2082-7-29

Date
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Engineering Economic

What is economic?

→ Economic is a social science it's basis function is to study how people (individuals), household, forms, adminition, maximize their gain from their limited resources and opportunities

Engineering Economics

→ Engineering Economic is the field of these activities which are concern with the systemetic & evaluation of the cost and benefits of purpose technical and business project, Design and analysis, Engineering decision ~~on~~ covers a wide varity of areas ranging from choosing airport location to improving production methods & determining budget requirement.

Study & important uses of Engineering Economics

i) Selecting betⁿ alternatives design for a component machine, structure, system, product or service during the engineering design process
ii) Estimating & analyzing the economic consequences of improvements in a factory operation
iii) Selecting among proposed project within the annual capital budget limit
iv) Analyzing whether the equipment in the service should replace or not.
v) Choosing betⁿ assest lease or purchase option to a produ

* Utility
The power of satisfaction to a consumer by consuming goods or services

* Inflation
The situation of rise in general price level & fall in value of money

* Deflation
The situation of falling price level or rise in value of money. It is opposite of inflation

* Opportunity cost
It is the cost of best rejected / foregoing opportunity to earn & return from the use of resource.
The value of second best opportunity foregone by deciding to do one thing rather than another.

* Demand
The various quantities of an item that a buyer is willing to buy at alternative price, other things being equal. Desire with availability to pay & willingness to pay.

* Supply
The various quantities of an item that a seller is willing to sell at alternative price, other things being equal. Desire to sell with availability to sell & willingness to sell.

* Marginal Revenue (MR)
The change in total revenue due to one extra unit of quanting sold. It is the addition made to the total revenue when one more unit of output is sold

$$MR = TR_{n+1} - TR_n$$

where MR = Marginal Revenue,
TR_n = Total revenue upto n^{th} unit of output sold
TR_{n+1} = Total revenue upto $(n+1)^{th}$ unit of output sold

$$MR = \frac{\Delta TR}{\Delta Q} : \frac{\text{change in total revenue}}{\text{change in quanting sold}}$$

* Marginal Cost (MC)
The change in total cost due to one extra unit of output produced.
It is the addition to the total cost caused by producing one unit of output

$$MC = TC_{n+1} - TC_n$$

where, MC = Marginal Cost
TC_n = Total cost upto n^{th} unit of output
TC_{n+1} = Total cost upto $(n+1)^{th}$ unit of output

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\text{Change in total cost}}{\text{change in output produced}}$$

* Marginal Utility (MU)
The change in total utility due to one more / addition unit of consumption.
It is the utility derived by single unit in each case.

$MU = TU_{n+1} - TU_n$

where MU = Marginal Utility

TU_n = Total Utility upto n^{th} unit of output consumed

TU_{n+1} = Total utility upto $(n+1)^{th}$ unit of output consumed

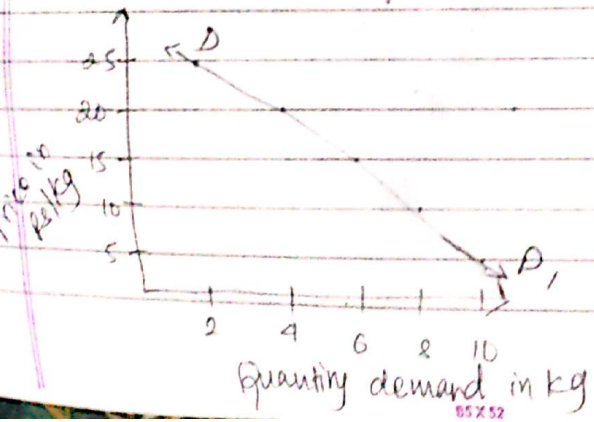
$MU = \frac{\Delta TU}{\Delta Q}$ = $\frac{\text{change in total utility}}{\text{change in quantity consumption}}$

* Principle of Economics

1) law of Demand

→ It is defined as "all other things remaining the same the quantity demanded of a commodity increase when it's price decrease & vice versa"

Price in Rs/kg	Quantity demand in kg
5	10
10	8
15	6
20	4
25	2



In above figure, DD_1 is a demand curve & slope of demand curve is negative i.e downward sloping from left to right. Demand curve has explained the meaning of law of demand i.e quantity demand is increased when price decreases.

* Factors Influencing Demand

i) Price of commodity
ii) Income of consumer
iii) Price of related goods
iv) weather
v) Cushion of fashion
vi) Size of population
vii) Future expectation

* Elasticity of Demand (Ed)

→ The term elasticity denotes the quantity of goods to expand & contract. Hence, the change in quantity demanded due to change in price, income etc is called elasticity of demand. It is defined as "elasticity of demand is the measure of relative change in quantity demand in response to a relative change in any of its determinants (price of the commodity, income of the consumer, price of related goods

→ E_d = $\frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in any one quantitive determi}}$ of demand

In ~~mde~~ modern time, broadly speaking the elasticity of demand is classified into three major types

a) Price elasticity of demand
b) Income elasticity of demand
c) Cross elasticity of demand

a) Price elasticity of demand (E_p)

→ It is defined as the degree of responsiveness of demand for a commodity to the change in its price. It shows that at what rate the demand changes with change in price

E_p : Proportionate change in quantity demanded of the commodity

Proportionate change in the price of the commodity

Symbolically,

$$E_p = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where, E_p = Price elasticity of demand

ΔQ = change in quantity demanded

Q = Initial quantity demand

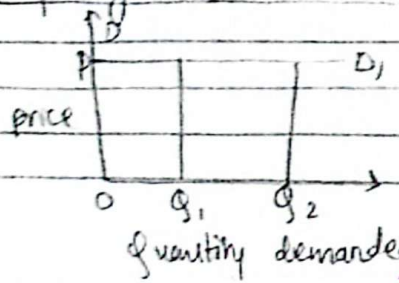
ΔP = Change in price

P = Initial price

* Types / Degree of price elasticity

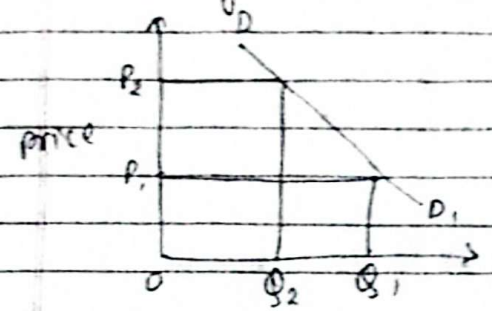
- There are 5 types of price elasticity of demand which are as follows -

i) Perfectly elastic demand, $E_p = \infty$



In the above figure, price is measured along Y axis & quantity is measured along X-axis. Horizontal demand curve DD. indicates small rise in price brings quantity demand to zero & small fall in price leads to increase quantity demand infinitely

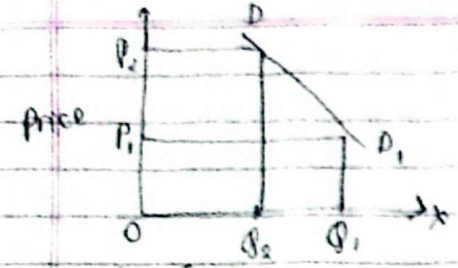
ii) Relatively elastic demand, $E_p > 1$



In the above figure, price & quantity demanded is measured along Y-axis & X-axis respectively when price decreases from P_2 to P_1 the demand increases ~~in price which refers relatively elastic price elasticity of demand is greater than decrease in price which refers relatively elastic price~~ Q_2 to Q_1. Here increase in demand is greater than decrease in price which refers relatively elastic price elasticity of demand.

Incase of luxurious & cosmetic goods, such demand can be realised

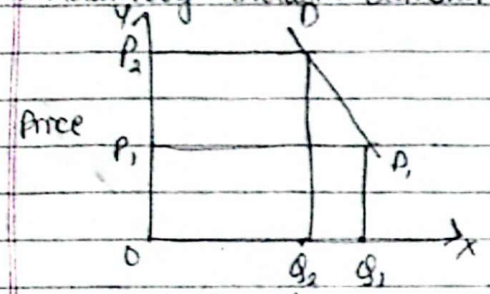
iii) Unitary elastic demand, $E_p = 1$



Quantity demanded

In the above figure, price & quantity demanded is measured in along Y-axis & X-axis respectively. When on price decrease from P_2 to P_1, demand increases from Q_2 to Q_1 there increase in demand is just equal to the decrease in price.

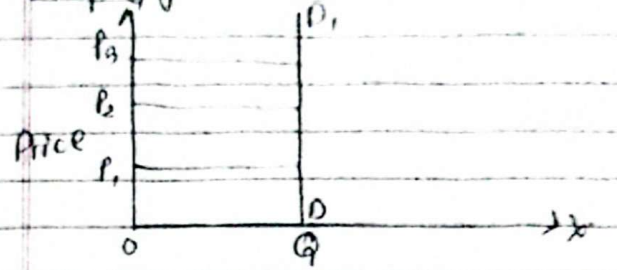
iv) Relatively inelastic demand, $E_p < 1$



Quantity demanded

In the above figure, DD_1 is relatively inelastic demand, because change in quantity demanded (Q_1Q_2) is less than change in price (P_2P_1). In other words, when price decreases from P_2 to P_1 demand ~~price~~ increases from Q_2 to Q_1 where increase in demand is less than decrease in price. In case of daily consumption (normal) goods, such demand can be realised.

v) Perfectly inelastic demand, $E_p = 0$



Quantity demanded

In the above figure, vertical straight demand curve DD, shows the ~~&~~ perfectly inelastic demand. Here, the quantity demanded remains fixed whatever changes in the price. It may be applicable in very low priced & bare necessary goods.

b) **Income elasticity of Demand (E_y)**

It refers to the change in quantity demanded due to the result of change in income other things remaining constant.

