

Comparative Analysis of Alternatives Page: _____

Comparing mutually exclusive alternatives having same useful life

1. Equivalent Worth Method: (PW, FW, AW)

Step 1: calculate equivalent worth of each project at MARR

Step 2: Prefer project with the greatest equivalent worth
(greatest positive equivalent worth is selected)

or

(least negative equivalent worth is selected)

Eg: Consider the following mutually exclusive alternatives

	Option 1	Option 2	Option 3
Investment cost (Rs)	269000	319000	330000
Annual Net savings (Rs)	81500	88500	98300
Useful life (years)	5	5	5
Salvage value (Rs)	100000	120000	120000

Which option should be selected based on equivalent worth method.

Soln:-

since useful life of each alternative is 5 years, simply calculate the equivalent worth of each option.

using PW formulation

option 1:

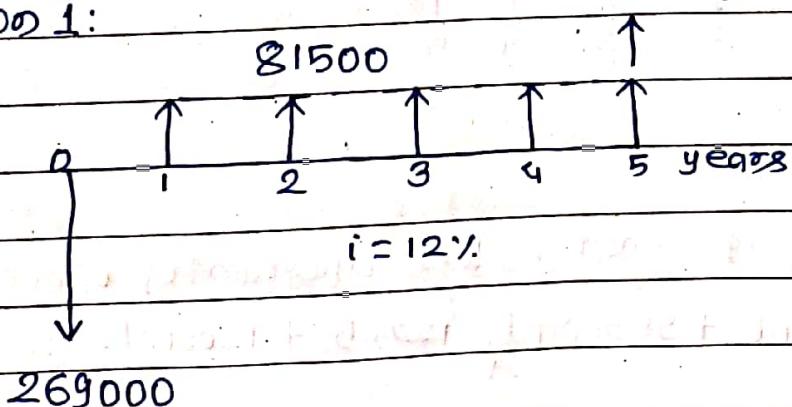


fig. cash flow diagram of option 1

$$\begin{aligned}
 PW(12\%)_1 &= -269000 + 81500 \left(\frac{P}{A}, 12\%, 5 \right) + 100000 \left(\frac{P}{F}, 12\%, 5 \right) \\
 &= -269000 + 81500 * 3.6048 + 100000 * 0.5674 \\
 &= Rs 81531.2
 \end{aligned}$$

Option 2:

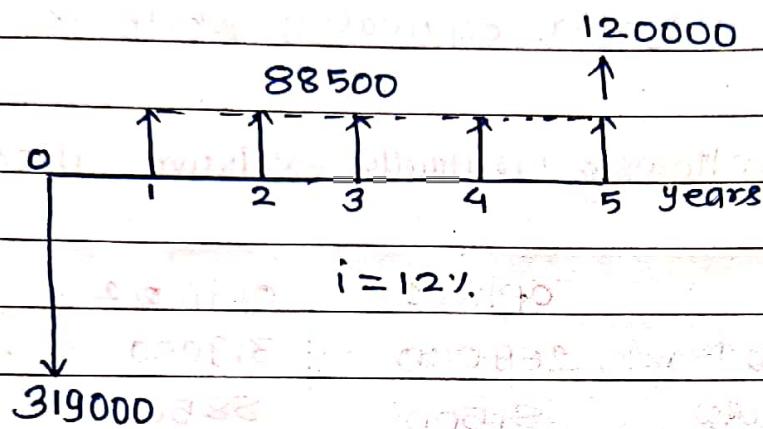


fig. cash flow diagram of option 2

$$\begin{aligned}
 PW(12\%)_2 &= -319000 + 88500 \left(\frac{P}{A}, 12\%, 5 \right) + 120000 \left(\frac{P}{F}, 12\%, 5 \right) \\
 &= -319000 + 88500 * 3.6048 + 120000 * 0.5674 \\
 &= Rs 68112.8
 \end{aligned}$$

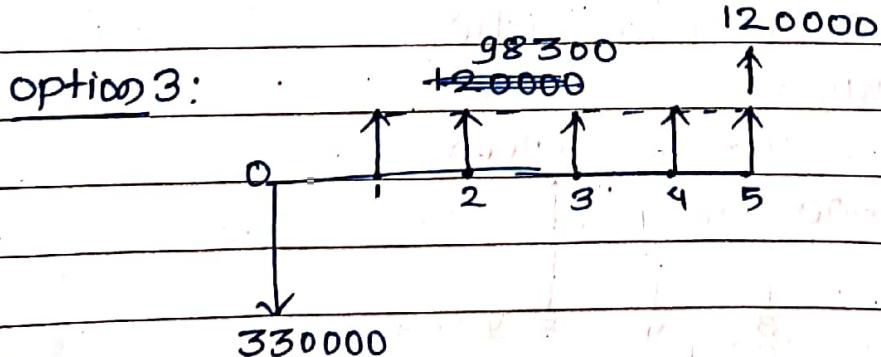


fig. cash flow diagram of option 3

$$\begin{aligned}
 PW(12\%)_3 &= -330000 + 98300 \left(\frac{P}{A}, 12\%, 5 \right) + 120000 \left(\frac{P}{F}, 12\%, 5 \right) \\
 &= -330000 + 98300 * 3.6048 + 120000 * 0.5674 \\
 &= Rs 92439.84
 \end{aligned}$$

Here, $PW(12\%)_3 > PW(12\%)_1 > PW(12\%)_2$

Hence Option 3 is most economical project.

Using FW Formulation:

$$\begin{aligned} FW(12\%)_1 &= -269000 \left(\frac{E}{P}, 12\%, 5\right) + 81500 \left(\frac{F}{A}, 12\%, 5\right) + 100000 \\ &= -269000 * 1.7623 + 81500 * 6.3528 + 100000 \\ &= Rs 143694.5 \end{aligned}$$

$$\begin{aligned} FW(12\%)_2 &= -319000 \left(\frac{E}{P}, 12\%, 5\right) + 88500 \left(\frac{E}{A}, 12\%, 5\right) + 120000 \\ &= -319000 * 1.7623 + 88500 * 6.3528 + 120000 \\ &= Rs 120049.1 \end{aligned}$$

$$\begin{aligned} FW(12\%)_3 &= -330000 \left(\frac{E}{P}, 12\%, 5\right) + 98300 \left(\frac{E}{A}, 12\%, 5\right) + 120000 \\ &= -330000 * 1.7623 + 98300 * 6.3528 + 120000 \\ &= Rs 162921.24 \end{aligned}$$

Here, $FW(12\%)_3 > FW(12\%)_1 > FW(12\%)_2$

Hence Option 3 is most economical project.

Using AW Formulation

$$\begin{aligned} AW(12\%)_1 &= -269000 \left(\frac{A}{P}, 12\%, 5\right) + 81500 + 100000 \left(\frac{A}{F}, 12\%, 5\right) \\ &= -269000 * 0.2779 + 81500 + 100000 * 0.1579 \\ &= Rs 22619.4 \end{aligned}$$

$$\begin{aligned}
 AW(12\%)_2 &= -319000 \left(\frac{A}{P}, 12\%, 5\right) + 88500 + 120000 \left(\frac{A}{F}, 12\%, 5\right) \\
 &= -319000 * 0.279 + 88500 + 120000 * 0.1579 \\
 &= R\$ 18897.4
 \end{aligned}$$

$$\begin{aligned}
 AW(12\%)_3 &= -330000 \left(\frac{A}{P}, 12\%, 5\right) + 98300 + 120000 \left(\frac{A}{F}, 12\%, 5\right) \\
 &= -330000 * 0.279 + 98300 + 120000 * 0.1579 \\
 &= R\$ 25646
 \end{aligned}$$

Here, $AW(12\%)_3 > AW(12\%)_1 > AW(12\%)_2$

Hence option 3 is most economical.

(2) Payback Period Method:

In payback period, the length of time required to recover the cost of an investment for two or more alternative projects are compared and one with least payback period is selected.

Eg: Automobiles company has two mutually exclusive project. Select the best project using payback period method. Study Period=5 years and MARR=15%.

Alternatives	A	B
Initial investment (Rs)	850000	400000
Net annual saving (Rs)	120000	110000

Take salvage value = 20% of initial investment.

SOL:- Using discounted Payback period method
For alternative A

Periods	Net cash flows	PW of Net cash flows at $i = 15\%$	Cumulative cash flows
0	-850000	-850000	-850000
1	120000	104347.83	-745652.17
2	120000	90737.24	-654944.22
3	120000	78901.95	-576012.27
4	120000	68610.39	-507401.88
5	120000 + 170000	144181.25	-363220.68

[At year 5, salvage value = 170000] = 20% of 850000

Here, the cumulative cash flows does not change in positive in 5 years. It indicates that the required payback period is more than 5 years.

For alternative B

Periods	Net cash flows	PW of Net cash flows at $i = 15\%$	Cumulative cash flows
0	-400000	-400000	-400000
1	110000	95652.17	-304347.83
2	110000	83175.80	-22172.03
3	110000	72326.79	-148845.24
4	110000	62892.86	-85952.38
5	110000 + 80000	94463.58	8511.20

At year 5, Salvage value = 20% of 400000 = 80000

Here, cumulative cash flows turns into positive in the year

5. By interpolation

$$\text{Payback period} = 4 + \frac{85952.38}{94463.58} = 4.91 \text{ years}$$

Hence we should choose project B as the best one which has payback period of 4.91 years.

[Payback period B < Payback period A]

So select B

(3) Rate of Return method and Benefit cost ratio method

The projects having highest value of IRR, ERR and BCR may not be the preferred alternative, they are just relative measure and can not be in way as equivalent worth (PW, FW, AW) method.

For this purpose we adopt incremental analysis.

(Steps) procedure for incremental analysis:-

1. Identify all the alternatives
2. compute the IRR / ERR / BCR of each alternative. Any alternative with $IRR < MARR$ / $ERR < MARR$ / $BCR < 1$ should be rejected.
3. order alternatives in increasing order of investment cost to ensure that the increments have cash flow corresponding to investments.
4. Establish a base alternative: Alternative having least capital investment is established as the base alternative and should have been pre qualified i.e $IRR > MARR$ / $ERR > MARR$ / $BCR > 1$
5. perform an incremental analysis between the base alternative and the alternative ~~with~~ with the next higher initial cost. If the incremental $IRR > MARR$ / $ERR > MARR$ / $BCR > 1$

reject the base alternative and accept the higher cost alternative and retain it as base alternative.

6. Select the next higher cost alternative and perform the incremental analysis until all the alternatives have been evaluated.

Decision Rule:

If $\text{IRR}, \text{ERR} \rightarrow$

if $\text{IRR}_{A-B} > \text{MARR} / \text{ERR}_{A-B} > \text{MARR} / \text{BCR}_{A-B} > 1$

Select 'A' and reject 'B'

if $\text{IRR}_{A-B} < \text{MARR} / \text{ERR}_{A-B} < \text{MARR} / \text{BCR}_{A-B} < 1$

Select 'B' and Reject 'A'

if $\text{IRR}_{A-B} = \text{MARR} / \text{ERR}_{A-B} = \text{MARR} / \text{BCR}_{A-B} = 1$

Select either one.

Eg: consider the following three set of mutually exclusive alternatives:

Alternatives

EOY	D1 (RS)	D2 (RS)	D3 (RS)
0	-2000	-1000	-3000
1	1500	800	1500
2	1000	500	2000
3	800	500	1000

which project would you select based on IRR, ERR and BCR methods on incremental investment assuming that $\text{MARR} = \epsilon = 15\%$?

SOP:

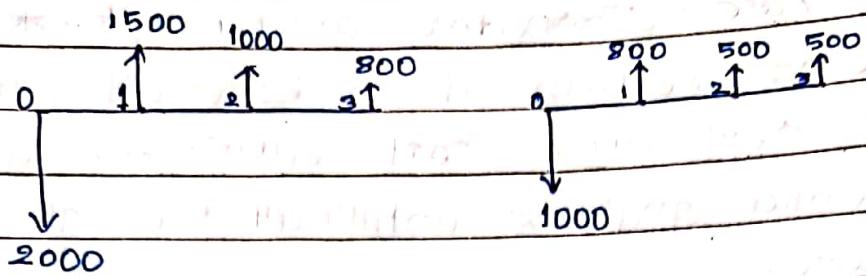


fig. CFD of D1

fig CFD of D2

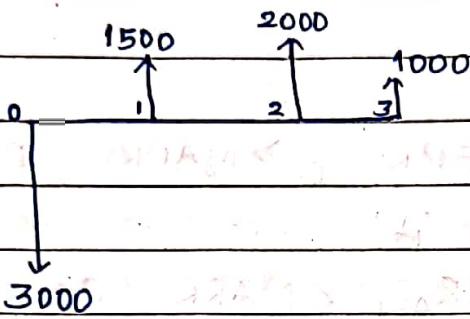


fig. CFD of D3

1 IRR method:

calculate the IRR of the each project

using PW formulation

IRR of D1

$$-2000 + 1500 \left(\frac{P}{F}, i^*, 1 \right) + 1000 \left(\frac{P}{F}, i^*, 2 \right) + 800 \left(\frac{P}{F}, i^*, 3 \right) = 0$$

$$\text{or, } -2000 + 1500 (1+i^*)^{-1} + 1000 (1+i^*)^{-2} + 800 (1+i^*)^{-3} = 0$$

$$i^* = 34.37\% > \text{MARR (15\%)} \text{ Justified}$$

IRR of D2

$$-1000 + 800 \left(\frac{P}{F}, i^*, 1 \right) + 500 \left(\frac{P}{F}, i^*, 2 \right) + 500 \left(\frac{P}{F}, i^*, 3 \right) = 0$$

$$\text{or, } -1000 + 800 (1+i^*)^{-1} + 500 (1+i^*)^{-2} + 500 (1+i^*)^{-3} = 0$$

$$i^* = 40.76\% > \text{MARR (15\%)} \text{ Justified}$$

IRR OF D₃:

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$$-3000 + \frac{1500}{F} (P_{\bar{F}}, i^!, 1) + \frac{2000}{F} (P_{\bar{F}}, i^!, 2) + \frac{1000}{F} (P_{\bar{F}}, i^!, 3) = 0$$

$$\text{or, } -3000 + 1500 (1+i^!)^{-1} + 2000 (1+i^!)^{-2} + 1000 (1+i^!)^{-3} = 0$$
$$i^! = 24.81\% > \text{MARR (15\%)} \text{ Justified}$$

Since we required to select any one of them, we perform incremental analysis.

Incremental analysis:

n	D ₂	D ₁ - D ₂	D ₃ - D ₁	
0	-1000	-1000	-1000	
1	800	700	800	
2	500	500	1000	
3	500	300	200	
Incremental IRR	40.76%	27.61%	8.8%	
Is incremental justified	Yes	No		
	Select D ₁	Select D ₁		
	Reject D ₂	Reject D ₃		

IRR OF D₁ - D₂:

$$-1000 + 700 (1+i^!)^{-1} + 500 (1+i^!)^{-2} + 300 (1+i^!)^{-3} = 0$$

$$i^! = 127.61\% > \text{MARR (15\%)} \text{ Justified}$$

IRR OF D₃ - D₁:

$$-1000 + 0 + 1000 (1+i^!)^{-2} + 200 (1+i^!)^{-3} = 0$$

$$i^! = 8.8\% < \text{MARR (15\%)} \text{ Not justified}$$

Decision: From incremental analysis, it is seen that D₁ is the best alternative.

