q_{BEP} = \frac{F.C.}{S - V} = \frac{40000}{7-3}$

$= \frac{40000}{4} = 10000$

(b) Total sales - Total cost = Profit

S x Q - (F.C. + V x Q) = 50000

$Q = \frac{50000 + FC}{S - V}$

$= \frac{50000 + 40000}{7-3} = \frac{900000}{4} = 225000$

Decision tree & Sequential investment decision.

- A decision tree is a graphical device that shows a sequence of strategic decision and the expected consequences under ~~its~~ each possible set of circumstances.
- It is constructured from left to right and includes each possible decision & outcomes.

Component of decision tree:

a) Decision Node

b) Probability Node

c) Branch

Line connecting the nodes from left to right of a diagram

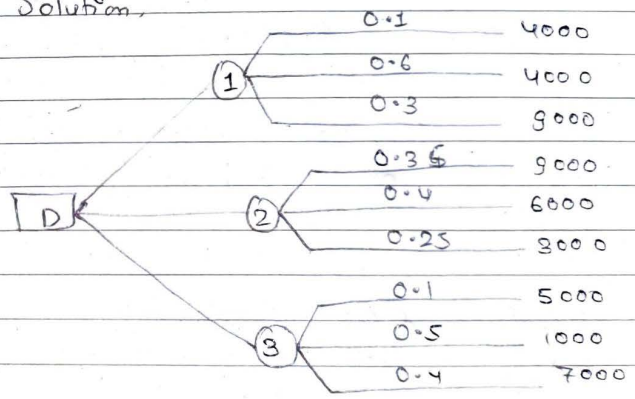
Probability tree ~~of nodes~~: approach

It is a graphical or tabular approach for organising the possible ~~case~~ of cash flow stream generated by an investment.

Q. A company establishing three sells branches each will have investment cost of Rs. 90,000 from the initial survey following data are obtained. Determine the best decision.

Sell Branch 1		Sell Branch 2		Sell Branch 3	
Probability	Income	Probability	Income	Probability	Income
0.1	4000	0.35	9000	0.1	5000
0.6	4000	0.4	6000	0.5	1000
0.3	9000	0.25	3000	0.4	7000

Solution,



Sell Branch 1

Probability	Income	Expected Return
0.1	4000	400
0.6	4000	2400
0.3	9000	2700
		5500

Sell Branch 2

Probability	Income	Expected Return
0.35	3000	3150
0.4	6000	2400
0.25	3000	750
		6300

Sell Branch 9

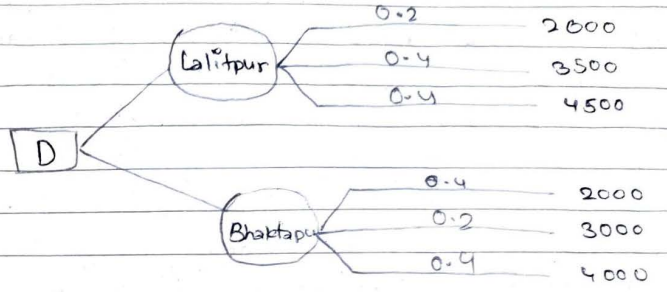
Probability	Income	Expected Return
0.1	5000	500
0.5	1000	500
0.4	7000	2800
		3800

Since, the expected return of sell branch 2 is highest: Sell branch 2 is selected. //

Q. A Kathmandu Business firm is considering the possibility of expanding its business to one of the two possible market area Lalitpur & Bhaktapur. A preliminary analysis produce the following data

Lalitpur		Bhaktapur	
Probability	Profit (000)	Probability	Profit (000)
0.2	2000	0.4	2000
0.4	3500	0.2	3000
0.4	4500	0.4	4000

The cost for advertising Lalitpur is Rs. 2,00,000 & for Bhaktapur is Rs. 1,50,000. Find out which market should be targeted by the firm.



Lalitpur

Probability	Profit (000)	Expected Return (000)
0.2	2000	400000
0.4	3500	1400000
0.4	4500	1800000
		3600000

Bha Total profit = Total Expected Return - Cost for adv.
= 3600000 - 200000
= 34,00,000

Bhaktapur

Probability	Profit	Expected Return
0.4	2000000	800000
0.2	3000000	600000
0.4	4000000	1600000
		30,00,000

Total profit = Total Expected Return - Cost
= 3000000 - 1,50,000 = 28,50,000

∴ Lalitpur is selected.