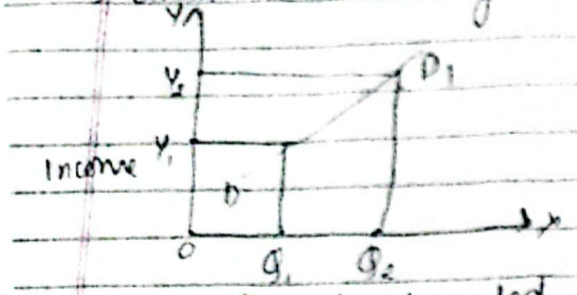
$$E_y = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in income}}$$

symbolically, $E_y = \dfrac{\frac{\Delta Q}{Q}}{\frac{\Delta Y}{Y}} = \dfrac{\Delta Q}{\Delta Y} \times \dfrac{Y}{Q}$

where, E_y = Income elasticity of demand
ΔQ = change in quantity demanded
Q = Initial demand
ΔY = change in income
Y = Initial income

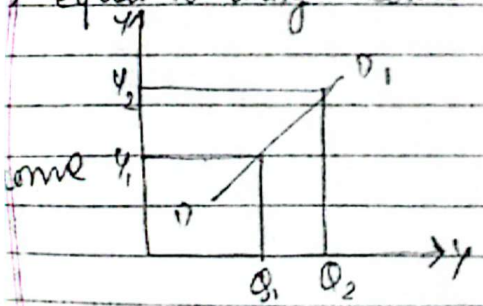
* Types of Income elasticity

i) Greater than a unity income elasticity ($E_y > 1$)



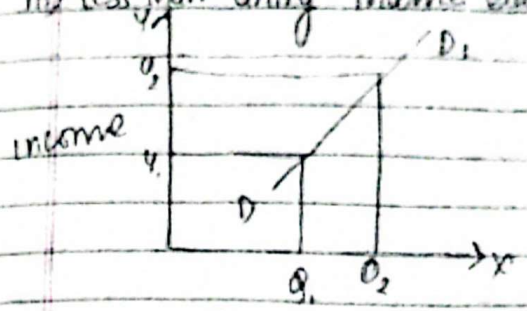
Income is measured along Y-axis & quantity demanded is measured along X-axis. Flatter demand curve DD, shows income elasticity is greater than unity. When income increases from Y_1 to Y_2, demand increases from Q_1 to Q_2. Here, increase in demand is greater than increase in income i.e. $Q_1Q_2 > Y_1Y_2$. Incase of luxurious goods, such elasticity can be found.

) Equal to unity income elasticity ($E_y = 1$)



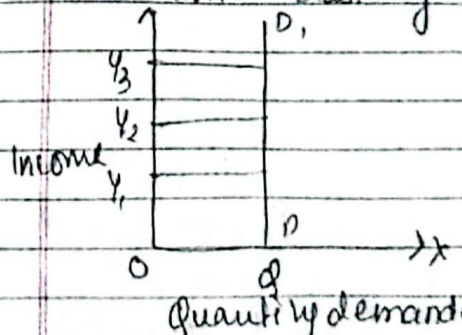
In the above figure, the demand curve DD_1 shows unitary income elasticity because when income increases from Y_1 to Y_2, it leads to increases demand from Q_1 to Q_2 where change in income & change in demand are equal.

iii) Less than unity income elasticity ($E_y < 1$)



In the above figure, the steeper demand curve DD, shows the less than unity income elasticity. Here, the change/increase in quantity demanded Q_1Q_2 is less than the change/increase in income Y_1Y_2. Incase of normal goods such elasticity can be realised.

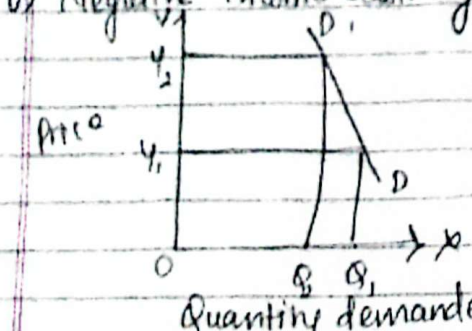
iv) Zero income elasticity ($E_y = 0$)



In the above figure, vertical straight demand curve DD_1 indicates zero income elasticity. Here, quantity demanded has remained constant whatever changes in the income of the consumer. Thus

happen in case of neutral (more necessary) goods like salt, matches, etc.

ii) Negative Income elasticity ($E_y < 0$)



Quantity demanded

In the above figure, the negative slope demand curve DD, indicate negative income elasticity of the demand. In this situation, Increase in income leads to decrease in quantity demanded. If goods are in fevior then the demand vary inversly with income because higher income inspire people to consume superior goods.

c) [Cross elasticity of demand (E_c)]

→ If the change in price of one commodity brings the change in the demand for other commodity then it is called cross elasticity of demand. In case of related goods (substitute & complimentary) such elasticity arise

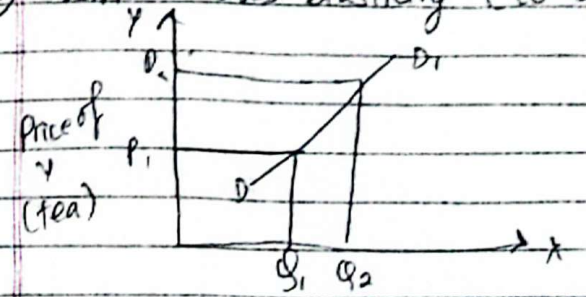
E_c : Proportionate change in quantity demanded of X / Proportionate change in price of Y

Symbolically; $E_c = \frac{\Delta Q_x}{Q_x} \div \frac{\Delta P_y}{P_y} = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{P_x}$

where, ΔQ_x = Change in quantity demanded for X commodity
Q_x = Initial demand for X commodity
ΔP_y = change in price of Y commodity
P_y = Initial price of Y commodity

* Types of Cross elasticity of demand

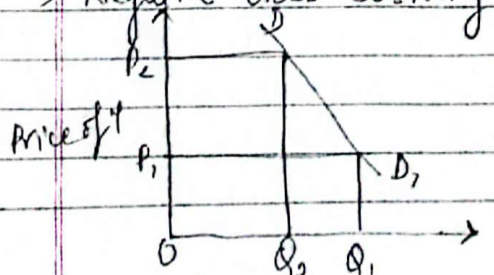
i) Positive Cross elasticity ($E_c > 0$)



Quantity demanded for X (Coffee)

In the above figure, the upward sloping demand curve DD, shows positive cross elasticity of demand. Here, the increase in price of commodity Y (tea) leads to increase in demand of commodity X (coffee). It is because of people substituting tea for coffee due to high price of tea when price of coffee is remaining constant

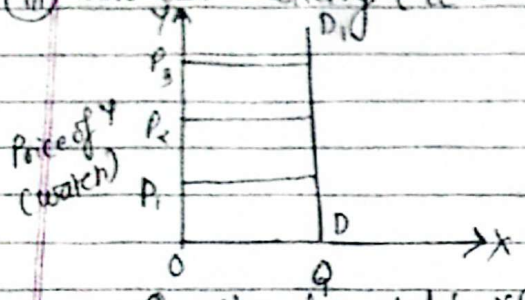
ii) Negative cross elasticity ($E_c < 0$)



Quantity demanded for X

In the above figure, downward sloping demand curve shows the negative cross elasticity of demand here, the increase in price of commodity Y (petrol) leads to reduce the demand of commodity X (motorbike) it is because of people couldnot use motorbike due to high price of petrol.

(iii) Zero cost elasticity ($E_c = 0$)



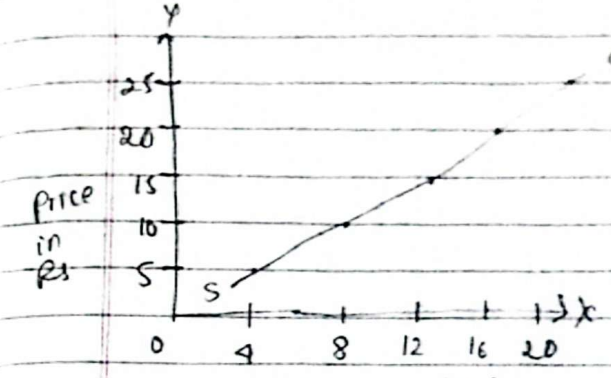
Quantity demanded for X (Sugar)

In the above figure, vertical straight demand curve D_1D_1 shows the zero cross elasticity of demand. Here, increase in price of commodity y (watch) doesnot have any effect to the demand for commodity x (sugar). It is because these goods are not related with eachother.