2. ERR Method:

calculate the ERR of the each project

ERR of D1:

Step1: calculate all cash inflow to the

Step1: Discounting all cash outflow to the present value

1500 2000

Step2: compound all cash inflow to the Future value

$$1500 \left(\frac{F}{P}, 15\%, 2\right) + 1000 \left(\frac{F}{P}, 15\%, 1\right) + 800$$

$$= 3933.75$$

Step3: Making the equivalence of two equation

$$2000 (1+i^*)^3 = 3933.75$$

$$i^* = 25.29\% > \text{MARR}(15\%) \text{ Justified}$$

Similarly,

ERR of D2:

$$1000 (1+i^*)^3 = 800 \left(\frac{F}{P}, 15\%, 2\right) + 500 \left(\frac{F}{P}, 15\%, 1\right) + 500$$

$$\text{or, } 1000 (1+i^*)^3 = 2133$$

$$i^* = 28.72\% > \text{MARR}(15\%) \text{ Justified}$$

ERR of D3:

$$3000 (1+i^*)^3 = 1500 \left(\frac{F}{P}, 15\%, 2\right) + 200 \left(\frac{F}{P}, 15\%, 1\right) + 100$$

$$\text{or, } 3000 (1+i^*)^3 = 5283.75$$

$$\text{or, } 3000 (1+i^*)^3 = 20.76\% > \text{MARR}(15\%) \text{ Justified}$$

EOY	D ₂	D ₁ - D ₂	D ₃ - D ₁
0	-1000	-1000	-1000
1	800	700	0
2	500	500	1000
3	500	300	200
Incremental ERR	28.72%	21.66%	9.13%
Is incremental		Yes	No
Justified		Select D ₁ Reject D ₂	Select D ₁ Reject D ₃

ERR OF D₁-D₂:

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$$1000(1+i^*)^3 = 700(\frac{F}{P}, 15\%, 1) + 500(\frac{F}{P}, 15\%, 2) + 300(\frac{F}{P}, 15\%, 3)$$

$$i^* = 21.66\% > MARR (15\%) \text{ Justified}$$

ERR OF D₃-D₁:

$$1000(1+i^*)^3 = 0 + 1000(\frac{F}{P}, 15\%, 2) + 200(\frac{F}{P}, 15\%, 3)$$

$$i^* = 9.13\%$$

Decision: From incremental analysis it is seen that D₁ is the best alternative.

3. BCR Method:

Calculate the BCR of the each project using PW formulation

$$\text{BCR} = \frac{\text{PW (Benefits)}}{\text{PW (Costs)}}$$

BCR of D₁:

$$\text{PW (Benefits)} = 1500(\frac{P}{F}, 15\%, 1) + 1000(\frac{P}{F}, 15\%, 2) + 800(\frac{P}{F}, 15\%, 3) \\ = \text{Rs } 2586.5$$

$$\text{PW (Costs)} = \text{Rs } 2000$$

$$\text{BCR of D}_1 = \frac{2586.5}{2000} = 1.293 > 1 \text{ Justified}$$

BCR of D₂:

$$\text{PW (Benefits)} = 800(\frac{P}{F}, 15\%, 1) + 500(\frac{P}{F}, 15\%, 2) + 500(\frac{P}{F}, 15\%, 3) \\ = \text{Rs } 1402.48$$

$$\text{PW (Costs)} = \text{Rs } 1000$$

$$\text{BCR of D}_2 = \frac{1402.48}{1000} = 1.402 > 1 \text{ (Justified)}$$

BCR of D3:

$$\begin{aligned}
 PW(\text{Benefits}) &= 1500 \left(\frac{P}{F}, 15\%, 1 \right) + 2000 \left(\frac{P}{F}, 15\%, 2 \right) \\
 &\quad + 1000 \left(\frac{P}{F}, 15\%, 3 \right) \\
 &= \text{Rs } 3474.1
 \end{aligned}$$

$$PW(\text{Costs}) = \text{Rs } 3000$$

$$BCR \text{ of } D3 = \frac{3474.1}{3000} = 1.15 > 1 \text{ (Justified)}$$

Since we required to select any one of them,
we perform incremental analysis.

Incremental Analysis:

D	D ₂	D ₁ - D ₂	D ₃ - D ₁
0	-1000	-1000	-1000
1	800	700	0
2	500	500	1000
3	500	300	200
Incremental BCR		1.18	0.88
Is incremental Justified		Yes	No
		Select D ₁	Select D ₁
		Reject D ₂	Reject D ₃

Incremental BCR

BCR of D₁ - D₂:

$$\begin{aligned}
 PW(\text{Benefits}) &= 700 \left(\frac{P}{F}, 15\%, 1 \right) + 500 \left(\frac{P}{F}, 15\%, 2 \right) + 300 \left(\frac{P}{F}, 15\%, 3 \right) \\
 &= \text{Rs } 1184.02
 \end{aligned}$$

$$PW(\text{Costs}) = \text{Rs } 1000$$

$$BCR \text{ of } D_1 - D_2 = \frac{1184.02}{1000} = 1.18 > 1 \text{ Justified}$$

BCR of D₃-D₁:

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$$PWC(\text{Benefits}) = 0 + 1000 \left(\frac{P}{F, 15\%, 2} \right) + 200 \left(\frac{P}{F, 15\%, 3} \right)$$

$$= Rs 887.56$$

$$PWC(\text{Costs}) = Rs 1000$$

$$BCR \text{ of } D_3 - D_1 = \frac{887.56}{1000} = 0.88 < 1 \text{ (Not Justified)}$$

Decision: From incremental analysis it is seen that D₁ is the best alternative.

D₁ is the best alternative.

Comparing mutually exclusive alternatives having different useful life:

1. Repeatability Assumption Method:

- Two alternatives having different useful life are changed into projects having same useful life by expanding their life upto least common year.
- The study period is equal to the LCM of the life of alternatives.
- The economic consequences that are estimated to happen in an alternative's initial life span will also happen in all succeeding life spans.

e.g.: Make a selection from the following two mutually exclusive alternatives:

Alternative	A	B
Capital investment (Rs)	450000	600000
Annual Revenues (Rs)	22000	26000
Annual Expenses (Rs)	7450	11020
Useful life (Yrs)	6	8
Market value (Rs)	25000	28000
MARR	10% per year	

Using Repeatability assumption method.

SOLN:

Here useful life of alternative A and B is 6 and 8 years respectively

Study period = LCM of 6 and 8 years = 24 years
and both the project will be analyzed over this year.

Alternative A should be repeated $\frac{24}{6} = 4$ times

Alternative B should be repeated $\frac{24}{8} = 3$ times

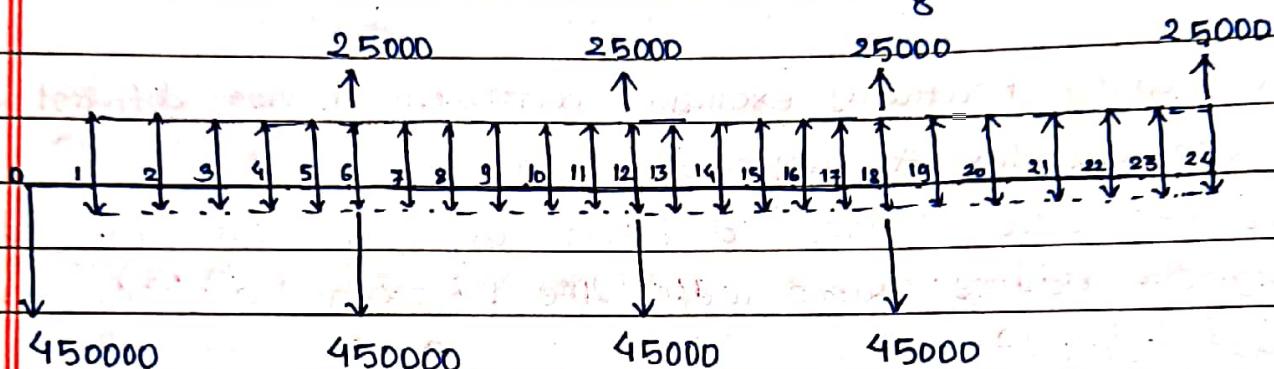


fig. CFD for alternative A

Using PW Formulation

$$\begin{aligned}
 PW(10\%) &= -450000 \left[1 + \left(\frac{P}{F}, 10\%, 6 \right) + \left(\frac{P}{F}, 10\%, 12 \right) + \left(\frac{P}{F}, 10\%, 18 \right) \right] \\
 &\quad + (22000 - 7450) \left(\frac{P}{A}, 10\%, 24 \right) + \\
 &\quad 25000 \left[\left(\frac{P}{F}, 10\%, 6 \right) + \left(\frac{P}{F}, 10\%, 12 \right) + \left(\frac{P}{F}, 10\%, 18 \right) + \left(\frac{P}{F}, 10\%, 24 \right) \right] \\
 &= -Rs 768510
 \end{aligned}$$

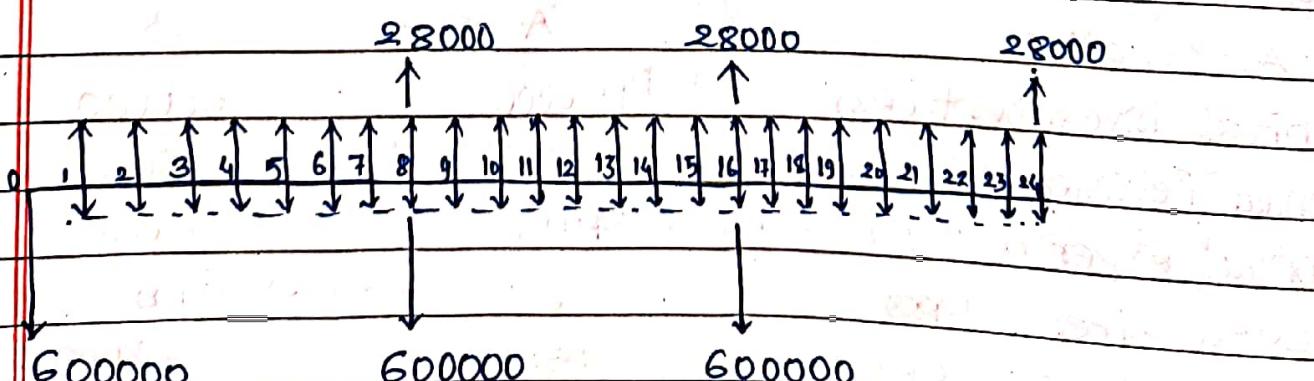


Fig. CFD for alternative B

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$$\begin{aligned}
 PW(10\%) &= -600000 \left[1 + \left(\frac{P}{F}, 10\%, 8 \right) + \left(\frac{P}{F}, 10\%, 16 \right) \right] + 26000 - 11020 \left(\frac{P}{A}, 10\%, 24 \right) \\
 &\quad + 28000 \left[\left(\frac{P}{F}, 10\%, 8 \right) + \left(\frac{P}{F}, 10\%, 16 \right) + \left(\frac{P}{F}, 10\%, 24 \right) \right] \\
 &= -Rs 85387.2
 \end{aligned}$$

Decision: Both alternatives have negative value, in which alternative 'A' has less negative. So, alternative A is recommended.

Eg: Use repeatability assumption to select the best project from the following projects.

Project	A	B	C
Initial investment (Rs)	100000	200000	250000
Annual expenditure (Rs)	25000	20000	15000
Useful life (yrs)	3	5	7
Salvage value (Rs)	40000	50000	60000
MARR	14% per year		

SOL:-

Study period = LCM of 3, 5 and 7 years = 105 years

Project A should be repeated $\frac{105}{3} = 35$ times

Project B should be repeated $\frac{105}{5} = 21$ times

Project C should be repeated $\frac{105}{7} = 15$ times

Study period is very large
For this case we have to use summation approach.

Using PW Formulation

for project A:

$$PW(14\%)_A = \sum_{x=0}^{34} -100000 * (1.14)^{-3x} - 25000 \left[\frac{(1.14)^{105} - 1}{0.14(1.14)^{105}} \right] + \sum_{x=1}^{35} 40000 (1.14)^{-3x}$$

Solve by using calculator

$$PW(14\%)_A = -Rs 403170.21$$

For project B:

$$PW(14\%)_B = \sum_{x=0}^{20} -200000 (1.14)^{-5x} - 20000 \left[\frac{(1.14)^{105} - 1}{0.14(1.14)^{105}} \right] + \sum_{x=1}^{21} 50000 (1.14)^{-5x} = -Rs 504946.13$$

For project C:

$$PW(14\%)_C = \sum_{x=0}^{14} -250000 (1.14)^{-7x} - 15000 \left[\frac{(1.14)^{105} - 1}{0.14(1.14)^{105}} \right] + \sum_{x=1}^{15} 60000 (1.14)^{-7x} = -Rs 483617.02$$

Decision: All projects have negative value, in which A has less negative. So project A is recommended.

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2. Co-terminated assumption method:

- The co-terminated assumption method uses a finite and identical study period for all alternatives.
- Used when repeatability assumption is not applicable.
 - This is the approach most frequently used in engineering practice.

case I. Useful life < study period

calculate the FW at the end of useful life and move

this to the end of the study period using the MARR.

case II. Useful life > study period

The alternative having useful life greater than the study period is replaced with an alternative having same useful life cashflow upto the end of study period.

The imputed market value of the alternative is then placed at the end of the study period to replace all cash flows after the study period.

Imputed market value calculation:

$$IMV \text{ or } MV_T = CR [P/A, i, N-T] + S(\frac{P}{F}, i, N-T)$$

where,

$$CR = I(A, i, N) - S(\frac{A}{F}, i, N)$$

Where T = study period

N = life of project

Case - I

Eg: From the following information select the best project using co-terminated assumption. useful life = Study period = 8 years.