Law of supply

It can be defined as "Other things remaining the same as the price of commodity rises, its supply is extended & as price falls, its supply is contracted"

Price of tomato in Rs/kg	Quantity of supply in kg
5	4
10	8
15	12
20	16
25	20



Quantity supplied in kg

* Factors influencing supply

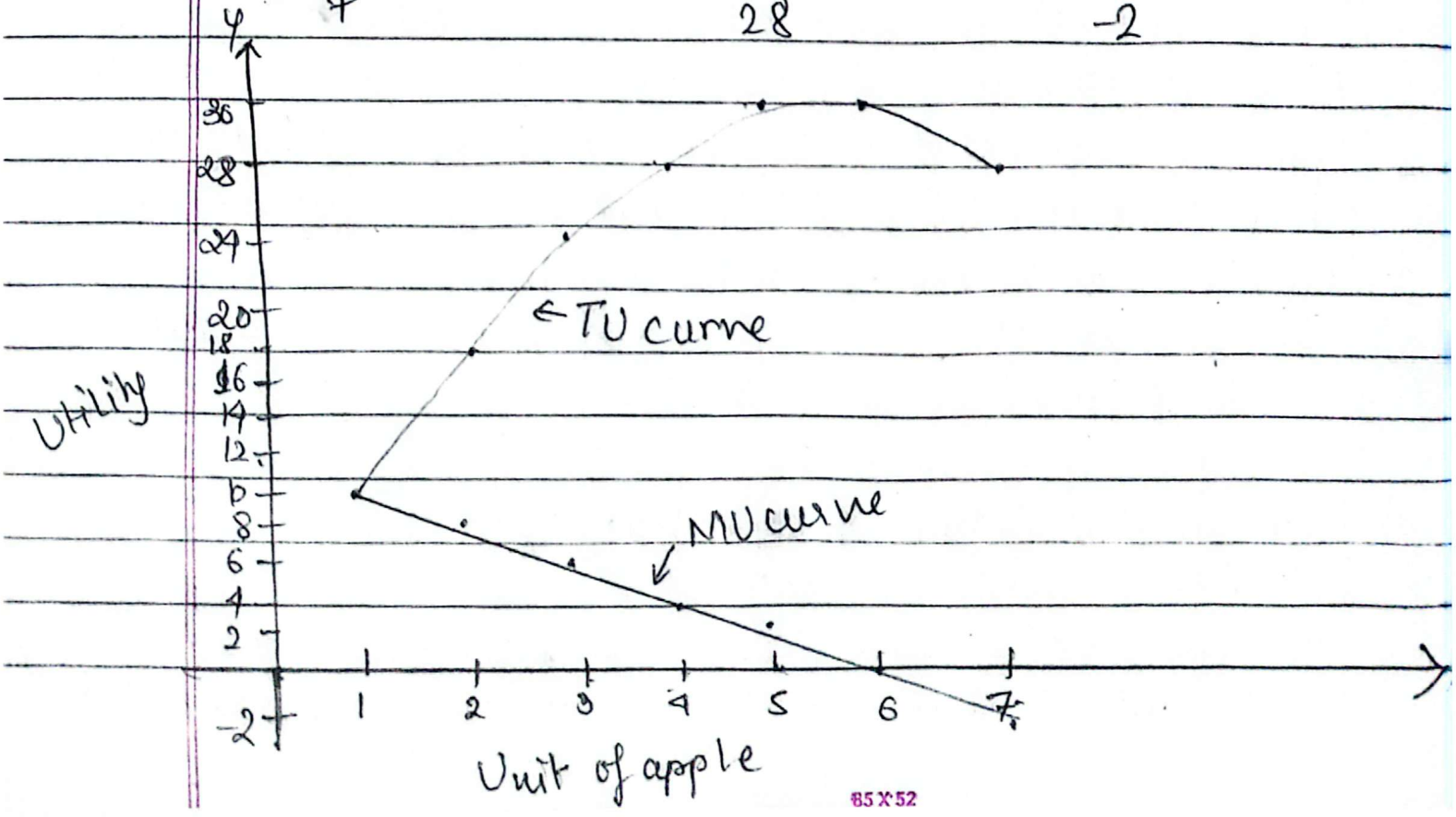
(i) Price of commodity
(ii) Price of factors of production
(iii) Price of related goods
(iv) Production technology
(v) Change in money income
(vi) New invention
(vii) Taxes & subsidies
(viii) Development in infrastructure
(ix) State of natural resources

Law of diminishing marginal utility

It states that in the process of fulfilling human wants, when a consumer consumes more & more unit of commodity, the

utility derived from its successive unit of the commodity goes on decreasing. Hence, the relationship betⁿ quantity consumed & utility derived from its successive unit is called the law of diminishing marginal utility.
According to Marshall "the additional benefit which a person derives from an increase of his stocks of a thing diminishes with the growth of the stock that he already has."

Unit of apple	Total utility	Marginal Utility
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2
6	30	0
7	28	-2



Time value of Money

It is defined as the time dependent value of money because of changes in purchasing power (inflation or deflation) & real earning capacity of capital overtime.

Interest

It is the prize of money, services or it is the fee that is charged for the use of money. Interest depends upon the total amount of money & length of time over which it is borrowed. There are two methods of interest calculation (Simple & compound)

Nominal & Effective Interest Rate

i) Nominal Interest Rate

If a financial institution uses a unit of time less than one year in length such as moth, a quarter or

ii) Effective Interest Rate

The actual rate of interest earned during one year known as effective rate & it is also expressed on the annual basis, unless specifically stated otherwise. It is represented by i

we know, $F = P(1+i)^N$

Let i = effective interest rate per year

r = nominal interest rate per year

m = no. of compounding period in year

Then, the interest rate per single compounding period would be, $i = \frac{r}{m}$.

$$i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$$

Alternatively, $I_N = (1+i)^N - 1$

N = no. of compounding period

I = interest rate per compounding period.

m = compounding period per year.

Derivation of compound interest formulas of single cashflow

1) finding F when given P

$$F = P(1+i)^N$$

Here, the factor term of the bracket i.e. $(1+i)^N$ is called single payment compound amount factor functionally, it is denoted by $(F/P, i\%, N)$ & it is read as find F given P at $i\%$ interest for N periods

2) find F when given A

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

Note: If annuity starts at the beginning

$F = A(F/A, i\%, N) \cdot (1+i)$ is needed.

3) Finding P when given A

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

Q. Suppose you have invested Rs 1000 at present. How long does it take for your investment to double if interest rate is 8% compounded initially?

Soln:-

$P = Rs\,1000$, $i = 8\%$, $F = 2P = Rs\,2000$.

We know

$$F = P(1+i)^N$$

$$2000 = 1000(1+8\%)^N$$

$$2 = (1.08)^N$$

$$\log 2 = N \log 1.08$$

$$\therefore N = 9 \text{ year}$$

Q. Find the effective interest rate when the nominal rate of interest is 18% per year & compounding is (i) Monthly (ii) daily (iii) hourly (iv) Continuously.

Soln:

$$i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1$$

i) Monthly

$$i_{eff} = \left(1 + \frac{0.18}{12}\right)^{12} - 1 = 0.19561$$

ii) Daily,

$$i_{eff} = \left(1 + \frac{0.18}{365}\right)^{365} - 1 = 0.1971$$

iii) Hourly

$$i_{eff} = \left(1 + \frac{0.18}{365 \times 24}\right)^{365 \times 24} - 1 = 0.1972$$

Q. A person deposits Rs 9000 at a nominal interest rate of 20% for 5 year. Find the maturing of the deposit when the interest is compounding quarterly.

Soln:

$$F = P(1+i)^N$$

$$i_{eff} = \left(1 + \frac{0.2}{4}\right)^4 - 1$$

$$= 0.2155$$

Now

$$F = P(1+0.2155)^5$$

$$= Rs\ 10612.91796$$

Imp

Q. Mr. Adikari wants to have Rs 80,09000 for the studies of his son after the perid of 15 years. How much rupees does he has to deposite end of each year for 10 continuous year in a saving account that earns 16% interest annually.

→ Soln:

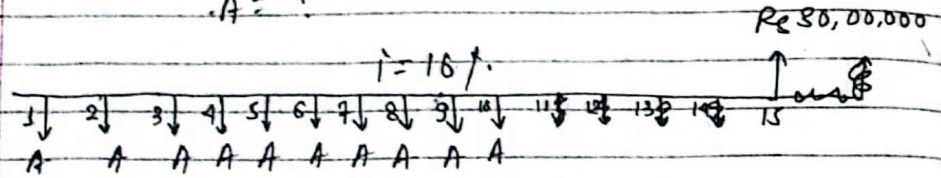
Given

F = Rs 80,00,000

N = 15 years

i = 16%

A = ?



Discounting Rs 80,00,000 to the year 10

P = Rs 80,00,000 (P/F, i%, N)

= 80,00,000 (1+0.16)$^{-5}$

= Rs 14,28,939

By using sinking fund factor,

$A = (A/F, 16\%, 10)$

$= 1428939 \left[\frac{0.16}{(1+0.16)^{10}-1}\right]$

$= Rs\ 66,990.696$ #

Q. How many deposites of Rs 25,000 is should make per month so that the final accumulation amount will be Rs 1000000 if the bank interest Rate is 12% per year.

→ Given. A = Rs 25,000 per month.

F = Rs 10,00,000

i = 12% per year

N = ?

Here, we need to monthly effective interest rate

$i_{monthly} = (1 + i_{yearly})^{1/12} - 1$

$i_m = (1+0.12)^{1/12} - 1$

$= 0.0099$

$= 0.99\%$

By using uniform series compound amount factor

$F = (F/A, 0.99, 12)$

$10,00,000 = 25000 \left[\frac{(1+0.0099)^N - 1}{0.0099}\right]$

$0.396 = (1.0099)^N - 1$

$1.396 = 1.0099^N$

log.

Now Taking log on both side

$\log 1.876 = N \log 1.0094$

$N = \frac{\log 1.876}{\log 1.0094}$

$N = 64.11$ deposite

Q. A man aged of 20 years now had borrowed Rs 4 Lakh from bank for his futher studing at the age of 20 year. The Bank was charged interest at 10% per year compounded quarterly. He wishes to pay that loan from last 10 same annual ~~with~~ way with equal installment basies and now he just cleared the loan. what ~~mon~~ amount did he pay in his installment?

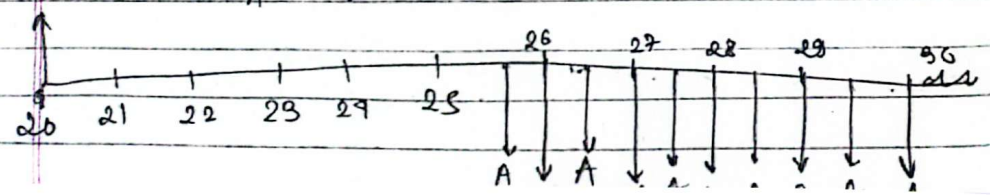
→ Given.

P = Rs 4,00,000

i = 10% per year and compounded quarterly

N = 10 years

A = ?



Quarterly interest rate, $i_q = \frac{10\%}{4} = 2.5\%$

Semi arrival interest rate,

$i_{sem} = (1+i_q)^2 - 1$

$= (1+0.025)^2 - 1$

$= 1.025^2 - 1$

$= 0.050625$

$= 5.0625\%$

Using single payment compound amount factor

$F = 40,0000\ (F/P, 5.06\%, 20)$

$= \text{Rs } 10,73,515$

Using uniform series compound amount factor

$F = A(F/A, 5.06\%, 10)$

or, $\text{Rs } 10,73,515 = A\left[\frac{(1+0.0500)^{10} - 1}{0.0500}\right]$

$\therefore A = \text{Rs } 85,110.62$

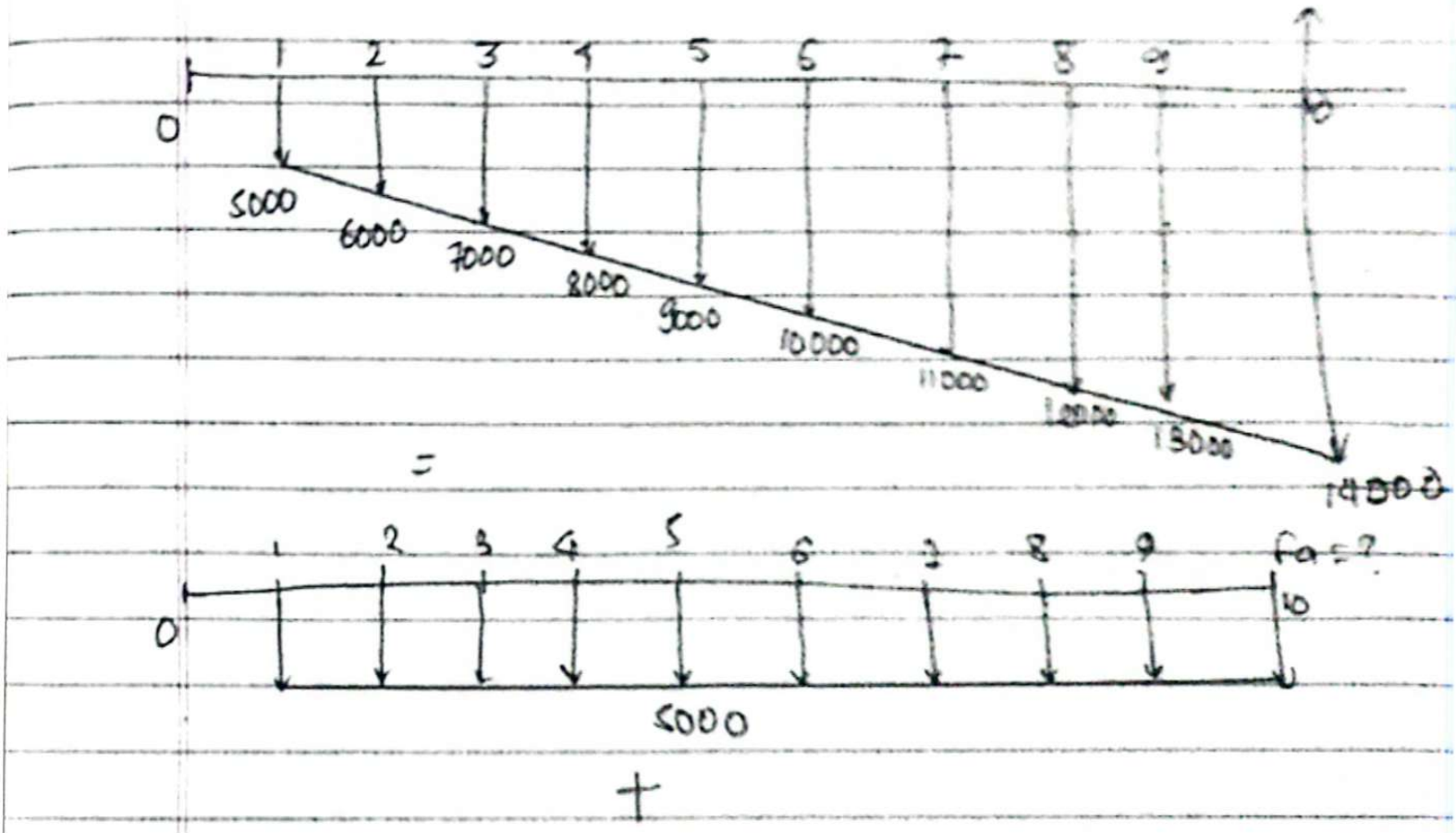
Gradient

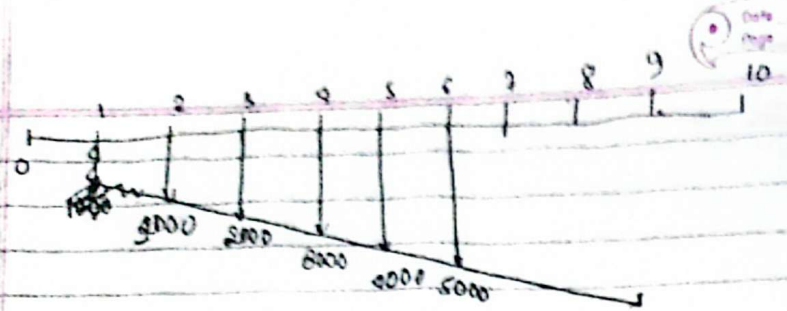
Interest calculation for uniform gradient and arthmetical progression of ~~cash flow~~ seu cashflo service which begins to increase or decrease from the end of 2nd period onwards is called linear gradient ~~series~~ seriu. and it is gene knowledge gradient.

Q A person is planning for his future life and retirement years of service. He would like to deposit Rs. [illegible] salary which is 5000 at the end of 1st year and there after he wishes to deposit the amount with an annual increase of Rs 500 in the next 9 years with an interest rate of 15%. Find the total amount at the end of 10th year with the above series

Sol:

G = Rs 1000
A = Rs 5000
N = 10 yrs
i = 15%.
F = ?





Using uniform series and gradient to compute future equivalence.

$$F = F_A + F_B$$

$$= (F/A, 15\%, 10) + \frac{G}{i}(F/G, i\%, 10)$$

$$= A\left[\frac{(1+i)^N - 1}{i}\right] + \frac{G}{i}\left[\frac{(1+i)^N - 1}{i}\right] - \frac{NG}{i}$$

$$= 5000\left[\frac{(1+0.15)^{10}-1}{0.15}\right] + \frac{1000}{0.15}\left[\frac{(1+0.15)^{10}-1}{0.15}\right] - \frac{10\times 1000}{0.15}$$

$\therefore F = Rs\ 190,209.83/-$

Chapter 1

Basic Studies Methods of Engineering Economic Studies

5 Mark

Minimum attractive rate of return (MARR)

- The minimum attractive rate of return (MARR) is that interest rate at which an investor can accept to earn or borrow money easily. It is regarded as a minimum rate of return that required to make the money. In engineering economic analysis, MARR is an interest rate and an indispensible factor to calculate the time value of money.
Generally, MARR is determined by top management from public level so it may be different from time to time and form to firm i.e.
MARR is determined from the opportunity cost view point.

Payback period

- The payback period methods calculate the number of years required for positive cash flow to just equal the total investment (I). Hence, this method is screens the projects on the basis of how long it takes for net recieve to equal investment.
On the basis of way to compute payback period method

can be classified into two types
a) Simple payback period
b) Discounted payback period

a) Simple payback period
→ Simple payback indicates the required time period to break even on an investment without considering time value of money. It is computed as follows.

Simple payback period (Sp) = initial investment / expected saving or net cash inflow for period

b) Discounted payback period.
→ This method includes time value of money for determining payback period. Hence, it is defined as numbers of years required to recover the investment from discounting cashflow i.e. considering time value of money.

Steps:
1) Discount each of the future cashflow into present
2) Calculate the required numbers of years to recapture initial investment

✓ Calculate the simple & discounted payback period from the given cashflow of a project when MAR is 20%.

End of period	Net cash flow (Rs)
0	-2500
1	+8000
2	+8000
3	+8000
4	+8000
5	+18000

Sol^n:-

Simple payback period

End of period	Net cash flow (Rs)	Cumulative cashflow
0	-25000	-25000
1	+8000	-17000
2	+8000	-9000
3	+8000	-1000
4	+8000	+7000
5	+13000	+20000

Here,
Cumulative cashflow turns to positive in period 4. Therefore payback period lies bet^n period 3 and 4. By interpolating, we get payback period

$= 3 + \frac{1000}{8000}$

Q. 3.45 periods

Discounted payback period.

End of flow	Net cash flow (Rs)	Discounted cash flow into pre (Rs) @ 20%
0	-25000	-25000
1	+8000	6667
2	+8000	5556
3	+8000	4630
4	+8000	3858
5	+13000	5229

Cummulative Cashflow (Rs.

-25000
-18333
-12,777
-8,147
-4289
835

$P = F(1+i)^{-N}$

when, $N = 0, 1, 2, 3, 4, 5$

Here, cumulative cash flow turns to positive in Period 5

Therefore, payback period lies bet^n period 4 & 5

By interpolating we get the required payback period

$= 4 + \frac{4289}{5,229}$

$= 4.82$ period.

$P = 8000\ (1+0.2)^{-3}$

$= 4629.62.$

Equivalent worth method

→ Equivalent worth method convert all cash flows into equivalent worth at some point of time (present or annual or future) by using an interest rate equal to minimum attractive rate of return (MARR)

a) Present worth method (PW)

→ Present worth method is based on the concept of equivalent worth of all cash flows to the base point or begining point in time called the present. Hence, according to this method, all cash inflows outflows are discounted to the base point at an interest rate for the economic study period.