Alternative	A	B
Investment (Rs)	450000	600000
Annual Revenue (Rs)	22000	26000
Annual cost (Rs)	7450	11020
Useful life (yrs)	6	8
Salvage value (Rs)	25000	28000
MARR	10% per year	

Soln:

Study period = 8 years

(Note: always take study period equal or greater than useful life of all alternatives, if not given in the question)

For project A:

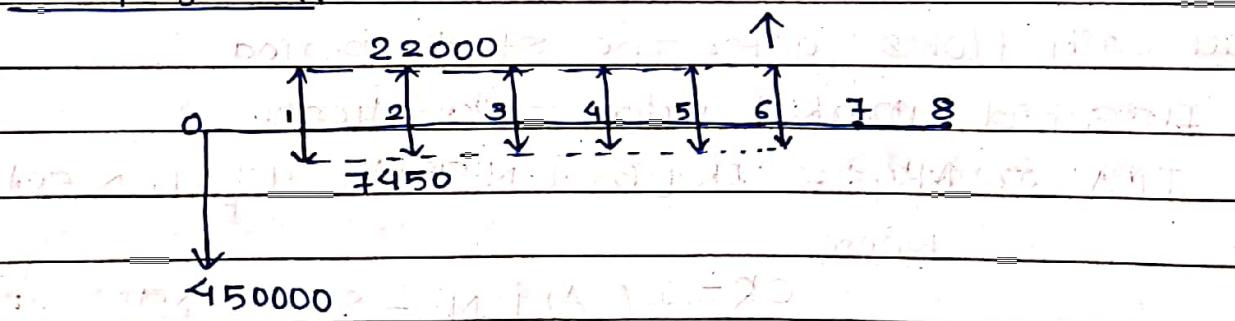


fig. CFD of project A

For project A, the cash flow accumulated at end of useful life is reinvested for extended periods.

$$\begin{aligned}
 FW(10\%)_A &= [-450000(E_{P,10\%,6}) + (22000 - 7450)(E_{A,10\%,6}) \\
 &\quad + 25000] * (F/P, 10\%, 2) \\
 &= -Rs 798549
 \end{aligned}$$

For Project B:

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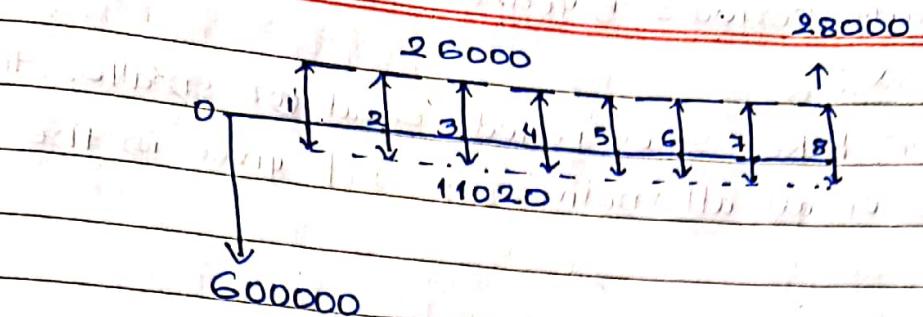


Fig. CFD of Project B

No adjustment is required for project B because study period is equal to useful life.

$$\begin{aligned}
 FV(10\%)_B &= -600000 \left(\frac{1}{F, 10\%, 8} \right) + (26000 - 11020) \left(\frac{F, 10\%, 8}{A} \right) \\
 &\quad + 28000 \\
 &= -Rs 1086850
 \end{aligned}$$

Decision: Both project have negative value. But least negative is of project A. So project A is selected.

Case II:

Eg: From the following information Select the best project using co-terminated assumption. ~~useful life = study period = 5 years~~

Items	X	Y	Z
Initial Investment (Rs)	50000	40000	30000
Annual Revenue (Rs)	20000	15000	14000
Annual Expenses (Rs)	15000	10000	8000
Useful life (yrs)	5	7	9
Salvage value (Rs)	1000	500	0

MARR: 10% per year

SOLN: Study period = 5 years

For project X:

(Note: always take study period equal to or smaller than useful life of all alternatives, if not given in the question).

For project X:

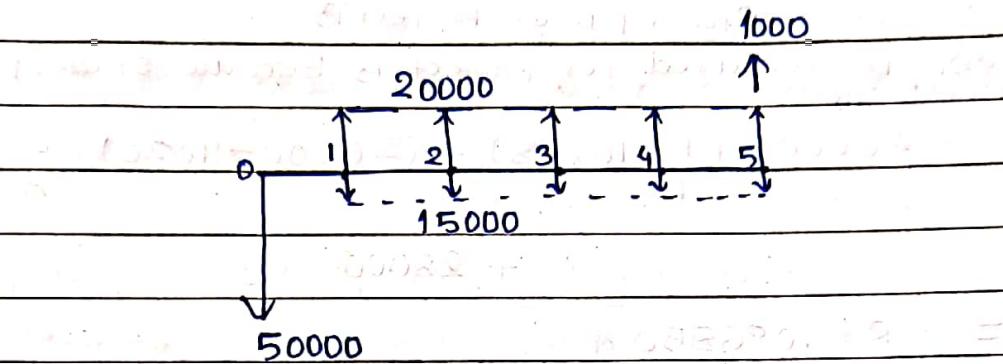


Fig. CFD of project X

Using FW formulation

$$\begin{aligned}
 FW(10\%)_X &= -50000 \left(\frac{P}{P} , 10\% , 5 \right) + (20000 - 15000) \left(\frac{E}{A} , 10\% , 5 \right) \\
 &\quad + 1000 \left(\frac{F}{P} , 10\% , 5 \right) \\
 &= -50000 * 1.6105 + 5000 * 6.1051 + 1000 \\
 &= -Rs 48999.5
 \end{aligned}$$

For project Y:

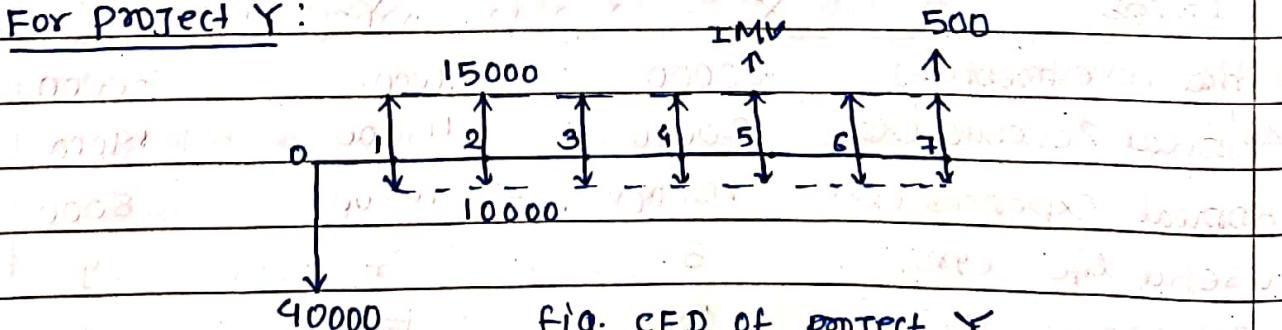


fig. CFD of project Y

By using imputed market value (IMV) technique

$$MV_{\frac{P}{F}} = CR \left(\frac{P}{A} , i , N-T \right) + S \left(\frac{P}{F} , i , N-T \right)$$

$$\text{Where } CR = I \left(\frac{A}{P} , i , N \right) - S \left(\frac{A}{F} , i , N \right)$$

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$$MV_5 = CR \left(\frac{P}{A}, 10\%, 7-5 \right) + 500 \left(\frac{P}{F}, 10\%, 7-5 \right)$$

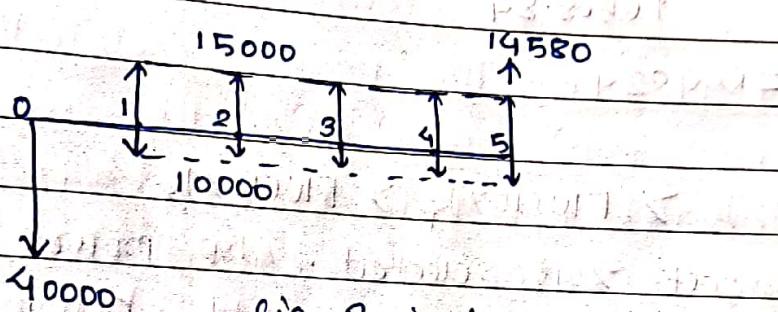
$$CR = \frac{40000 \left(\frac{A}{P}, 10\%, 7 \right)}{P} - 500 \left(\frac{A}{F}, 10\%, 7 \right)$$

$$= 40000 * 0.2054 - 500 * 0.1054$$

$$= \text{Rs } 8163.30$$

$$MV_5 = 8163.30 * 1.7355 + 500 * 0.8264$$

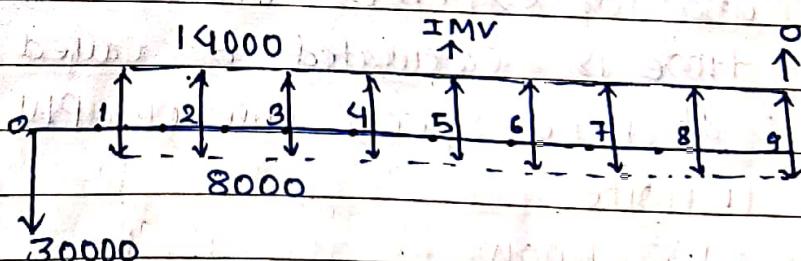
$$= 14580$$



$$FW(10\%)_Y = -40000 * \left(\frac{F}{P}, 10\%, 5 \right) + (15000 - 10000) \left(\frac{F}{A}, 10\%, 5 \right) + 14580$$

$$= \text{Rs } 19344.50$$

For project Z:



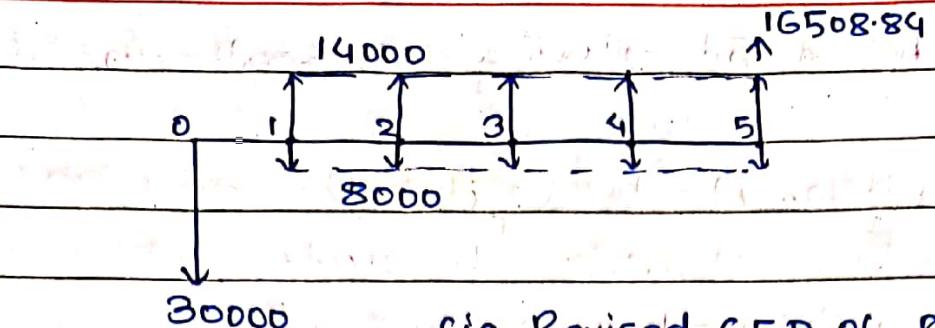
$$MV_5 = CR \left(\frac{P}{A}, 10\%, 9-5 \right) + S \left(\frac{P}{F}, 10\%, 9-5 \right)$$

$$\text{where } CR = 30000 \left(\frac{A}{P}, 10\%, 9 \right) - 0 = 30000 * 0.1736$$

$$= 5208$$

$$MV_5 = 5208 \left(\frac{P}{A}, 10\%, 4 \right) + 0$$

$$= 5208 * 3.1699 = 16508.84$$



$$\begin{aligned}
 FW(10\%)_Z &= -30000 \left(\frac{1}{P} \right) + 14000 \left(\frac{1}{F}, 10\%, 5 \right) - 8000 \left(\frac{E}{A}, 10\%, 5 \right) + \\
 &\quad 16508.84 \\
 &= \text{Rs } 4824
 \end{aligned}$$

Here,

$$FW(10\%)_Z > FW(10\%)_Y > FW(10\%)_X$$

Hence, project Z is selected. Also project X and Y has negative value so Z is most economical item.

(3) Capitalized worth method: (CW)

- The process in which present worth of all revenues and for expenses over an infinite length of time is calculated is called CW method.
- It is a special case of PW where life is infinite.
- We know,

$$PW(i\%) = A \left(\frac{1}{P}, i, \infty \right)$$

$$= A \left[\lim_{N \rightarrow \infty} \frac{(1+i)^N - 1}{i(1+i)^N} \right]$$

$$= A \left[\lim_{N \rightarrow \infty} \frac{1 - \frac{1}{(1+i)^N}}{\frac{i}{(1+i)^N}} \right]$$

$$\frac{1}{i}$$

$$\therefore CW(i\%) = \frac{AW(i\%)}{i}$$

$$CW(i\%) = \frac{AW(i\%)}{i\%}$$

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Eg: Assume infinite project life; recommend one of the following mutually exclusive projects.

	A	B
Initial investment (Rs)	50000	120000
Salvage value (Rs)	10000	10000
Annual cost (Rs)	9000	6000
Useful life (years)	10	25
MARR	15%	15%

SOLN:

Calculate the AW of the both alternatives

$$AW(15\%)_A = -50000 \left(\frac{A}{P}, 15\%, 10 \right) - 9000 + \frac{10000}{F} \\ = -Rs 18470.08$$

$$AW(15\%)_B = -120000 \left(\frac{A}{P}, 15\%, 10 \right) - 6000 + \frac{10000}{F} \\ = -Rs 24516.23$$

NOW,

$$CW(15\%)_A = \frac{AW(i\%)}{i\%}$$

$$CW(15\%)_A = \frac{-18470.08}{0.15} = -Rs 123133.87$$

$$CW(15\%)_B = \frac{-24516.23}{0.15} = -Rs 163446.2$$

Both have negative value. But least negative value is of project A. So project A is recommended.

Comparing mutually exclusive, contingent and independent projects in combination.

(a) Independent project: A project is said to be independent if its selection is free from the accept-reject decision of any other projects in the group.

Eg: The purchase of a machine, office furniture and truck constitutes three independent projects.

(b) Dependent project: The projects related to one another in such a way that the acceptance or rejection of one project influences the acceptance of other are called dependent projects.

The two types of dependencies are as follows:

(i) Contingent projects: Two or more projects are said to be contingent if the acceptance of one requires the acceptance of another.

Eg: The purchase of a computer printer is dependent upon the purchase of a computer, but computer may be purchase without considering the purchase of the printer.

(ii) Mutually exclusive projects: When there are several alternatives to achieve the same objectives and we can choose only one of them then the alternatives are called mutually exclusive projects.

Formation of combination of projects: Suppose we have two independent project A and B. We can make the combination as follows:

Mutually exclusive combination

	Explanation	Project Intensity
1	Do nothing	A=0, B=0
2	Accept A	A=1, B=0
3	Accept B	A=0, B=1
4	Accept A, Accept B	A=1, B=1

(2) Mutually exclusive projects: Suppose we have three mutually exclusive projects A, B & C. We can make the combination as follows:

Mutually exclusive combination

	Explanation	Project Intensity
1	Do nothing	A=0, B=0, C=0
2	Accept A	A=1, B=0, C=0
3	Accept B	A=0, B=1, C=0
4	Accept C	A=0, B=0, C=1

(3) Contingent projects: Suppose we have three projects A, B & C where the project C is contingent on the acceptance of B and acceptance of B is contingent on acceptance of A. We can make the combination as follows:

Mutually exclusive combination

	Explanation	Project		
		A	B	C
1	Do nothing	0	0	0
2	Accept A	1	0	0
3	Accept B	1	1	0
4	Accept	1	1	1

Eg. Engineering projects A, B₁, B₂, C are being considered with cash flows estimated over ten years as shown in table below. The capital investment budget limit is Rs 100000, and the MARR is 12% per year.

- (a) List all possible alternatives
- (b) Develop the net cash flows for all feasible alternatives.
- (c) Which investment alternative (combination of projects) should be selected? Use the PW method.

	A	B ₁	B ₂	C
Capital investment (Rs)	30000	22000	70000	82000
Annual Revenues (Rs)	8000	6000	14000	18000
Market value (Rs)	3000	2000	5000	7000
B ₁ and B ₂	Mutually Exclusive			
C		Dependent on acceptance of B ₂		
A			Dependent on acceptance of B ₁	

SOL:

- (a) List of all possible alternative as follows:

Mutually Exclusive project

Combination	A	B ₁	B ₂	C
1	0	0	0	0
2	0	1	0	0
3	0	0	1	0
4	0	0	1	1
5	1	1	1	0

- (b) Present worth of each project:

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$$PW(12\%)_A = -30000 + 8000(P_A, 12\%, 10) + 3000(P_F, 12\%, 10)$$

$$= \text{Rs } 16168$$

$$PW(12\%)_{B1} = -22000 + 6000(P_A, 12\%, 10) + 2000(P_F, 12\%, 10)$$

$$= \text{Rs } 12545$$

$$PW(12\%)_{B2} = -70000 + 14000(P_A, 12\%, 10) + 5000(P_F, 12\%, 10)$$

$$= \text{Rs } 10713$$

$$PW(12\%)_C = -82000 + 18000(P_A, 12\%, 10) + 7000(P_F, 12\%, 10)$$

Combined projects cash flow = $\text{Rs } 21958$

Mutually Exclusive Combination	PW(12%)	Invested Capital
1	0	0
2 (B1)	12545	22000
3 (B2)	10713	70000
4 (B2 & C)	32671	152000
5 (A & B1)	28713	52000

c)

Decision: As our capital investment budget limit is to Rs 100000, the mutually exclusive combination (4) is excluded from the list. Out of the remaining combinations, the combination (5) has the highest PW(12%). The combination (5) (Project A & B1) is selected.

Origin/Sources of Project Risks:

1. cash flow estimate:- Inaccuracy of the cash flow estimates and measurements error.
2. Nature of business:- All business are not same nature because some types of business operation are less stable than others.
Eg: Mining enterprise / projects are more risky than Farming projects with the expectation of stability and income generation.
3. Rate of interest / Rate of inflation:- It depends on current health of economy and further expectation of economic condition.
4. Study period:- Long study period generally increases the uncertainty of a capital investment and economic return.
5. Unclear specification
6. Volatile & unpredictable future
7. Social risks
8. Variability in o/p .

- # Methods of describing project risk
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- There are three methods for describing project risk:
1. Break-even analysis
 2. Sensitivity analysis
 3. Scenario analysis
1. Break-even analysis:- one of the most common tools used in evaluating the economic feasibility of a new enterprise or product is the break even analysis.
- The main objective of break even analysis is to find out the condition of no loss and no gain.
 - The break even point is the point at which revenue is exactly equal to costs.
- Break even analysis for a single project

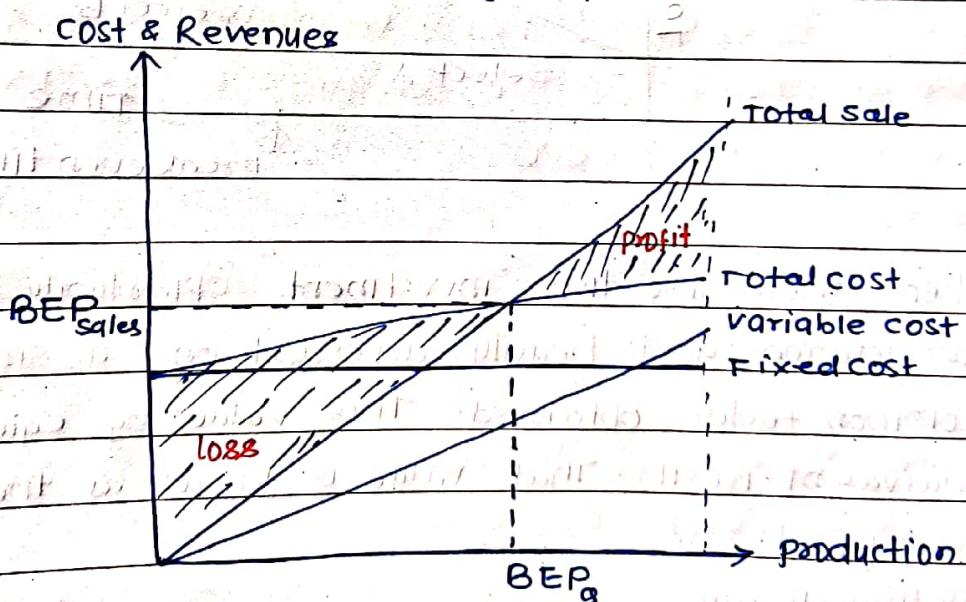


Fig. Break even analysis

Let, s be the selling price per unit
 v be the variable cost per unit

FC is the fixed cost per period

Q is the quantity of production

$$\text{total sales} = s * Q \quad \dots \text{(1)}$$

$$\text{total cost} = \text{variable cost} + \text{Fixed cost}$$

$$= v * Q + FC \quad \dots \text{(2)}$$

At intersection point

$$\text{total cost} = \text{total sales}$$

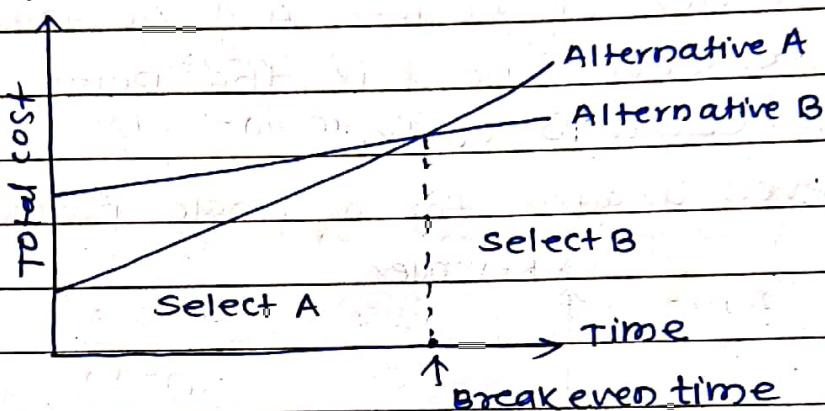
$$V * Q + FC = S * Q$$

$$\text{or, } FC = (S - V)Q$$

$$\text{or, } Q = \frac{FC}{(S - V)}$$

$$\therefore Q_{BEP} = \frac{FC}{(S - V)} \text{ (units)}$$

Break even analysis for comparing two alternatives



When there are two investment opportunity under consideration and heavily dependent on a single and common factor obtained. This value by equating equivalent worth. That value is known as the break-even point.

Mathematically,

$$EW_A = f_1(y) \text{ and } EW_B = f_2(y)$$

where, EW_A = Equivalent worth calculation for the net cash flow of alternative A

EW_B = Equivalent worth calculation for the net cash flow of alternative B.

y = A common factor affecting the equivalent worth values of alternative A and alternative B.

$$\text{At break even point, } EW_A = EW_B \\ \Rightarrow f_1(y) = f_2(y)$$

(2) Sensitivity analysis: or what if analysis:

- Sensitivity analysis is a general non-probabilistic methodology readily available, to provide information about potential impact of uncertainty in selected factor estimates.
- Its routine use is fundamental to developing economic information useful in the decision process.
- In general, sensitivity means the relative magnitude of change in the measure of merit.
- Steps for sensitivity analysis:
 - I. Base case situation:- which is developed using the most likely values for each input.
 - II. Change the specific variable:- by several specified percentage above and below the most likely value, while holding other variables constant.
 - III. Calculate a new IEW/ROR for each of these values.
 - IV. Plot the sensitivity graph.
 - V. The slope of line shows level of sensitivity.
 - VI. The steeper the slope, more sensitive.

(3) Scenario analysis:-

- Scenario analysis is the process of calculating the value of a specific comprehensive approach to deal with uncertainty than sensitivity analysis and break even analysis investments under a variety of scenarios i.e., future possibilities.
- A more comprehensive approach to deal with uncertainty than sensitivity analysis and break even analysis is scenario analysis.
- It examines several possible situations, usually worst case, most likely case and best case.
-

Scenario	PW/FW/AW	NPV	IRR	Payback
Worse case	+ve	-ve	-ve	-ve
Most likely case	+ve	+ve	-ve	-ve
Best case	+ve	+ve	+ve	-ve
Risk position	Risk free	LOW RISK	HIGH RISK	No invest

Eg: A company produces an electronic timing switch that is used in consumer and commercial products made by several other manufacturing firms.

The fixed cost and the total costs are Rs 40000 and Rs 85000 respectively. The total sales are Rs 105000 and sales volume is 15000 for this situation,

- (i) Find breakeven point in terms of number of units
- (ii) What should be the output if the profit desired is Rs 50000?

SOLN:-

$$\text{Fixed cost (FC)} = \text{Rs } 40000$$

$$\text{Total cost (TC)} = \text{Rs } 85000$$

$$\text{Total Sales} = \text{Rs } 105000$$

$$\text{Sales volume} = 15000$$

$$\text{Break even point (Q_BEP)} = ?$$

$$(a) \text{ Total cost} = \text{Fixed cost} + \text{variable cost}$$

$$85000 = 40000 + \text{variable cost}$$

$$\text{variable cost} = 45000$$

$$\text{variable cost per unit (v)} = \frac{45000}{1500} = \text{Rs } 3 \text{ per unit}$$

$$\text{Selling cost per unit (s)} = \frac{10500}{1500} = \text{Rs } 7 \text{ per unit}$$

$$Q_{BEP} = \frac{FC}{s-v} = \frac{40000}{7-3} = 10,000 \text{ units Ans}$$

(b) If the profit desired is Rs 50000

$$\text{Profit} = \text{Total sales} - \text{Total cost}$$

$$50000 = S_Q - (FC + VC)$$

$$= 7Q - (40000 + VQ)$$

$$90000 = 7Q - 3Q$$

$$\therefore Q = 22500 \text{ (units)}$$

Eg: A 40-kW generator has the following information:

Purchase cost (Rs)	300000
Annual maintenance cost (Rs)	8000
Annual energy generated at fullload	12000 kWh
Value of energy generated	Rs 3/kWh
Salvage value (Rs)	6000
MARR (per year)	8% per year

How long will it take before it becomes profitable?

SOL:

For Break-even point

$$\text{EW of Cost} = \text{EW of Revenue}$$

Using PW formulation

$$PW(8\%)_{\text{cost}} = 300000 + 8000 \left(\frac{P}{A}, 8\%, N \right)$$

$$PW(8\%)_{\text{Revenue}} = 6000 \left(\frac{P}{F}, 8\%, N \right) + 12000 \times 3 \left(\frac{P}{A}, 8\%, N \right)$$

$$\therefore 300000 + 8000 \left(\frac{P}{A}, 8\%, N \right) = 6000 \left(\frac{P}{F}, 8\%, N \right) + 36000 \left(\frac{P}{A}, 8\%, N \right)$$

$$\text{or, } 300000 = 6000 \left(\frac{P}{F}, 8\%, N \right) + (36000 - 8000) \left(\frac{P}{A}, 8\%, N \right)$$

$$\text{or, } 300000 = \frac{6000}{(1.08)^N} + 28000 \left[\frac{(1.08)^N - 1}{0.08(1.08)^N} \right]$$

$$\text{or, } 300000 \times 0.08 \times (1.08)^N = 6000 \times 0.08 + 28000 (1.08)^N - 28000$$

$$\text{or, } (1.08)^N = 5.8$$

Taking log both sides

$$N \log 1.08 = \log 5.8$$

$$N = \frac{\log 5.8}{\log 1.08}$$

$$= 22.84 \text{ years Ans.}$$

Eg: calculate breakeven hours of operation per year to become cost equal and recommend economic pump if it is to be operated 5 hours daily at full load.

	KHASA Pump	SARVO Pump
capacity	100 hp	100 hp
Purchase cost (Rs)	500000	1000000
Tax per year (Rs)	10000	15000
Maintenance cost per year (Rs)	36500	29200
Efficiency	80%	90%
Life (year)	5	5
Salvage value	20% of purchase cost	
MARR	12% per year	
Electricity cost	Rs 10/Kwh	

SOL)

For KHASA pump:

calculating annual equivalent cost

$$1. \text{ Capital Recovery (CR)} = I(A_p, i, N) - S(A_F, i, N)$$

$$\text{Salvage cost} = \text{value (S)} = 20\% \text{ of } 500000 \\ = 100000$$

$$\therefore CR = 500000(A_p, 20\%, 5) - 100000(A_F, 20\%, 5) \\ = Rs. 122960$$

2. TAX = Rs 10000 Per year

3. Maintenance cost = Rs 36500

4. operating expenses

Let x be the number of hours of operation per year

Operating expenses = Input * rate * Hours of operation
we have

$$\text{efficiency}(\eta) = \frac{i/p}{o/p}$$

$$i/p = \frac{o/p}{\eta} = \frac{100}{0.746} = \frac{100}{0.80}$$

efficiency

∴ operating expenses = $\frac{\text{output}}{\text{efficiency}} * \text{rate} * \text{Hours}$

$$= \frac{100 * 0.746 * 10 * x}{0.80}$$

[$\because 1 \text{hp} = 0.746 \text{ kW}$]

$$\begin{aligned} \text{Total cost (annual)} &= 122960 + 10000 + 36500 + 932.5x \\ (\text{KHASA Pump}) &= 169460 + 932.5x \quad \dots \dots (1) \end{aligned}$$

Similarly for SARVO Pump

$$1. CR = I(A, 12\%, 5) - S(A, 12\%, 5)$$

$$\text{Salvage value} = 20\% \text{ of } 1000000 = \text{Rs } 200000$$

$$\therefore CR = 1000000(A, 12\%, 5) - 200000(A, 12\%, 5)$$

$$= \text{Rs } 245920$$

$$2. \text{ Maintenance cost} = \text{Rs } 29200$$

$$3. \text{ TAX} = \text{Rs } 15000$$

$$4. \text{ operating expenses} = \frac{100 * 0.746 * 10 * x}{0.90} = \text{Rs } 828.88x$$

$$\therefore \text{Total annual cost} = 245920 + 29200 + 29200 + 15000 +$$

$$(\text{SARVO pump}) = 290120 + 828.88x \quad \dots \dots (2)$$

For breakEven point, equate the total cost of two pump

$$169460 + 932.5x = 290120 + 828.88x$$

$$\therefore x = 1164.4 \text{ hours/year}$$

Need of yearly operating hours = $5 * 365$

$$= 1825 \text{ hours/yearly}$$

To operate 1825 hours/yearly

for KHASA PUMP Total annual cost

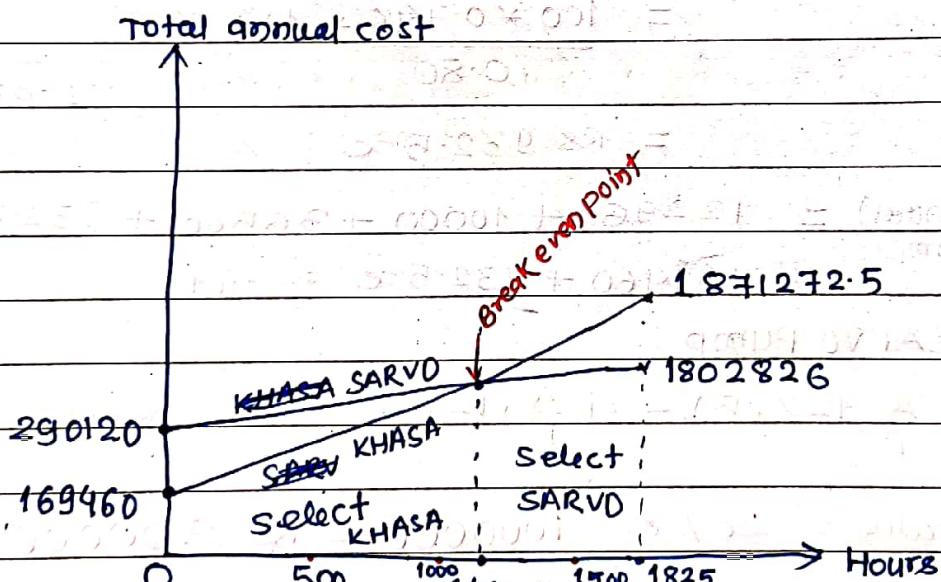
$$= 169460 + 932.5 * 1825$$

$$= \text{Rs } 1871272.5$$

For SARVO PUMP total annual cost

$$= 290120 + 828.88 * 1825$$

$$= \text{Rs } 1802826.$$



For 1825 hours/yearly operating, SARVO Pump selected.