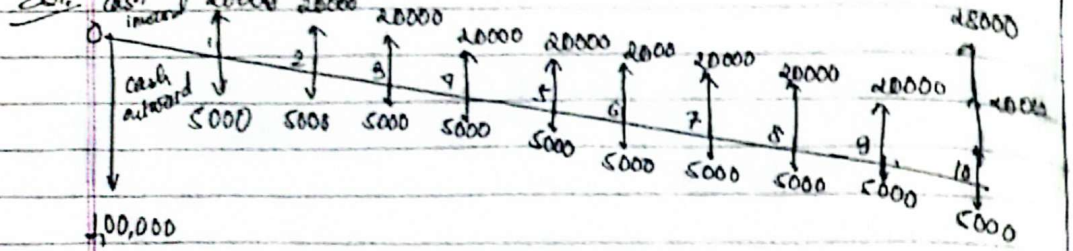
Decision rule

1) If PW(i%) > 0, accept the project
2) If PW(i%) = 0, remain indifferent
3) If PW(i%) < 0, reject the project

~~0 - 8.75 percents~~

Q. A new computer costing of Rs 1 lakh is estimated to have life of 10 years and expected annual revenue Rs 40,000 with annual & annual cost Rs 5000 determine the investment decision to this computer if salvage is Rs 25000 & MARR is 10% per year. Make also cashflow diagram.

Soln:



i = 10%.

Fig: Cashflow diagram

$$PW(10\%) = -100000 + \underbrace{15000}_{(20000-5000)}(P/A, 10\%, 10) + 25000(P/F, 10\%, 10)$$

$$= -100000 + 15000\left[\frac{(1+i)^N - 1}{i(1+i)^N}\right] + 25000(1+i)^{-N}$$

$P/A = \frac{(1+i)^N - 1}{i(1+i)^N}$

$P/F = (1+i)^{-N}$

$$= -100000 + 15000\left(\frac{(1+0.1)^{10} - 1}{0.1(1+0.1)^{10}}\right) + 25000(1+0.1)^{-10}$$

$$= Rs\ 1807.08$$

Since, PW(10%) > 0, the project is acceptable for

b) Annual worth method (AW)

Annual worth of a project is a uniform series of amount for a stated study period. It provide the basis for measuring investment worth in the series of equal payment at the end of each period.

$$AW(i\%) = R - E - CR$$

where,

R: Annual Recovery expenses
E: Annual equivalent expenses
CR: Annual equivalent capital Recovery amount

Decision Rules:

i) If AW(i%) > 0, accept the project
ii) If AW(i%) = 0 remain indifferent
iii) if AW(i%) < 0, reject the project

A Capital Recovery (CR)

→ Generally there are two types of cost in business operation operating cost (labor, raw material, fuel, etc) estimated on the annual production basis, while capital cost (land, building, equipments, etc) are fixed in initial period therefore for the purpose of annual equivalent cost analysis, capital cost must be

converted into anyal basis over the study period and such annual equivalent capital cost is denoted by capital recovery (CR). CR cost covers depretiation of capital assets and interest of invested money to the capital asset. Capital assets includes initial investment amount (I) and galvage value (S) of any business operation. So CR cost can be calculated as follows:

$CR(i) = I(A/P, i\%, N) - S(A/F, i\%, N)$

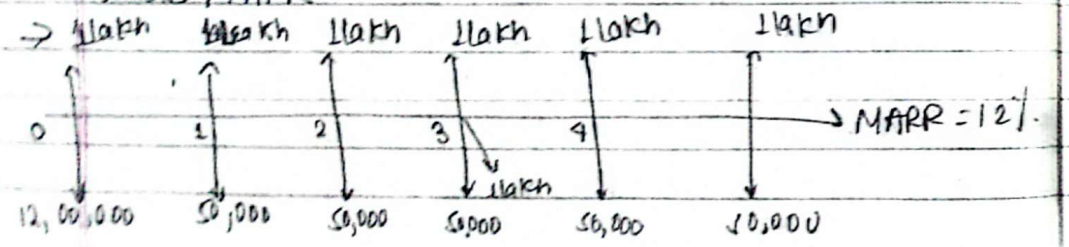
or

$CR(i) = (I-S)(A/F, i\%, N) + I(i\%)$

Or,

$CR(i) = (I-S)(A/P, i\%, N) + S(i)$

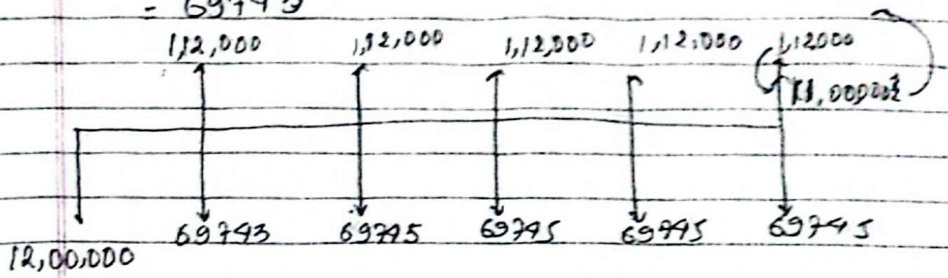
Q. Suppose you purchased a new car 5 years ago at Rs 12,00,000 the car needed Rs 50,000 to maintain at annual basis at the end of 3rd year. Rs 1 lakh was extra spent for air conditioning setup, now suppose, you wants to sell it for Rs 11 lakh and you are recieving rent of Rs 1 lakh per year at beginning of each year from the car. Evaluate your investment on car by annual worth the method where MARR



→ AR = 1,00,000 (1+i) = 100000 (1+0.12) = Rs 1,12,000

AE = 50000 + {1,00,000 (P/F, 12%, 3)}(A/P, 12%, 5)

= 69745



$CR = I(A/P, 12\%, 5) - S(A/F, 12\%, 5)$

$= 12,00,000\,(0.2774) - 11,00,000(0.1570)$

$= 3,32,880 - 1,78,140$

$= Rs\ 1,59,740$

We know,

AWC 12%) = R - E - CR

= 1,12,000 - 69,745 - 1,59,740

= - Rs 1,17,485

Since

PW(12%) < 0, the investment decision on the car is not beneficial.

c) Future worth Method (Fw)

→ Future worth of a project is the equivalent worth of all cash flows at the end of study period, hence according to this method all cash inflows & outflows are compounded forward to a reference point in time called future with given MARR to obtain future worth

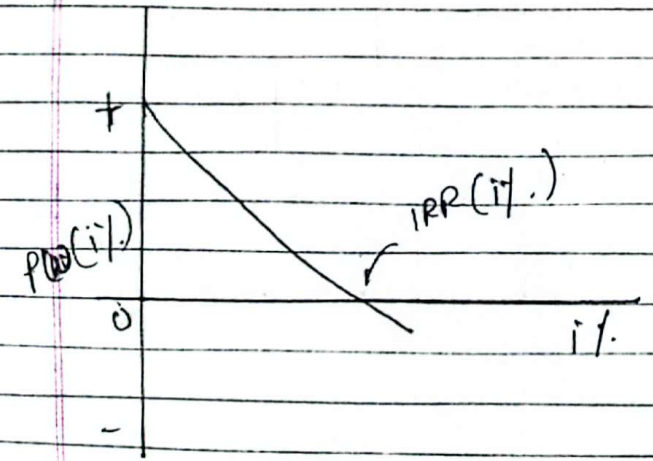
Decision Rules:

- if Fw(i%) < 0, Reject the project
- if FW(i%) > 0, accept the project
- if FW(i%) = 0, Remain indifferent

V.V.Imp. Rate of return method

a) Internal rate of return (IRR)

→ Internal rate of return (IRR) is that interest rate (return rate) which equiates the equivalent woord of an alternatives cash inflows to the cash outflow ~~cashflow~~ Inanother words, IRR is the breakeven interest rate at which equivalent worth of project cashflow is zero. At this particular rate of return the equivalent worth of rebenue generated by the project is enough to bear the equivalent worth of expences absorbed by the project without into. imposing anyother fhacial & burdon to the project. IRR is the term used for the rate of return that ~~sp~~ stresses the ~~into~~ interest or earned by project that is internally invested.



Method of calculating IRR

Step 1: Develop an equation for equivalent worth of any point of time & indicating rate of return (interest) by i%/percentage whoes value is to be found out

Step 2: Equate the developed eqn as to zero

step 3: Solve it to get the value of i%/~~percent~~ which could be IRR

& Decision Rule

i) if IRR ≥ MARR, accept the project

ii) if IRR = MARR, remain indifferent

iii) if IRR < MARR, reject the project

Note: To calculate the IRR we can use, Ru

$$IRR = i_1' = \frac{PW_1}{PW_1 - PW_2}(i_2 - i_1) \qquad i' = PW_1$$

Q. Compute the IRR for the following project also unrecovered investment balance in the gra tabular form.

initial interest ~~Rs=0~~ Rs20000 | MARR

Net annual revenue = Rs 8000

Salvage value = Rs 5000

useful life = 5years

Pw
i = i' = 0

2022-8-12

Sol^n By writting an eq^n with given information for net Pw and setting as to zero

$$PW) = 0$$

$$\Rightarrow -25000 + 8000(P/A, i'\%, 5) + 5000(P/F, i'\%, 5) = 0$$

Solving i'% by trail and error procedure

i'%	Pw(i'%)
10	$-25000 + 8000(3.7908) + 5000(0.6209) = 8931$
20	$-25000 + 8000(2.9906) + 5000(0.4019) = 939$
21	$-25000 + 8000(2.926) + 5000(0.3855) = 335$
22	$-25000 + 8000(2.864) + 5000(0.367) = -253$
25	$-25000 + 8000(2.6893) + 5000(0.3277) = -1887$

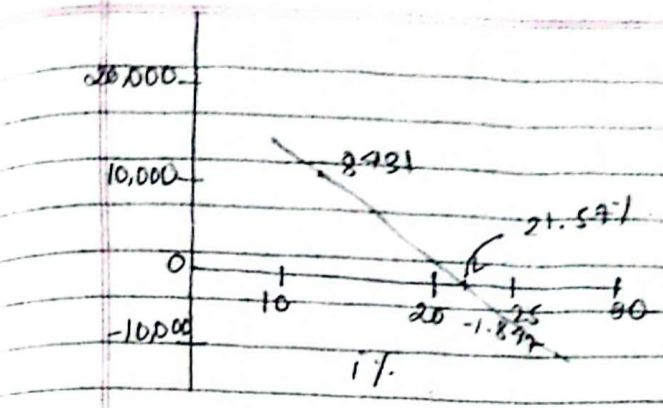
Since, we have both +ve & -ve Pw, we can use following formula to get required IRR,

$$IRR = i_1 + \frac{PW_1}{PW_1 - PW_2}(i_2 - i_1)$$

$$= 21\% + \frac{335}{335 - (-253)}(22\% - 21\%) = 21.57\%$$

Required IRR = 21.57%.