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Eg: perform sensitivity analysis of the following project over range of $\pm 40\%$ at the interval of $\pm 10\%$. in

- i) Initial investment
- ii) Net annual Revenue
- iii) Salvage value
- iv) Useful life; use PW Formulation. Draw also sensitivity graph.

Soln:-

PW

Capital investment (I) = Rs 11500

Annual Revenue (R) = Rs 5000

Annual expenses (E) = Rs 2000

Market value (~~N~~) = (S) = Rs 1000
 or Salvage value

Useful life = 6 years

MARR = 10%.

Soln:-

Prime equation,

$$PW(12\%) = -11500 + (5000 - 2000) \left[\frac{1 - (1+10\%)^6}{0.10} \right] + 1000 \left[\frac{1}{(1+10\%)^6} \right]$$

$$= Rs 2130$$

For $\pm 40\%$ Fluctuation in

(i) Initial investment (I)

(ii) Net annual Revenue ($R-E$) = A

(iii) Salvage value (S)

(iv) Useful life (N)

$$PW(12\%) = -I + A \left[\frac{(1+10\%)^N - 1}{0.10(1+10\%)^N} \right] + S \left[\frac{1}{(1+10\%)^N} \right] \quad \dots (1)$$

Calculation table

PW(10%)

Variation	-40%	-30	-20%	-10%	0	10%	20%	30%	40%	Remarks
Investment (I)	6730	5580	4430	3280	2130	980	-170	-1320	-2470	A, S, N const
Net annual Revenue (A)	-3096	-1789	-483	823	2130	3436	4743	6050	7357	I, S, N const
Salvage value (S)	1904	1960	2017	2073	2130	2186	2243	2299	2356	I, A, N const
Useful life (N)	-2077	-933	147	1167	2130	3040	3900	4711	5477	I, A, S const

For P.W.C. = 10% the sensitivity graph is as follows. It shows that among the four factors I, R-E, S, N, R-E is more sensitive due to its high slope.

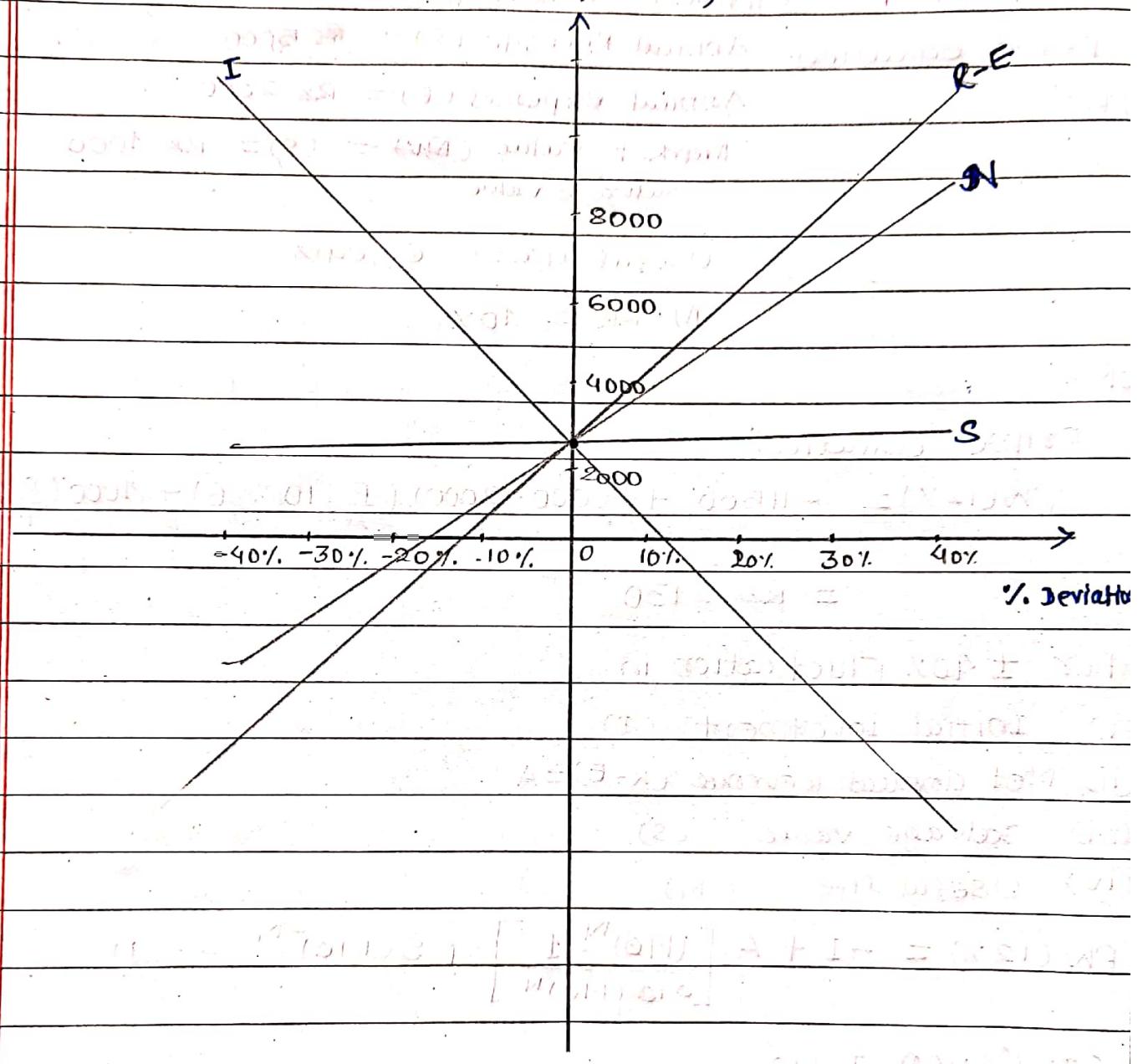


fig Sensitivity graph

Among I, R-E, S, N → R-E is more sensitive than others.
S is insensitive. P.W.C. is not affected by S.
I, R-E, N is sensitive and R-E is more sensitive due to its high slope.

Eg: From the following information, conduct scenario analysis based on FW Formulation. Assume investment = Rs 225000, MARR = 13.5%; and life of project = 5 years. Also give your remarks based on result of different scenarios.

Variable considered	Worst case scenario	Most likely Scenario	Best case scenario
Annual sales	86000	110000	137000
Annual variable cost	37000	40000	38000
Annual fixed cost	21000	20000	18000
Salvage value	40000	50000	60000

Sqno:

Using FW Formulation

(a) Worst case scenario

$$\begin{aligned}
 FW(13.5\%) &= -225000 \left(\frac{F}{P}, 13.5\%, 5 \right) + (86000 - 37000 - 21000) \left(\frac{F}{A}, 13.5\%, 5 \right) \\
 &\quad + 40000 \\
 &= -225000 [1.135]^5 + 28000 \left[\frac{(1.135)^5 - 1}{0.135} \right] + 40000 \\
 &= -200544 \text{ (Loss)}
 \end{aligned}$$

(b) Most Likely scenario

$$\begin{aligned}
 FW(13.5\%) &= -225000 \left(\frac{F}{P}, 13.5\%, 5 \right) + (110000 - 40000 - 20000) \left(\frac{F}{A}, 13.5\%, 5 \right) \\
 &\quad + 50000 \\
 &= -46556 \text{ (Loss)}
 \end{aligned}$$

(c) Best case scenario

$$\begin{aligned}
 FW(13.5\%) &= -225000 \left(\frac{F}{P}, 13.5\%, 5 \right) + (137000 - 38000 - 18000) \left(\frac{F}{A}, 13.5\%, 5 \right) \\
 &\quad + 60000 \\
 &= 166334 \text{ (Profit)}
 \end{aligned}$$

Decision: Scenario analysis indicates that there is risk for investment in worst case and most likely scenario while there is no risk for investment in best case scenario. i.e. Scenario analysis indicates, there is high risk for investment.

CH-8
Depreciation and corporate Income Taxes:

Depreciation:

- depreciation can be defined as a gradual decrease in utility of fixed assets with use and time.
- depreciation may be defined as the permanent decrease in the value of assets due to use and or the lapse of the time.
- Engineers need to learn about depreciation because their design designs can affect the way investments and annual operating costs are treated from an income tax perspective.

cause of depreciation:

- (a) wear and tear:- The continuous use of an asset makes it old and decrease in working capacity and hence the value of asset decreases.
- (b) Accident: Accidental causes due to natural disaster or by manmade disaster.
- (c) Effusion of time: with the passage of time, the value of some asset diminishes even if they are not used in the business.
- (d) Fall in Market value:- The value of an asset may decrease due to fall in market price of the assets.
- (e) obsolescence:- An existing asset may lose its usefulness due to an improvement in technology, new invention, change in style etc.

Asset depreciation (Economic depreciation)

Asset depreciation refers to the gradual decrease in the economic value of fixed assets like, equipments, real estate, vehicles, with passing the time and wear & tear. so it is also called economic depreciation.

Asset depreciation categories:

(i) Physical depreciation: It can occur in any fixed asset due to:-

(a) wear and tear

(b) Deterioration (interaction with the new environment)

Physical depreciation results decline in performance and require high maintenance costs.

(ii) Functional depreciation: It occurs as a result of change in technology. It decrease or eliminate the need for an asset due to inability to meet increased quantity and quality demand of market.

Economic depreciation = purchase price - Salvage value

= purchase price - current market value

Accounting Depreciation:- Accounting depreciation provides information to make financial statement (P/L account) of any organization. we put depreciation in Dr. side of P/L account.

- Accounting depreciation is the systematic allocation of asset's value (initial cost) into book value in proportion of its total depreciable life.

- It is mostly used in engineering economic analysis because it provides a basis for determining the income taxes associated with any project undertaken.

- Basically accounting depreciation is used to estimate after tax cash flow of any project.

Depreciation Methods:

1. Straight Line Method:

: It assumes that a constant amount is depreciated each year over the depreciable life of the asset.

: Mathematically,

$$D_n = \frac{(I-S)}{N}$$

where, D_n = Annual depreciation deduction in the year N.

I = Initial cost

S = Salvage value

N = Life of the asset

If Rate is given,

$$\text{Annual depreciation} = \text{Total depreciable value} \times \text{Rate (\%)} / 100$$

$$\text{Rate of depreciation} = \frac{\text{Annual depreciation}}{\text{Total depreciable value}} \times 100$$

$$= \frac{1}{N} \times 100$$

$$\text{and Total depreciable value} = I + \text{all other expenses} - S$$

Eg: Consider the following automobile data.

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cost of the asset (I) = Rs. 10000
useful life (N) = 5 years
estimated salvage value (S) = Rs. 2000

Use the straight line depreciation method to compute the annual depreciation allowance and the resulting book values.

Soln: Given,

$$I = \text{Rs. } 10000$$

$$S = \text{Rs. } 2000$$

$$N = 5 \text{ years}$$

$$\text{Annual depreciation } (D_n) = \frac{I - S}{N} = \frac{10000 - 2000}{5} = \text{Rs. } 1600$$

Now, the asset would have the following book value during the ~~the~~ its useful life.

n	B_{n-1} (Rs)	D_n (Rs)	B_n (Rs)
1	10000	1600	8400
2	8400	1600	6800
3	6800	1600	5200
4	5200	1600	3600
5	3600	1600	2000

where, B_{n-1} and B_n represents the book value before and after depreciation respectively.

2. Declining / Diminishing balance method (DB)

: It is assumed that the annual cost of depreciation is fixed percentage of the book value at the beginning of the year.

$$\text{Depreciation rate } (D_n) = \frac{1}{N} * \text{Multiplier}$$

most commonly used multipliers 2 (called 200% or double declining balance DB) and 1.5 (called 150% DB).

Eg: consider the following accounting information for a

Computer system:

Cost Basis of the asset (I) = Rs. 10000

Useful life (N) = 5 years

Estimated salvage value (S) = Rs 778

Compute the annual depreciation allowances and the resulting book values using the double declining depreciation method.

SOL:

$$\text{Depreciation rate } (\alpha) = \frac{1}{N} * 2$$

$$= \frac{1}{5} * 2$$

$$= 0.4$$

$$= 40\%$$

We obtain the depreciation value and book value as shown in table:

n	B_{n-1} (Rs)	D_n (Rs)	B_n (Rs)
1	10000	4000	6000
2	6000	2400	3600
3	3600	1440	2160
4	2160	864	1296
5	1296	518	778

Issue regarding salvage value is:

If final book value (B_N) doesn't equal to estimated salvage value (S), we have to make the adjustment in our depreciation analysis method.

CASE I: $B_N > S$

To reduce the final book value (B_N) to salvage value, it can be done by switching from declining balance (DB) to straight line (SL).

switching Rule

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If depreciation by declining balance in any year is less than or equal to the depreciation by straight line, then we would switch to and remain with straight line for the duration of the project's depreciable life.

The straight line depreciation in any year n is calculated by

$$D_n = \frac{\text{Book value at the beginning of year } n - \text{Salvage value}}{\text{Remaining useful life at the beginning of year } n}$$

Eg: Consider the following accounting information for a computer system:

cost basis of the asset (I) = Rs 10000

useful life (N) = 5 years

salvage value (S) = Rs 100

Determine the optimal time to switch from DB to SL depreciation and the resulting depreciation schedule.

Soln:-

$$\text{Declining balance rate} (\alpha) = \frac{1}{N} \times 2$$

$$= \frac{1}{5} \times 2$$

$$= 0.4 = 40\%$$

First, computing the DB depreciation for each year

n	B_{n-1} (RS)	D_n (RS)	B_n (RS)
1	10000	4000	6000
2	6000	2400	3600
3	3600	1440	2160
4	2160	864	1296
5	1296	518	778

Here, the book value is Rs 778 at the end of 5 year

which is greater than Rs 100. Therefore we use the switching fundamentals
so, compute the SL depreciation for each year and compare with DDB and use the decision rule.

n	SL depreciation	DDB depreciation	switching decision
1	$(10000 - 100) = 1900$	< 4000	do not switch
2	$(6000 - 100)/4 = 1475$	< 2400	"
3	$(3600 - 100)/3 = 1166.67$	< 1440	"
4	$(2160 - 100)/2 = 1030$	> 864	switch to SL

The optimal year is 4 in this situation

The depreciation schedule is

year (n)	DDB with switching to SL	End of year Book value
1	4000	6000
2	2400	3600
3	1440	2160
4	1030	1130
5	1030	100

case 2: when $B_n < S$

depreciation amount are adjusted as $B_n = S$

Eg: Compute the double declining (DDB) depreciation schedule for the data as follows:

cost basis of the asset (I) = Rs 10000

useful life (N) = 5 years

salvage value (S) = Rs 2000

Sol:-

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EoY	B ₀₋₁	D _n	B _n	
1	10000	4000	6000	
2	6000	2460	3600	
3	3600	1440	2160	
4	2160	864 > 160	2000	
5	2000	0	2000	

- (3) Sum of Year Digit (SOYD) Method:
- Larger depreciation charge during the years of asset and smaller depreciation charges as asset getting old.
 - Each year depreciation charge is calculated as the remaining useful life at the beginning of the year divided by the sum of the years digit for the total useful life.

$$SOYD = 1+2+3+\dots+N = \frac{N(N+1)}{2}$$

Depreciation each year is calculated as

$$D_n = \frac{(N-n+1)(I-S)}{SOYD}$$

Eg: Compute the SOYD depreciation schedule for the following: cost basis of the asset (I) = Rs. 10000
useful life (N) = 5 years
salvage value (S) = Rs 2000

Sol:-

$$SOYD = \frac{N(N+1)}{2} = \frac{5(5+1)}{2} = 15$$

$$D_n = \frac{(N-n+1)(I-S)}{SOYD} = \frac{(5-n+1)(10000-2000)}{15} = \frac{(6-n)1600}{15}$$

EOY (n)	B _{n-1} (RS)	D _n (RS)	B _n (RS)
1	10000	2667	7333
2	7333	2133	5200
3	5200	1600	3600
4	3600	1067	2533
5	2533	533	2000

(4) Sinking Fund method

The fixed sum depreciated at the end of every time period earns an interest rate of i.v. compounded annually.

The annual equivalent amount of depreciation charge(A)

$$= (I-S) \left(\frac{A}{F}, i\%, N \right)$$

$$\text{Net depreciation charge } D_n = A \left(\frac{E}{P}, i\%, n-1 \right)$$

Eg: Compute the depreciation charge and book value in each year by using sinking fund method with following information.

cost of the asset(I) = Rs 200000

salvage value(S) = Rs 20000

Life of the asset(N) = 6 years

i = 12 %

SOL:-

$$\text{Fixed annual depreciation } (A) = (I-S) \left(\frac{A}{F}, 12\%, 6 \right)$$

$$= (200000 - 20000) * 0.1232$$

$$= Rs 22176$$

Net depreciation for each year

$$D_n = A(F_{P,12Y}, n-1)$$

$$= 22176 \times (1.12)^{n-1}$$

n	B _{n-1}	D _n	B _n
1	200000	22176	177824
2	177824	24837.12	152986.88
3	152986.88	27817.57	125169.31
4	125169.31	31155.68	94013.63
5	94013.63	34894.37	59119.26
6	59119.26	39081.69	20037.57 ≈ 20000

(5) Modified Accelerated cost Recovery System (MACRS)

- Historically, for tax purpose and accounting an asset's depreciable life was determined by its estimated useful.
- The MACRS scheme totally abandon this practice and simpler guidelines were set which created several classes of assets and each with more or less arbitrary life called recovery period.
- The salvage value of property is always zero.
- MACRS scheme includes 8 categories of assets: 3 years, 5 years, 7 years, 10 years, 15 years, 20 years, 27.5 years and 39 years.
- Half year depreciation is allowed for the first year and full year's depreciation is allowed in each of the remaining half year depreciation in the end year of recovery period.
- The MACRS asset is depreciated initially by the declining balance and then to straight line method.

Eg: A tax payer wants to place in service a Rs 20,000 asset that is assigned to the 5 year class. Compute the MACRS percentage depreciation amounts and book value for the asset.

SOL:-

MACRS deduction percentages, beginning with the first taxable year and ending with the 6th year are computed as follows.

$$\text{Straight line (SL) rate} = \frac{1}{N} = \frac{1}{5} = 0.2 = 20\%$$

$$\text{Double declining balance (DDB) rate} = \frac{1}{N} \times 200\% = \frac{1}{5} \times 200\% = 40\%$$

Under MACRS, salvage value = 0

Year	calculation	MACRS	Decision Dep.
1	$\frac{1}{2} \text{ year DDB} = \frac{1}{2} \times 0.4 \times 100 = 20\%$	20%	switch to SL
2	DDB = $0.4 (100 - 20)\% = 32\%$ SL dep = $\frac{1}{4.5} (100 - 20)\% = 17.78\%$	32%	do not switch
3	DDB = $0.4 (100 - 52)\% = 19.2\%$ SL dep = $\frac{1}{3.5} (100 - 52)\% = 13.71\%$	19.2%	do not switch
4	DDB = $0.4 (100 - 71.2)\% = 11.52\%$ SL dep = $\frac{1}{2.5} (100 - 71.2)\% = 11.52\%$	11.52%	switch to SL
5	SL dep = $\frac{1}{1.5} (100 - 82.72)\% = 11.52\%$	11.52%	
6	$\frac{1}{2} \text{ year SL dep} = \frac{1}{2} \times 11.52\% = 5.76\%$	5.76%	

In the year 4, SL depreciation is \geq DDB depreciation and we switch to SL.

calculation the depreciation amounts from the percentages

Year	MACRS	Depreciation Basis	Depreciation amount (Ans)	Book value after dep (B _{n-1})
1	20%	20000	4000	16000
2	32%	20000	6400	9600
3	19.2%	20000	3840	5760
4	11.52%	20000	2304	3456
5	11.52%	20000	2304	1152
6	5.76%	20000	1152	0

(6) Unit of production (Service - output) Method

All the depreciation method discussed above are based on elapsed time (year). But if the decrease in value of asset is based on the total working hour or production unit, then it is called service output method. This method gives equal depreciation charge for each unit of output or working hour regardless of the lapse of time involved.

$$\text{Depreciation} (D_o) = \frac{\text{Units of production used}}{\text{Total Working hours or production unit}} \times (I - S)$$

Such a method is useful where a company has many fixed assets with varying usage.

Eg: A truck for hauling coal has an estimated net cost of Rs 5,5000 and is expected to give service for 25000 miles, resulting in a salvage value. Compute the allowed depreciation amount and book value for truck usage of 30000 miles.

SOL:

∴ Depreciation = $\frac{\text{unit of production used}}{\text{Total working hours}} \times (\text{I-S})$

$$= \frac{30000}{250000} \times (55000 - 5000)$$

$$= \text{Rs } 6000$$

∴ Book value after depreciation = $55000 - 6000$
 $= \text{Rs } 49000$

Corporate income tax:

- : Income tax on corporation is known as the corporate income tax or corporate tax.
- : Corporation is a word used to cover a variety of business enterprises, all of which are entities having a legal personality and distinct from their owners.
- : There are various types of business enterprises but corporations and companies have only a separate legal personality.
- : On the view of corporate tax, it is only a way of including all corporate source of income in the personal income tax base.
- : The corporate income tax allows deductions of the costs of goods sold, salaries and wages, rent, interest, advertising, depreciation, amortization, depletion etc as expenses. This is an amount levied by a government on the profits of a company.

According to income tax act (2002), the applicable tax rates vary from 5% to 30% based on the business undertaken by any entity.

		Tax Rate
1.	Bank and financial institutions General insurance business Telecommunication and internet services Money transfer Tobacco and alcohol Capital market business Securities business Merchant banking	30%
2.	Cooperatives registered under cooperative act, 2074 School Public Guthi	20%
3.	Income from industrial enterprises Infrastructure project like road, bridge, tunnel, electric power generation, Ropeway, trolley bus etc.	25%
4.	Cooperative involved in financial transaction and operated at metropolitan and sub-metropolitan city	10%
5.	Cooperative involved in financial transaction and operated at Municipality	5%

concession on business income: Special industry or FIT providing direct employment throughout the year to 100 or more Nepalese citizens

100 or more Nepalese citizens	10% of AR (Applicable Tax rate)
300 or "	20% of AR
500 or "	25% of AR
1000 or "	30% of AR

~~Taxation Law in Nepal~~

Additional 10% concession is provided if direct employment is provided to 100 or more Nepalese citizens including at least 33% of women, oppressed or handicapped person.

~~Taxation Law in Nepal~~

- : Nepal has a long history in the taxation.
- : Land tax has been found to be ~~registered~~ practised from Lichhavi period and exise duty was imposed on Rana regime.
- : Shah regime also continued the tax system of the Mallas, which was based on land and trade.
- : In Nepal, modern taxation system was introduced only after the introduction of multiparty system in 1951.
- : Income tax act 2058, which is the modern tax regulation in Nepal.
- : The taxation rights of GON, provincial and local government as per constitution of Nepal and Inter-governmental financial management act, 2074.
- : At present, following tax acts are enacting in Nepal:-

Income tax Act - 2058

Custom Tax Act - 2064

Excise Tax Act - 2056

VAT act - 2052

Depreciation Rates:

class	Assets included	Rate Applied
A	Buildings, structures, and similar works of permanent nature.	5% per year on base amount
B	Computers, data handling equipment, Fixtures, Office furniture, and office equipment	25%, ,
C	Automobiles, buses, and minibuses, and all other transport assets	20%, ,
D	Construction and earth moving equipment and other depreciable asset not included in another classes	15%, ,
E	All intangible assets including software	(cost price - Salvage value) / Useful life for each year

Personal Tax:

: personal tax is a direct tax and it is generally imposed by the central authority and collected through the local authorities.

: personal tax is mostly levied on income and property in Nepal.

(a) Income Tax:

: if the tax is levied on various sources of individual income, then it is known as personal income tax.

: The basic objectives of income tax are two fold:

- (i) Revenue collection (ii) Redistribution of social income

According to current tax of Nepal Govt. (2076/77-FY),

the taxable income of a resident will be taxed at the following rates.

Particular	Individual	Couple	Tax rate Applicable
Upto	400000	450000	1%
Next	100000	100000	10%
Next	200000	200000	20%
Next	1300000	1300000	30%
Above	2000000		36%

(b) property tax :

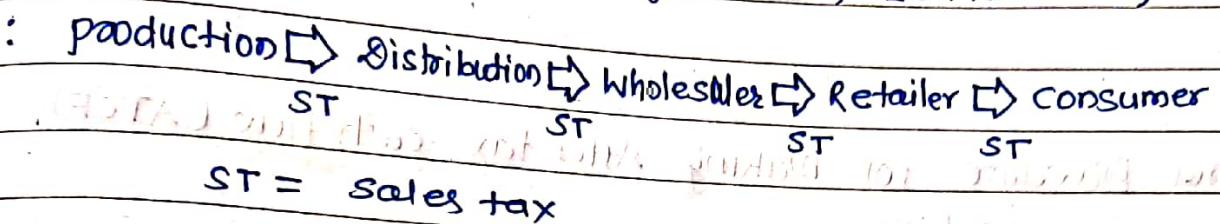
- : property tax is an annual tax on real property .
- : property taxes are compulsory levied on the ownership of land, building, vehicles, weapons and so on.
- : The main objective of any property taxing system is to raise revenue for the provision of social services by the local governments.
- : The revenue generated from it is normally used to provide services of public goods.
- : In Nepal, there are two types of property tax:
 - House and Land tax
 - Unified property tax

Value Added Tax (VAT):

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- A VAT is a type of tax in which the tax is applied to a product whenever any value is added, including in the products production and final stage (point of sale).
- This tax system used in 160 countries.
- Nepal introduced this system on 16 November, 1997.



- VAT rate is 13% in Nepal.
- Government offices should purchase taxable goods and service having price more than Rs. 5000 from the VAT registered trader compulsorily.
- At present, VAT has contributed about 30% of the government tax revenue.
- Objective to implement VAT in Nepal:
 - (i) To increase government revenue
 - (ii) To make transparent tax system
 - (iii) To avoid tax evasion
 - (iv) To increase in exports
 - (v) Avoids double taxation
 - (vi) To avoid cascading effect

Advantages:

- It minimizes avoidance
- It is easy to manage
- Removes the cascading of taxes
- Huge amount of Revenue is generated on a low tax rate through VAT
- Improves economic efficiency
- Consumer has minimum burden

Disadvantages:

- Tax evasion is possible through fake invoices
- Relatively complex to understand
- It is one kind of regressive tax. (The poor pay more in comparison than the rich)

General procedure for making After tax cash flow (ATCF)

Economic analysis

: It is the analysis of after tax cash flow estimates and profitability analysis of the project.

: General procedure for ATCF estimation:-

1. Find gross income before depreciation expenses also Known as BTCF (Before Tax Cash Flow)
2. Calculate depreciation income expenses for each year
3. Find taxable income (deduct depreciation from BTCF)
4. Find taxes for each period
5. Deduct tax amount from BTCF to get ATCF for each year
6. Find NPV and make economic analysis.

EOY	BTCF	Depreciation	Total Taxable Income	Tax Amount (T_K)	ATCF
K	$R_K - E_K$	d_K	$R_K - E_K - d_K$	$t(R_K - E_K - d_K)$	$(BTCF_K - T_K)$

Where,

R_K = Revenues from the project during period K

E_K = Expenses " " " " " "

d_K = depreciation amount of " " " " " "

t = income tax rate

T_K = income tax amount during period K.

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Ex: A construction equipment has initial cost and annual saving per year are of Rs 40000 and Rs 20000 respectively. with annual operating and maintenance cost of Rs 7000. It will be depreciated by MACRS method and will have no salvage value. The useful life of equipment is 5 years. Estimate before and after tax cash flow. The company pays income tax @ 40%.

Soln:-

MACRS, depreciation is calculated same as MACRS depreciation method

Now, Estimation of before and after tax cash flow:

$$I = \text{Rs } 40000$$

$$R = \text{Rs } 20000$$

$$E = \text{Rs } 7000$$

$$S = 0$$

$$t = 40\%$$

We have,

$$BTCF_K = R_K - E_K$$

$$ATCF_K = BTCF_K - T_K$$

$$T_K = BTCF_K - d_K$$

②

T_K = Taxable amount

d_K = Depreciation amount

Year (yr)	BTCF	d_K (MACRS%)	Net taxable income ($BTCF_K - d_K$)	TAX amount @ 40% (T_K)	ATCF
0@	-40000	-	-	-	-40000
1	$\frac{1}{2}(20000 - 7000)$	$20\% \text{ of } 40000 = 8000$	-1500	Notax	6500
2	$(20000 - 7000)$	$32\% \text{ of } 12000 = 3840$	200	$0.4 \times 200 = 80$	12920
3	"	$19.2\% \text{ of } 8160 = 1560$	5320	$0.4 \times 5320 = 2128$	10872
4	"	$11.52\% \text{ of } 6608 = 768$	8392	$0.4 \times 8392 = 3356$	9644
5	"	$11.52\% \text{ of } 5832 = 660$	8392	$0.4 \times 8392 = 3356$	9644
6	$\frac{1}{2}(20000 - 7000)$	$5.76\% \text{ of } 12304 = 710$	4196	$0.4 \times 4196 = 1678$	4822

CH-7 Ecological Limits and Economic Development

Page:

Economic Theory:

- It is a way to explanation of economic activities and its impact on various grounds.
- Economic theory is a broad concept for the explanation and understanding of the movements of goods in a market.
- Microeconomic theory focused on efficient use of scarce resources for satisfying unlimited wants.
- The macroeconomic theory is specially focused on achieve high level of employment & income.
- Modern economic theory has tended to overlook about the importance of ecosystem, the use of land and environment for balancing ecological constraints that refers ecological economics.
- It is more responsible for modern realities like ecological deterioration and record inequality.
- Economic theory involves generalization which are statements of general tendencies or uniformities of relationships among various elements of economic phenomena.

Ecological Limit:

- Ecological limit is to keep intact ecological services which is need to keep the sale of economy within the capacity of global ecosystem to sustain it.
- Functioning ecological mechanism of the earth to keep economic development with sustainable manner there must be limiting (minimum) availability of natural resources that technically refers ecological limit.

There are limits to the earth's capacity to act as a source of material inputs and feeding for the economic system and sink for the waste products.

Environment

Economical constraints are limiting the availability of natural resources. In response to classical and neoclassical economics, the approaches of the two schools of thought environmental economics, the approaches of the two schools and ecological economics was emerged.

These two schools of thoughts are emerged in response to the challenges posed by the ecological limits on economic development.