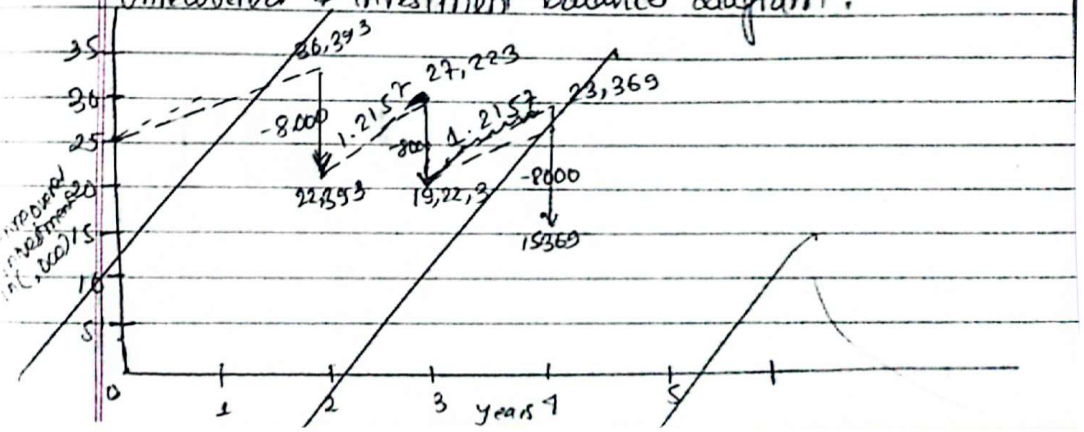
Since, IRR(21.57%) > MARR(20%), the project is accep



Unrecovered investment calculation in tabular form:

Year	Cash flow	Unrecovered Investment		Unrecovered investment
		Begining of year	End of year	-(P-F) after a year
0	-25,000	-	25000	-25000
1	8,000	-25000	30,893	-22,393
2	8,000	-22,393	-27,223	-19,223
3	8000	-19,223	-23,369	-15,369
4	8,000	-15,369	-18,689	-10,684
5	13,000	-10,684	-12,988	12

Unrecovered Investment balance diagram.



External Rate of Return (ERR)

→ The re-investment assumption of IRR may not always be practical for example if a firm's MARR is 20% per year and the IRR for the project is 40%. it may not be possible for the firm to reinvest net cash proceed from the project as much more than 20%. In this situation, coupled with computational demand and possible multiple interest rate associated with the IRR method has given rise to other rate of return method such as the external rate of return (ERR) method.

ERR method eliminates the drawbacks of reinvestment assumption to some extend. ERR method takes into account, the external reinvestment rate (e) at which net cash flows generated by a project over its life can be re-invested outside the firm.

Steps of ERR calculation

Step1:- All cash outflow are discounted to period 0 (the present @ at e% per compounding period)

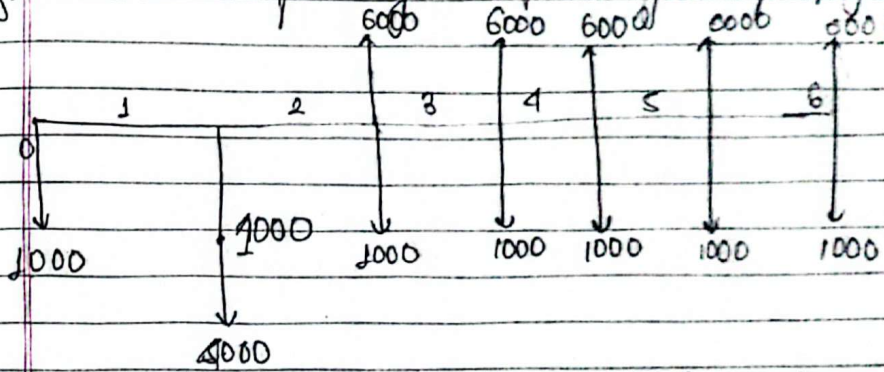
Step2:- All cash inflows are compounded to period N at e%

Step3: ERR is the interest rate that equivalence both the two quantities.

Decision value

1) if ERR > MARR, accept the project
2) if ERR = MARR, remain indifferent
3) if ERR < MARR, reject the project.

Q. Consider the following cashflow diagram of a project:



Calculate the ERR of the project if MARR = 10% and external reinvestment rate (e) = 15%. Is the project accepted?

Soln:

→ Discounting all the cash outflows to the present at 15%.

Cashoutflow =

= 1000 + 5000 (P/F, 15%, i) = 1000 + 5000(1 + 0.15)^-4

= 5347.32

$F/A = \frac{(1+i)^N - 1}{i}$

compounding

comparing all the cashoutflow to the year 6 at 15%

$= 5000\ (F/P, 15\%, 5)$

$= 5000\left(\frac{(1+0.15)^5 - 1}{0.15}\right)$

$= \$\ 33711.90$

Establishing the equivalence both two quantities

$5207.82\ (F/P, i', 6) = 33711.3$

or, $5847.82(1+i')^6 = 33,911.9$

or, $(1+i')^6 = 6.803$

$i' = 1.3591 - 1$

$i' = 0.3591$

$\therefore i' = 35.91\%$

Since, IRR (35.91%) > MARR (30%), the project is accepted.

$A/F = \frac{i}{(1+i)^N - 1}$ $A/P = \frac{i(1+i)^N}{(1+i)^N - 1}$

Benefit cost Analysis

Benefit cost (B/C) Ratio can be defined as the ratio of the equivalent worth of benefits to its equivalent worth of cost. It is also known as the saving investment ratio. Two commonly used formulation of B/C ratio are as follows:

1. Conventional B/C ratio

It is the ratio of gross benefits to cost and expressed as follows:

a) $B/C \text{ ratio} = \frac{PW(B)}{PW(I) - PW(S) + PW(O\&M)}$

b) with PW formulation

$B/C \text{ ratio} = \frac{FW(B)}{FW(I) - FW(S) + FW(O\&M)}$

c) With AW formulation

$B/C \text{ ratio} = \frac{AW(B)}{AW(I) - AW(S) + AW(O\&M)}$

$= \frac{AW(B)}{CR + AW(O\&M}$

2. Modified B/C ratio

It is the ratio of net benefits to cost and expr

a) B with PW formulation

$$B/C \text{ ratio} = \frac{PW(B) - PW(O\&M)}{PW(I) - PW(S)}$$

b) With FW formulation

$$B/C \text{ ratio} = \frac{FW(B) - FW(O\&M)}{FW(I) - FW(S)}$$

c) With AW formulation

$$B/C \text{ ratio} = \frac{AW(B) - AW(O\&M)}{AW(I) - AW(S)}$$

where B = benefits of proposed projects.
O&M = Operation & Maintenance cost of proposed project
S = Salvage value of the proposed project.
I = Initial investment in the proposal project.
CR = Capital Recovery Amount.

Decision Rule:

i) If B/C ratio < 1, reject the project.
ii) If B/C ratio = 1, remain indifferent
iii) If B/C ratio > 1, accept the project

3 Compare these two project by B/C ratio assuming that the projects are the independent investment opportunities and MARR is 10%.

Solution	Project A	Project B
Initial investment (Rs)	3000	5000
Annual benefits (Rs)	1900	2500
Annual O & M cost (Rs)	645	1383
Useful life (N)	4 yrs	8 yrs
Salvage value (Rs)	0	0

Solution

Using modified B/C ratio and AW formulation

	Project A	Project B
AW(B) - AW(O&M)	1255	
1900 - 645		
2500 - 1383		1117

CR cost	1104	
3500 (A/P, 10%, 4)		
5000 (A/P, 10%, 8)		937

Modified B/C ratio 1.14

$$\frac{1255}{1104}$$

1117

1..

Ch - 5

Comparative Analysis Of Alternatives

Mutually Exclusive Investment Alternatives interms of combination of Project

1. Independent Project
A project is said to be independent if it's selection is free from the acceptance ~~of~~ or rejection of any other projects in the group.

2. Dependent Project
The projects related to one another in such a way that the acceptance or rejection of one project influence of are called . The dependency among these projects may be classified into following 2 types.

(i) Mutually Exclusive Project
(ii) Contigent Project

(i) Mutually Exclusive project
→ They are these when one project is choosen all other are excluded in the group.