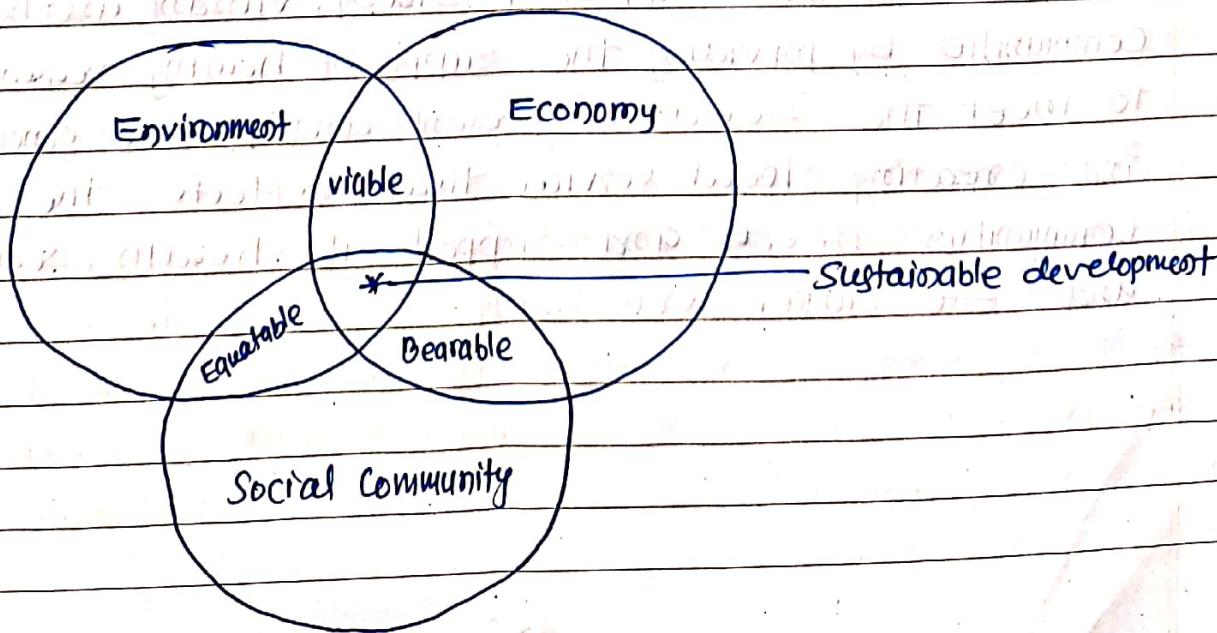
The environmental economics takes a more interdisciplinary approach of integrating ecological factors governing resources regeneration and waste absorption into the economic models.

The question of ecological limits to growth is implicitly or explicitly posed in terms of 3 major problems: Food resources, the physical capacity of ecosystem, and the territory territoriality of populations within ecosystems. The problem is made more complex by the fact that the objective of human societies compatible with resources.

All economic and demographic growth carries with it bioecological degradation.

concept of sustainable development:

- The concept of sustainable development embraces (Focus) the principle of resource management and carrying capacity of ecosystem.
- Sustainable development is an art of resource management that fulfills the need of present generation and also generates the fulfillment needs of the future generations.
- It is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainable development ties together concern for the carrying capacity of natural systems with the social, political and economic challenges faced by humanity.
- Sustainable development is a continuous process. There is an additional focus on the present generations responsibilities to regenerate, maintain and improve planetary resources for use by future generations.
- There are 3 components of sustainable development.
 - (a) Economic growth
 - (b) Environmental Stewardship
 - (c) Social inclusion



Social + Economic Sustainability = Equitable

Social + Environmental Sustainability = Bearable

Economic + Environmental sustainability = viable

only through balancing economic + social + environmental can we achieve true sustainability and a truly circular economy.

(a) Economic growth: Building a strong, competitive economy by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation, and in identifying then coordinating development requirement.

(b) Environmental Stewardship: Controlling to protecting and enhancing our natural and developed environment, while helping to improve biodiversity, use natural resources wisely, minimizing waste and pollution and adapting to and helping to decrease climate change, including a global shift to low carbon economy.

(c) Social inclusion: Supporting strong, vibrant and healthy communities by providing the supply of housing required to meet the needs of present and future generations, and creating local services that reflects the community's needs and support its health, social and culture well being.

Ecological Footprint:

- The ecological footprint represents the amount of productive land needed to support a nation's resources needs.
- An ecological footprint is the area of land and water required to sustainably provide all resources at the rate at which they are being consumed by a given population.
- It includes the population's waste disposal requirements.
- Ecological footprint refers the total direct and indirect requirement of land use for the given units of crop production with global average i.e. primary productivity for resource regeneration and waste absorption for the agriculture and industrial production and infrastructure development of an economy.
- The ecological footprint measures human demand on nature.
- Ecological footprint accounting measures the demand on and supply of nature.
- The ecological footprint tracks the use of six categories of productive surface areas: cropland, grazing land, fishing grounds, built-up land, forest area and carbon demand on land.
- The ecological footprint, in its most basic form is calculated using the following equation:

$$\text{Ecological Footprint} = \frac{\text{Annual demand of a product}}{\text{Annual yield of the same product}} \\ \text{which is expressed in global-hectares}$$

- The average per country ranges from over 10 to under 1 global hectares per person.
- There is also high variation within countries, based on individual lifestyle and economic possibilities.

Overcoming Ecological limits:

- It discusses how technology and human values can play a significant role in creating space for economic development by relaxing the ecological constraints.
- Overcoming ecological limits point out the scope maintaining between economic growth and environment through the development of renewable energy resources, decarbonization, recycling of wastes, taking organic view of technology and resource development.
- If sustainable development is considered possible as per the holistic approach which takes account of the interactive relation between the human system and the ecosystem, overcoming ecological limit is possible.
- Hence, each and every development institutions should follow the implementation policy of sustainable development by realizing the relationship between economic growth and natural environment.

Unit-9 Enterprise Financing and Capital InvestmentDate: _____
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Methods of financing:

The two broad choices a firm has for financing an investment project are:-

(1) Equity financing:

- It is the method of raising capital by selling company stock or shares to investors.

- Equity financing essentially refers to the sale of an ownership interest to raise funds for business purposes.

- Equity financing can take one of two forms:

(i) The use of retained earnings into company development

(ii) Issuing shares to outside investors

Both forms of equity financing use funds invested by the current or new owners of the company.

(2) Debt Financing:

- Debt financing means borrowing money and not giving up ownership.

- Both short-term borrowing from financial institutions and the sale of long term bonds, wherein money is borrowed from investors for a fixed period @ fixed interest.

- When the debt financing option is used, we need to separate the interest payments from the repayment of the loan for our analysis.

- Does not grant ownership of the firm.

- One of the primary method of debt financing is issuing bonds, that needs interest paid for each period regular basis but the principal is paid in a lump sum when the bond matures.

Capital Structure:

- : In method of financing, the ratio of total debt to total capital, generally called the debt ratio or capital structure.
- : It is the percentage of total capital provided by debt or borrowed funds.
- : $\text{Capital Structure} = \frac{\text{Total debt}}{\text{Total Capital}} = \text{debt ratio}$
- : A debt ratio 0.4 indicates that 40% of the capital is borrowed and 60% funds are provided by equity.
- This type of financing is called mixed financing.
- : When people refer to capital structure they are most likely referring to a firm's debt to equity ratio, which provides insight into how risky a company is.
- A company usually establishes a target capital structure in the process of financing decision.
- If the capital structure is current above the target, expansion capital will be raised by issuing stocks.

Cost of Capital:

- The cost of capital is the minimum required rate of earnings or the cutoff rate of expenditure.
 - Cost of Capital includes is the cost of a company's funds (both debt and equity).
- Importance:**

- Capital budgeting or investment decision
- Capital structure decision
- Dividend policy decision

Cost of equity: cost of equity is the minimum rate of return a firm must offer shareholders to compensate for waiting for their returns and for bearing some risk.

Cost of debt: cost of debt is the effective rate that a company pays on its current debt.

Weighted Average Cost of Capital (WACC):

- The WACC is the weighted average of after tax component costs of debt, preferred stock and common equity.
- The various steps involved in calculation of WACC are:
 1. Calculating the after-tax component costs.
 2. Find the weight of each source of financing
 3. Multiply the after tax cost of each source by its weight/proportion in the Capital structure.
 4. Add the weighted Component Costs to get the firm WACC.

Mathematically,

$$WACC = K_{dt} * w_d + K_{ps} * w_{ps} + K_s * w_s + K_e * w_e$$

Where,

K_{dt} = cost of debt after tax

w_d = weight of debt

K_{ps} = cost of preferred stock

w_{ps} = weights of preferred stock

K_s = cost of retained earnings / internal equity

w_s = weights of retained earnings / internal equity

K_e = cost of external (new issue) equity

w_e = weight of external (new issue) equity

Eg: If interest on debt is 12%, dividends to shareholders are 15%. Calculate the WACC if debt is 70% and equity is 30%. Tax rate is 20%.

Soln:-

$$\text{Interest on debt } (K_d) = 12\%$$

$$\text{Cost of equity } (K_e) = 15\%$$

$$\text{Weight of debt } (W_d) = 70\% = 0.7$$

$$\text{Weight on equity } (W_e) = 30\% = 0.3$$

$$\text{Tax rate } (t) = 20\% = 0.2$$

$$WACC = ?$$

We have,

$$WACC = K_d t + W_d + K_e + W_e$$

$$\text{Where } K_d t = K_d (1-t)$$

$$= 12\% \cdot (1 - 0.2)$$

$$= 9.6\%$$

$$\therefore WACC = 9.6\% \cdot (0.7) + 15\% \cdot (0.3)$$

$$= 11.22\% \quad \underline{\text{Ans.}}$$

Eg: Calculate the after tax cost of debt while the interest rate is 10% and tax rate is 40%.

Soln:-

$$\text{Interest rate} = 10\%$$

$$\text{Tax rate} = 40\% = 0.4$$

$$\therefore \text{After tax Cost of debt} = \text{interest rate} \cdot (1 - \text{tax rate})$$

$$= 10\% \cdot (1 - 0.4)$$

$$= 6\%$$

Eg: A bond issued by Everest bank Ltd. has a coupon rate of 8%. Interest is paid quarterly and the bond matures in 5 years. The Face value of the bond is Rs 1000. What is the present value of the bond if market interest rate is 7.5%.

Date: _____

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Soln:- Coupon rate = 8% compounded quarterly

$$\text{Effective coupon rate} = \left(1 + \frac{0.08}{4}\right)^4 - 1$$

$$= 0.0824 = 8.24\%$$

Yearly return amount = effective coupon rate * Face value

$$= 8.24\% \times 1000$$

interest rate (i) = 7.5%, $N = 5$ years
present value of bond

$$B_0 = 82.4 \left[\frac{1 - 0.075(1+i)^N}{i(1+i)^N} \right] + 1000(1+i)^{-N}$$

$$= 82.4 \left[\frac{1 - 0.075(1.075)^5}{0.075(1.075)^5} \right] + 1000(1.075)^{-5}$$

$$= \text{Rs } 1030.35 \quad \underline{\text{Ans.}}$$

Eg: If Asia Electric Company presently pays a dividend of Rs 12 per share and has a share price of Rs 110.

The expected growth is 8% forever then what is the required return on equity?

Soln:-

$$\text{Net income from dividend} = \text{Rs } 12$$

$$\text{Shareholder's equity} = \text{Rs } 110$$

$$ROE = \frac{\text{Net income}}{\text{Owner's equity}} \times 100\%$$

$$\text{ROE} = \frac{12}{110} \times 100\% \\ = 10.9\%$$

Project Funding Mechanism:

(i) Government budget:

The funding made by local and national/central government agencies to produce and deliver various public utilities etc. like: road, water supply, electricity, gas, telephone, hospitals etc are established and run by government funding through government budget.

(ii) public private partnership (PPP):

: joint initiative of public and private sectors to provide public or semi-public goods/services to the people.

Eg: hydropower projects, roads

: public = Government institutions like ministries, department, VDC, municipalities etc.

: private = Local and international body that may include financial and technical expertise relevant to the project.

: partnership = Formal agreement in which two or more parties cooperate to manage and operate a business or to provide services.

: In PPP, government as well as private sector both are active on commercial functions of the projects and work for their mutual benefits.

: Benefits from PPP:

i. improves service delivery

ii. increase investment in public infrastructure

iii. cost effectiveness

- (iv) Reduce public sector risk
- (v) Better use of resources
- (vi) project acceleration

Success Factors of PPP Models :-

- (i) Political will
- (ii) Security and privacy
- (iii) Legal framework
- (iv) project address a real need
- (v) transparent Selection procedures
- (vi) clear definition of the scopes, roles, risk and obligations
- (vii) consultation with stakeholders

(3) Private investment:

- : It includes domestic and foreign people or organization having financial and technical capabilities.
- : All of the private companies and business projects are established and run by the private investment.
- : private sector choose low risk and high return, low investment and short term run of the project.
- : At present, private sector has been the engine of growth in most of the countries.
- : At present, the government has emphasized globalization and liberalization approach by formulating proper policy and plans that has provided potential room for the development of private sector investment.
- : Its main objective is to maximize the profit rather than doing social welfare.

Financial Internal Rate of Return (FIRR):

- : It is the indicator to measure the financial return on investment of an income generation project and used to make the investment decision.
- : It is obtained by equating the present value of investment costs (cash outflows) and present value of net incomes (cash inflows).

Mathematically,

$$\sum_{n=0}^m \frac{I_n}{(1+r)^n} = \sum_{n=0}^m \frac{B_n}{(1+r)^n}$$

where, I_n = Investment expenditure for the entire project life period from year 0 to m .

B_n = Annual net incomes for the entire project life period from year 0 to m .

By Solving above equation, we can obtain the value of r which is FIRR.

If $FIRR > MARR$, Accept the project

If $FIRR < MARR$, Reject the project

If $FIRR = MARR$, Remain indifferent

- : FIRR is calculated by Financial analysis.
- : FIRR is mainly carried out by private sector.
- : Tax and Subsidies are incorporated in FIRR.
- : Market price is used.
- : Direct cost of projects and benefits are calculated by investors point of view.

Economic Internal Rate of Return (EIRR):

- The EIRR is calculated as the rate of discount for which the present value of the net benefit stream becomes zero, or at which present value of the benefit stream is equal to the present value of the cost stream.
- For the project should be acceptable the FIRR should be greater than the economic opportunity cost of capital.

$EIRR = FIRR + \text{profitability associated with consumers due to market price distortion} + \text{profitability associated with externalities expressed in market price} + \text{profitability associated with environment distortion.}$

- EIRR calculated by Economic analysis
- Direct as well as indirect cost and benefits are calculated by Social point of view in EIRR
- Tax & subsidies are ignored in EIRR
- so EIRR shadow price is used.

Return on Equity (ROE):

- ROE measures the return on the owner's investment in the firm.
- This shows how much income is earned for every rupees invested in the company.
- ROE shows the relationship between net income and common stockholder's investment in the company.

$$ROE = \frac{\text{Net income}}{\text{Owner's equity}}$$

The ROE concerned to be good if it is 20% or above

- : ROE is sometimes called return of net worth.
- : A rising ROE suggest that a company is increasing its ability to generate profit without needing as much ~~as~~ Capital.
- : Falling ROE is usually a problem.
- : Many investors choose to calculate the ROE at the beginning and end of period to see the change in return ratio.
- : ROE is a profitability ratio from the investors point of view not the Company point of view.