(ii) Contigent Project
→ Two or more projects are said to be contigent if

the acceptance of one project require the acceptance of another

formulation of Mutually Exclusive combination of Project

Mutually exclusive combination	Project A_1	A_2	B_1	B_2	Explaination
1	0	0	0	0	Do nothing
2	1	0	0	0	Accept A_1
3	0	1	0	0	Accept A_2
4	0	0	1	0	Accept B_1
5	0	0	0	1	Accept B_2
6	1	0	0	1	Accept A_1 & B_1
7	0	1	1	0	Accept A_1 & B_2
8	0	1	0	1	Accept A_2 & B_1

IMP

Q. Some engineering projects are being considered with cash flow estimated over 4 yrs as shown in table below. Using the Pw method and MARR = 10% per year. Determine what combination of project is best, if the capital to be invested is

(a) Unlimited (b) Limited to Rs. 50000

$$P/A = \frac{(i+1)^n - 1}{i(1+i)^n}$$

Project	B_1	B_2	C_1	C_2	D
Initial Investment (Rs.)	50000	30000	14000	15000	10000
Annual Revenue (Rs.)	20,000	12000	4000	5000	6000
B_1 and B_2	Mutually Exclusive & independent of C_1 & C_2				
C_1 and C_2	Mutually Exclusive and contingent on the acceptance of B_2				
D	Contingent on the acceptance of B_2 & C_1				

Soln

Pw calculation for Each project

Pw for project B_1 = $-50000 + 20000 (P/A, 10\%, 4)$
= Rs. 13,400

Pw for project B_2 = $-30000 + 12000 (P/A, 10\%, 4)$
= Rs. 8040

Pw for project C_1 = $-14000 + 4000 (P/A, 10\%, 4)$
= Rs. 1320.53 ≈ 1320

Pw for project C_2 = $-15000 + 5000 (P/A, 10\%, 4)$
= Rs. 849.32 ≈ 850

Pw for project D = $-10000 + 6000 (P/A, 10\%, 4)$
D = Rs. 9020

Mutually exclusive combination	Project B_1	B_2	C_1	C_2	D	Remarks
1	0	0	0	0	0	Do nothing
2	1	0	0	0	0	Accept B_1
3	0	1	0	0	0	Accept B_2
4	0	1	1	0	0	Accept B_2 & C_1
5	0	1	0	1	0	" B_2 & C_2
6	0	1	1	0	1	Accept B_2, C_1 & D

Combined project cash flows and Present worth

Mutually Exclusive combination	Cash flows (Rs.) for end of year 0	1	2	3	4	Invested capital (Rs.)	PW (Rs.) at MARR 10%
1	0	0	0	0	0	0	0
2	-50,000	20000	20,000	20,000	20000	-50,000	13400
3	-30,000	12000	12000	12000	12000	-30000	8040
4	-44000	16000	16000	16000	16000	-44000	6720
5	-45000	17000	17000	17000	17000	-45000	8890
6	-54000	22000	22000	20000	29000	-54000	15,740

Decision:

1) When the capital investment is unlimited, the mutually exclusive combination 6 is the best combination (bcz it has highest PW)

2) When capital investment is limited to Rs 50,000 mutually exclusive combination 2 is the best because it has highest present worth of Rs. 13,400

3) Comparison of alternatives using Capitalized worth (CW Method)

- CW is the present worth of an alternative for an infinite study period. CW method is introduced as a special case of PW criterion when revenue and expenses occur over an infinite length of time. Many public projects like hydropower, road, irrigation, bridge, etc. have substantially longer service life, and benefit is also extended over these period. Specially, this method is convinent for evaluating and comparing alternatives where the project has perpetual service life.
- Planning horizon is extermely long
- Repeatability & assumption is applicable in case of mutually exclusive alternative

Capitalized worth

$$CW_M(15\%) = -120 \cdot \frac{AW_M(15\%)}{i} = \frac{-4591.6}{0.15} = -Rs\,30610.$$

$$CW_N(15\%) = \frac{AW_N(15\%)}{i} = \frac{-719}{0.15} = -Rs\,97,606$$

we found that, $CW_M(15\%) < CW_N(15\%)$

Hence, select structure M. So as to reduce cost

Repeatability assumption

Q. By using PW (or FW) and repeatability Method select the best project.

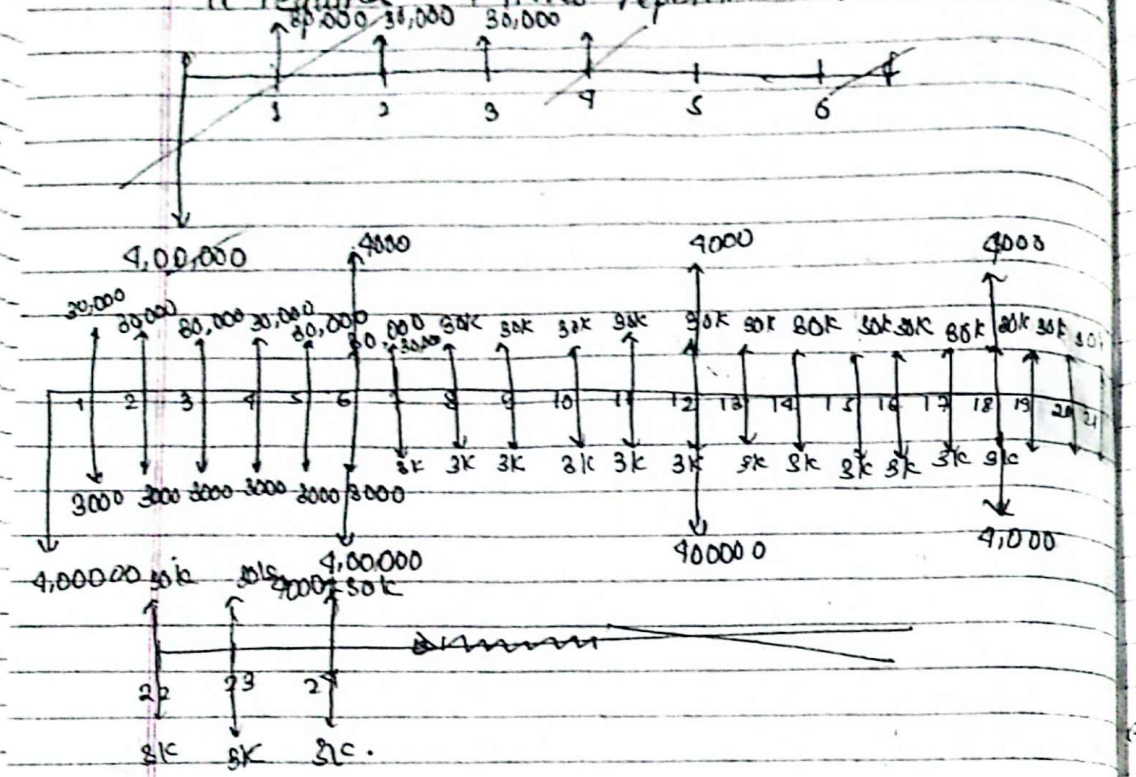
Project	A	B
Initial investment (Rs)	4,00,000	6,00,000
Annual Revenue (Rs)	30,000	35,000
~~Useful life~~		
Annual O & M (Rs)	3000	4000
Useful life (yrs)	6	8
Salvage value (Rs)	4,000	7,000
MARR %	18%	12%

Soln:-

Study Point : LCM of 6 and 8 = 24 yrs.

Project A

It requires 9 times repetition.



PW = - 4,00,000 - 4,00,000 (P/F, 12%, 6) - 400000 (P/F, 12%, 12) - 400000 (P/F, 12%, 18) + (8000 - 3000) (P/A, 12%, 24) + 4000 (P/F, 12%, 24) + 4,000 (P/F, 12%, 12) + 4000 (P/F, 12%, 24)

P/F = (1+i)^-n

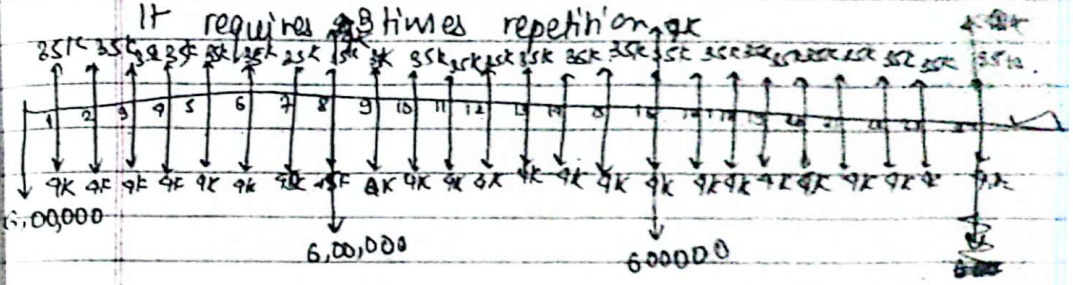
P/A = ((1+i)^n - 1) / (i(1+i)^n)

= - 400000 (1 + (4,00,000/400000) (1/(1+12/100))^6 + (1/(1+0.12))^12 +

(1+0.12)

For Project B

It requires 8 times repetition.



PW = - 600000 - 6,00,000 (P/F, 12%, 8) - 600000 (P/F, 12%, 16) - 600000 (P/F, 12%, 24) + (85000 - 4000) (P/F, 12%, 24) + 4000 (P/A, 12%, 8) + 40000 (P/A, 12%, 16) + 40000 (P/F, 12%, 24)

= - 600000 (1 + (1+0.12)^8 + (1+0.12)^16 + (1+0.12)^24) +

31000 (9.12

$= -600000 - 242,330 - 97,873 + 2,41,313 + 2,827$

$= 1,142,961$

$= Rs - 940203 + 245743$

$= Rs - 6,94,960$

Decision

Both projects have negative value that is both are not preferable but if decision is to be made we should go for lesser negative value i.e. project A is best.

Chapter-6

Risk Analysis.

It is defined as a state of knowledge in which decision makers can predict different alternatives and each alternative leads two on set of outcome and the probability of its outcome is none. So, risk refers to situation where project has a number of possible alternatives outcome but the probability of each occuring is known.

Certainity

It is define as a state of knowledge in which the decision maker knocons in advance the specific outcome to which each alternative will invariably lead. So, under certainity decision marker have perfect knowledge about future result of whatever decision he might make.

Uncertainty

It is a stare of knowledge in which there are so many alternatives whoes probabiliny cannot be estimated i.e. It is decision situation where several state / alternative are possible but sufficient informa is not available to assign probability values to there occurance.