CH-10 Basic Accounting Procedure

Accounting:

- : Accounting is a system of collecting, summarizing, analyzing, classifying and interpreting business information in financial and monetary terms.
- : Accounting is a science of recording transactions of economic nature in a systematic manner and also art of analyzing and interpreting them.

Assets:

- : The resources or properties owned by the business organizations to generate economic benefit are known as assets.
- : Assets provide current and future economic benefits like cash, land, plant and machinery, building etc.

Types of assets:

(i) Fixed assets:

Fixed assets are also said to be permanent resources or properties because such assets acquired by a business for long last.

Eg: Land, building, plant and machine, Furniture and fixtures, vehicles, patents, Copyrights, trademarks, good will etc.

(ii) Current assets:

: Current assets are short term in nature and consists of cash, bank balance and other exp. resources which get converted into cash within the current fiscal year or during the operating cycle of the firm. Eg: cash, bank balance, debtors, inventories, account receivables, pre-paid expenses, pre-paid expenses, stock in trade, Market securities

(iii) Fictitious assets:

: Fictitious assets are those assets which have any real value, nor have any physical form.

Eg: Advertisement suspense account, preliminary expenses, discount on shares and debentures, debt balance of profit and loss account etc.

(ii)

Liability:

- : Liabilities are debt payable in the future by the firm to its creditors
- : It represents economic obligation to pay cash or provide goods or services in future.
- : Outside sources from which a firm can borrow are termed as liabilities.
- : It is

(i) Long term liabilities:

- : long term liabilities are financial obligation of a company that become due more than one year.
- : Eg: Debentures and preference shares, bank loan, Bond, Mortgages, secured and unsecured loan

(ii) Short term Liabilities:

- : short term liabilities are financial obligation to outsiders repayable in a short period usually within the accounting period.

Eg: sundry creditors, Bills payable, Account payable, outstanding expenses, Bank overdraft, Advance payment (income), short term loan, provisions for taxation, income taxes payable

Fundamental Equation of Accounting:

- : The fundamental accounting equation also called the balance sheet equation, represents the relationship between the assets, liabilities and ~~owners~~ capital of a business.
- : Assets denotes resources, and capital and liabilities are sources of financial.
- : The value of source and resource must be equal.
- : The relationship between assets, liabilities and capital that can be expressed by using a mathematical form which is called accounting equation.
- : It can be expressed as

$$\text{Assets} = \text{Capital} + \text{Liabilities}$$

$$\text{Capital} = \text{Assets} - \text{Liabilities}$$

$$\text{Liabilities} = \text{Assets} - \text{Capital}$$

Financial statements:

- : Financial statements are statements of financial information to the managers and the shareholders.
- : Financial statements are the financial information of the firm which is needed to compare and evaluate the company activities.
- : Significance of financial statements:

1. Financial statements analysis summarize and provide an overview of events relating to the functioning of a firm.
2. Financial statements analysis helps identify:
 - a firm strengths and weaknesses

So that management can take advantages of a firm's strength and make plans to counter weaknesses of the firm.

Objective of financial statements

1. Providing financial information
2. Ascertaining profit / loss
3. Showing appropriation of profit
4. Portraying financial position
5. Showing the position of cash

Basic Financial statements are:

1. Balance sheet
2. Income statement
3. Cash flow statement

Balance sheet

- A balance sheet is a statement prepared with a view to measure the exact financial position of a business on a certain fixed date.
- It is prepared to know
 - (i) What the business owes
 - (ii) What the business owns at a certain date.

Main Features:-

1. Balance sheet is a statement & not an account.
2. It is prepared at a particular date and not for a particular period.
3. It is prepared after profit & loss account.
4. Total assets = Capital + Liabilities
5. Shows financial position of a business as a going concern.

General Format of balance sheet:

Balance sheet of XYZ. Company Date: _____

As on 11th March, 2020 Page: _____

Assets	Rs.	Liabilities and Capital	Rs.
<u>Fixed Assets:</u>		<u>opening capital:</u>	xx
Land and building	xx	Less: Drawing:	xx
Plant and machinery	xx	Add: Net profit:	xx
Equipments	xx	Less: Net loss:	xx
Furniture & Fixtures	xx	Reserve and Funds:	
vehicles	xx	General reserve	xx
Live stocks	xx	Capital reserve	xx
Goodwill	xx	Specific reserve	xx
Patent, trademark & copyright	xx	Other reserve & funds	xx
		Secured Loans:	
<u>Investment:</u>		Debenture	xx
Investment in shares & debentures	xx	Loan from bank	xx
Investment in government securities	xx	other secured loan and advance	xx
<u>Current assets:</u>		Mortgaged loan	xx
Inventory	xx	Bonds	xx
Sundry debtors	xx	Unsecured Loan:	
Cash in hand	xx	Fixed deposits	xx
Cash at bank	xx	Short term loan from bank	xx
Interest accrued on investment	xx	Bank overdraft	xx
Accrued incomes	xx	Current liabilities:	
Stores and spare parts	xx	Bills payable	xx
Loss tools	xx	Sundry creditors/Account payable	xx
Closing stock	xx	Advance receipts	xx
<u>Loan & Advance:</u>		Outstanding expenses/payable	xx
Deposit with suppliers/custom	xx	Provisions:	
Bills receivable	xx	provision for taxation	xx
Prepaid expenses	xx	provision for staff provident fund	xx
Advance paid (tax, rates, etc)	xx	pension Fund	xx
<u>Miscellaneous Expenditure:</u>			
Preliminary Expenses	xx		
Advertisement suspense	xx		
Unadjusted development expenditure	xx		
Total	xx		

INCOME STATEMENT: (PART I) - WITHIN THE ACCOUNTS

- : Income Statement presents a summary and of revenues and expenses of a firm for the specific period.
- : It indicates whether the company is making or losing money during a stated period.
- : The basic equation on which an income statement is based is:

$$\text{Revenue} - \text{Expenses} = \text{Net income or (Loss)}$$

- i) Case of trading business, it is prepared in two steps
- i) Trading account
- ii) profit and loss account

Importance of income statement :

1. To ascertain gross and net profit
2. To keep control on indirect expenses
3. Basis for managerial decision
4. Basis for preparing balance sheet

I Trading account:

- : Trading account is the first step of final accounts.
- : Trading account helps to find out gross profit or gross loss during the accounting period.
- : The excess of credit total over the debit total is a gross profit and the excess of debit over total over the credit total is a gross loss.
- : The result gross profit / loss is transferred to profit and loss account.

Features of trading account:

1. It is the first stage of final accounts of a trading concern.
2. It is prepared on the last day of an accounting period.

Date: _____

Page: _____

(3) Only direct expenses & revenue are considered in it.

(4) Direct revenues are recorded on its credit side and direct expenses are recorded on its debit side.

(5) ~~It will be suitable for a small business firm.~~Format of Trading Account: ~~Open your notes~~

Trading account of - X.Y.Z Company

For the year ending - 30th March 2020

Dr.		Cr.
particular	Amount	Rs.
<u>TO Opening Stock</u>	<u>xx</u>	<u>By Sales</u> <u>xx</u>
<u>TO Purchase</u> <u>xx</u>		<u>Less: Sales return or,</u>
Less: Purchase return / Return outward/		Return inward or,
Return to creditors <u>xx</u>	<u>xx</u>	Return from debtors <u>xx</u>
<u>TO purchase Expenses:</u>		<u>By closing stock</u> <u>xx</u>
Carriage / carriage inward	<u>xx</u>	<u>By Gross loss transferred to</u>
Freight / Freight inward	<u>xx</u>	<u>Profit and Loss account.</u>
Carriage / Freight on purchase	<u>xx</u>	
Dock charges	<u>xx</u>	
Clearing charges GOT coolie and cartage	<u>xx</u>	
Import duty	<u>xx</u>	
Custom duty on import	<u>xx</u>	
Packing on purchase	<u>xx</u>	
<u>TO Factory / Manufacturing Expenses:</u>		
Wages / Salaries	<u>xx</u>	
Factory Rent	<u>xx</u>	
Fuel and power	<u>xx</u>	
Coal gas & water	<u>xx</u>	
Heating & lighting	<u>xx</u>	
Store consumed (Soap/cotton/paper)	<u>xx</u>	
Excise duty	<u>xx</u>	
Royalties	<u>xx</u>	
All other factory expenses	<u>xx</u>	
<u>TO gross profit transferred to</u>	<u>xx</u>	
<u>Profit and loss account</u>		
<u>Total</u>	<u>xx</u>	<u>xx</u>

Profit and loss account:

- Profit and loss account is prepared after the completion of trading account.
- Gross profit or loss of a business is ascertained through trading account and net profit is determined by deducting all the indirect expenses from the gross profit through profit and loss account.

Importance of profit and loss account:

- To ascertain net profit or net loss
- To keep control on indirect expenses
- Basis for preparing balance sheet
- Basis for managerial decision
- Helps for calculation of financial ratios

Format of profit and loss account:

Profit and loss account of XYZ Company

For the year ended 30th March 2020

Dr:

Cr

Particulars	Rs	Particulars	Rs
<u>To Gross loss</u>	xx	<u>By Gross profit</u>	xx
<u>To Office & Administrative expenses:</u>		<u>By interest received</u>	xx
<u>Salary and wages</u>	xx	<u>By Rent received</u>	xx
<u>Promotion and Stationary</u>	xx	<u>By dividend received</u>	xx
<u>Rent & taxes</u>	xx	<u>By discount received</u>	xx
<u>Insurance & Interest</u>	xx	<u>By Commission received</u>	xx
<u>Telephone & Electricity</u>	xx	<u>By Bad debt recovered</u>	xx
		<u>By profit on sale of assets</u>	xx

Date: _____

Page: _____

Audit & license fee	xx	By appreciation on fixed assets xx
Lighting & heating	xx	xx
Bonus & other official expenses	xx	By net loss transferred to <u>Balance sheet</u>
<u>TO Selling and distribution expenses:</u>		
Salesman salary & commission	xx	xx
Packing & travelling	xx	xx
Advertising and publishing	xx	xx
Free sample & ware house	xx	xx
Carriage & Freight outwards	xx	xx
Export duty & discount allowed	xx	xx
Research and development expense	xx	xx
<u>VAT and bad debts</u>	xx	xx
<u>TO other expenses and losses:</u>		
Depreciation	xx	xx
Repair & maintenance	xx	xx
Abnormal loss on goods, machine	xx	xx
<u>To net profit transferred to</u>	xx	xx
<u>balance sheet</u>		
<u>Total</u>	xx	xx

Cash flow Statement:

- : A statement which explains the changes in cash position from one balance sheet date to the next balance sheet date is known as cash flow statement.
- : Cash flow statement explains how the company generated the cash it received and how the company used that cash during the reporting period.
- : The cash flow statement reports cash flows during the period in three category:
 - I. operating activities
 - II. financing activities
 - III. investing activities

Importance of cash flow statement:

1. Showing the cash flow from different business activities.
2. Helpful for measuring liquidity
3. Facilitating the preparation of cash budget
4. Helpful for dividend decision
5. Helpful in planning

Financial Ratios:

- : Financial ratios are the ratios of the values of different components in the financial statements.
- : These ratios help in formulating various plans and policies to bring the company and the management on the right track.

Importance of ratio analysis:

1. Helpful in planning and decision making
2. Helpful in future forecasting
3. Helpful in corrective action
4. Helpful in cost control
5. Helpful in measuring profitability
6. Helpful in seeing performance trend and future forecasting.
7. Helpful in examining the strengths and weaknesses of a company.

Types of Financial Ratios:

1. Profit Margin (PM):

- profit margin on sales indicates the profit per rupees of sales
- we can say Company's operations are efficient if PM is 10% or above.

$$PM = \frac{\text{Net income}}{\text{Sales (Revenues)}}$$

$$= \frac{\text{Net income}}{\text{Sales (Revenues)}} \times 100$$

2. Return on Assets (ROA):

- ROA measures a company's success in using its assets to earn profit.
- we can say the Company has utilized its asset efficiently to make profit if it has ROA above 10%.

$$ROA = \frac{\text{Net income} + \text{Interest expenses} (1 - \text{tax rate})}{\text{Total assets}}$$

$$= \frac{\text{Net income} + \text{Interest expenses} (1 - \text{tax rate})}{\text{Total assets}} \times 100$$

3. Assets Turnover Ratio (ATR):

- It measures how effectively the firm uses its total assets in generating its revenues
- Its value usually should be 1 or more.

$$ATR = \frac{\text{Sales}}{\text{Total assets}}$$

4. Debt Ratio (DR): or debt to asset ratio

: It shows the relation between total debt and total assets

: Shows the proportion of the company's assets that it has financed with debt.

$$DR = \frac{\text{Total debt}}{\text{Total assets}}$$

: It's value should be (1.2 - 1.5 around)

5. Current Ratio (CR):

: It is used to measure the ability of the firm to meet its obligations due within one year.

: It is a measure of margin of safety of the creditors.

$$CR = \frac{\text{Current assets}}{\text{Current liabilities}}$$

: Its value should be (around 1.2 - 1.5)

6. Quick (Acid test) Ratio (QR):

: It tells us whether the company could pay all its current liabilities if they came due immediately.

: Its value should be approaches to 1 (0.6 - 0.8)

$$QR = \frac{\text{Quick assets}}{\text{Current liabilities}} = \frac{\text{current assets} - \text{inventories}}{\text{current liabilities}}$$

7. Inventory Turnover Ratio (ITOR):

- : It measures how many times the company sold and replaced its inventory over a specified period.

$$\text{ITOR} = \frac{\text{Cost of goods sold or sales}}{\text{Average inventory}}$$

8. Price earning Ratio (P/E):

- : It gives the idea about the how much investor are willing to pay a unit income of share.
- : This ratio is usually (15 : 1)

$$\text{P/E} = \frac{\text{Market price per share}}{\text{Earnings per share}}$$

9. Book value per share (BVPS):

- : It is also called net worth per share.

$$\text{Book value per share} = \frac{\text{Total equity}}{\text{Number of outstanding shares of common stock}}$$

- : Higher BVPS indicates increase in net worth per share.

Date: _____

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Profit and Loss account of - ... company

For the year ended ~~2010~~ 30th December 2010

Particulars	RS	Particulars	RS
To Salaries & Wages	27500	By Gross profit	122000
To Rent	7500	By interest received	750
To Selling Expenses	12500	By dividend received	1250
To Net profit	76500		
Total	124000		124000

Balance Sheet of - ... company

as on 30th December 2010

Assets	RS	Liabilities & Capital	RS
Goodwill	14500	Capital 250000	
Land & Building	135000	Add: Net profit 76500	326500
Plant & Machinery	225000	Reserve Fund	50000
Investment	12000	Bank loan	50000
Closing Stock	30000	Bank overdraft	23500
Sundry debtors	50000	Sundry creditors	39000
Cash at bank	10000		
Deposit with custom office	7500		
Advertisement suspense	5000		
	489000		489000

Golden Rules of Accounting:

There are three types of Golden Rules:

1. Personal A/c:

Debit the Receiver and credit the Giver.

: Related to natural & artificial person like Ram's Account, institutions account

2. Real A/c:

Debit what comes in and credit what goes out

: Related to all those properties and assets which are tangible & intangible
e.g. cash, Furniture, Land, building, Goodwill, trademarks.

3. Nominal A/c:

Debit all expenses and losses, and credit All incomes & gains

: Related to income, gains expense and losses of the business

Eg: wages, salaries, rent, advertisement, commissions, discounts