Origin| source of project risk

- There are 4 major source of risk and uncertainty that affect f npw (net present worth) i.e. engineering economic studies

1) Cash flow estimate

- Risks arises from inaccurate projections of inflows and outflows, leading to potential shortfalls in liquidity or unexpected financial constraints.

2) Nature of business

- Industry-specific challenges, such as market volatility, competition, or regulatory changes, can impact project outcomes

3) Rate of interest

- Fluctuations in interest rates affect borrowing costs, investment returns, and overall financial viability.

4) Study Period

- The time frame for project evaluation may introduce risks. If it fails to account for long-term uncertainties, market dynamics or life cycle changes.

** Methods of dealing project risk :-

- There are 3 methods for dealing project risk

1. Sensitivity analysis
2. Break even analysis
3. Scenario analysis

1. Sensitivity analysis:

- Sensitivity analysis: ~~tests~~ reveal how much the NPW of a project will change in response to a given change in one input variable / parameter.

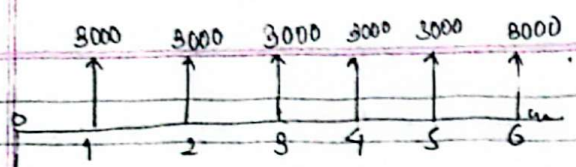
+imp

Q) Perform sensitivity analysis of the following project's range of ±40% in a) initial investment b) annual net revenue c) Salvage ~~est~~ value d) useful life

initial investment (i) = ₹ 11,000
net annual revenue (A) = 3000
Salvage (S) = 1000
useful life (N) = 6 yrs
MARR = 10%

draw also sensitivity diagram / graph.

Sol^n:-



Rs 11,500

$PW(10\%) = -11{,}500 + 3000\,(P/A, 10\%, 6) + 1000(P/F, 10\%, 6)$

$= -11{,}500 + 8000\left(\frac{(0.1+1)^6 - 1}{(0.1+1)^6\, 0.1}\right) + 1000\,(1+0.1)^{-6}$

$= 2130.25$

a) When initial investment (I) varies ±40%. the PW would be

$I = +40\%$, $PW = -11500\,(1.4) + 13065.6 + 569.4 = -2970$

$i = -40\%$, $PW = -11500 \times 10.6 + 13066.6 + 569.4 = 6730$

When net annual revenue AR value ±40%., PW would be

-40% $AR = -11500 + (9000 + 1200) \times 4.35526 + (1000 + 900)\,0.5643$

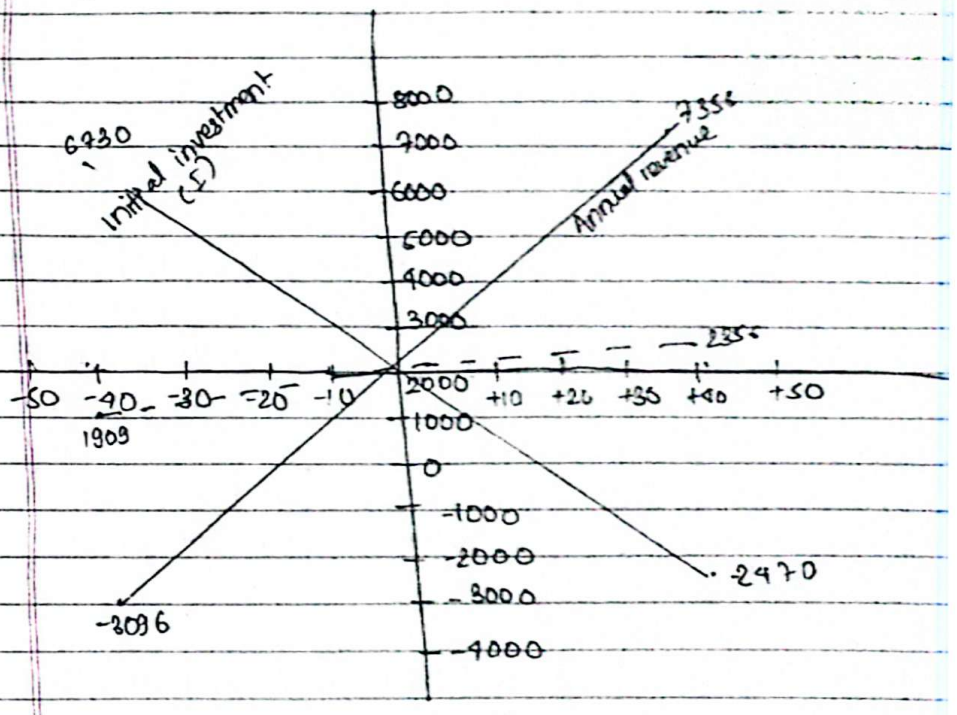
$= 7582.11$

-40% $AR = -11500 + (9000 - 1200) \times 4.35526 + (1000 - 900)\,0.5$

$= -3321.992$

Calculation table

Parameter	PW(10%) -40%	-20%	0%	+20%	+40%
I	6730		2130		-2970
AR	-3096		2130		7356
S	1909		2130		2356
N	-2077		2130		8920



On the basis of calculation table & sensitivity diagram, annual revenue AR parameter of the project is highly sensitive when compared to other parameter.
i.e. AR curve is more steeper than other in diagram.
It is followed by investment (i) parameter and useful life (N) parameter respectively
Salvage value (S) parameter is least sensitive on this particular project.

2) Scenario Analysis:

It is a technique that considers that sensitivity of NPW due to change in key variables at a time and the range of likely values of those variable. for example, the decision maker may examine two extreme case. A worse case scenario (low sales / low price / high cost and so on) and a best case scenario. (High sales, high price, low cost & so on)

Q From the following information of different variables/parameters and cases, calculate NPW for each scenario by assuming i = 12%, MARR = 15%. and unit demand, fixed cost for 5yrs are equal.

Variable considered	Worst-case scenario	Most likely case	Best case scenario
Unit Demand	1800	2000	2400
Unit price (Rs)	48	50	53
Variable cost (Rs)/unit	17	15	12
Fixed cost (Rs)	11000	10000	8000
Salvage value (Rs)	30000	40000	50000

Soln:

1) Worst case scenario.

$$NPW(15\%) = -125000 + (1600 \times 48 - 1600 \times 17 - 11000)(P/A, 15\%, 5) + 30000\,(P/F, 15\%, 5)$$
$$= -125000 + 38600\,(3.3522) + 30000\,(0.4972)$$
$$= -125000 + 129395 + 14915$$
$$= 19311$$

2) Most likely scenario:

$$NPW(15\%) = -125000 + (2000 \times 50 - 2000 \times 15 - 10000)(P/A, 15\%, 5) + 90{,}000\,(P/F, 15\%, 5)$$
$$= -125000 + 60000 \times (3.3522) + 90000\,(0.497$$

$= -125000 + 201132 + 19888$

$= 96020$

3) Best case scenario

NPW (15%) $= -125000 + (2400 \times 53 - 2400 \times 12 - 8000)$ (P/A, 15%, 5) $+ 50000$ (P/F, 15%, 5)

$=$

$= 2,02,899$

9) Breakeven Analysis:

Breakeven Analysis is a most common methodology use for economic evaluation of new investment alternati It determines the value of a critical factor at which economic tradeoff balanced. When the equivalen worth of cash inflows & outflows are depended upo a single factor (parameter) the value of this fact for which equivalent worth of cash outflows equ the equivalent worth of cash inflow is called breakeven point & it's analysis is called breakeven analysis.

Q. Consider the following two motors, each of 100H output capacity.

Item	motor A	motor B
Purchase cost (Rs)	125,000	160,000
efficiency (η)	94%	92%
life (yrs)	10	10
Maintences cost per year	5000	2500
Annual tax & insurance	1½% of investment	
MARR	15%	

a) How many hours per year would the motor have to be operated at full load for the annual cost to be equal? If the electricity cost is Rs 5 per kilowatt hr

b) If annual operation is more than 5500 hrs, which motors should be selected.

Soln:- For motor A

Calculating the annual equivalent cost

i) Capital recovery (CR) cost = Rs 125000 (A/P, 15%, 10)
= Rs 29,906.5

ii) Maintence cost = Rs 5000

iii) Tax and insurance = 1.5% of 125000
= Rs 1875

iv) Operating expenses for power (electricity cost), we know that,

$$\text{Efficiency } (\eta) = \frac{\text{Output}}{\text{input}}$$

$$\therefore \text{input} = \frac{\text{output}}{\text{efficiency}}$$

let, x be the number of hours of operation per year.

Operating expenses = input x Rate x hours

$$= \frac{\text{output}}{\text{efficiency}} \times \text{rate} \times \text{hours}$$

[∵ Note: 1 hp = 0.746 kW]

$$= \frac{100 \times 0.746}{0.79} \times 5 \times x$$

$$= 500.95x$$

∴ Total amount equivalent cost of motor A (Ans of x)

= Rs 29,906.5 + Rs 5000 + Rs 1875 + 500.95x

= Rs 36,781.5 + 500.95x ——— (1)

For Motor B

Calculating the annual equivalent cost

i) Capital Recovery (CR) cost = Rs 60,000 (A/P, 15%, 5)
= Rs 27,763.56 31,880.33

ii) Maintence cost = Rs 2500

iii) Tax and insurance = 1.5% x 160000 = 2400

iv) Operating expense for power (electricity cost), we know that

$$\text{efficiency } (\eta) = \frac{\text{Output}}{\text{input}}$$

$$\therefore \text{input} = \frac{\text{Output}}{\text{efficiency}}$$

let x be the number of hours of operation per year.

Operating expenses = input x Rate x hrs

$$= \frac{\text{output}}{\text{efficiency}} \times \text{rate} \times \text{hr}$$

$$= \frac{100 \times 0.746}{0.92} \times 5 \times x$$

$$= 405.43x$$

Total amount equivalent cost of motor B (Ans of x)

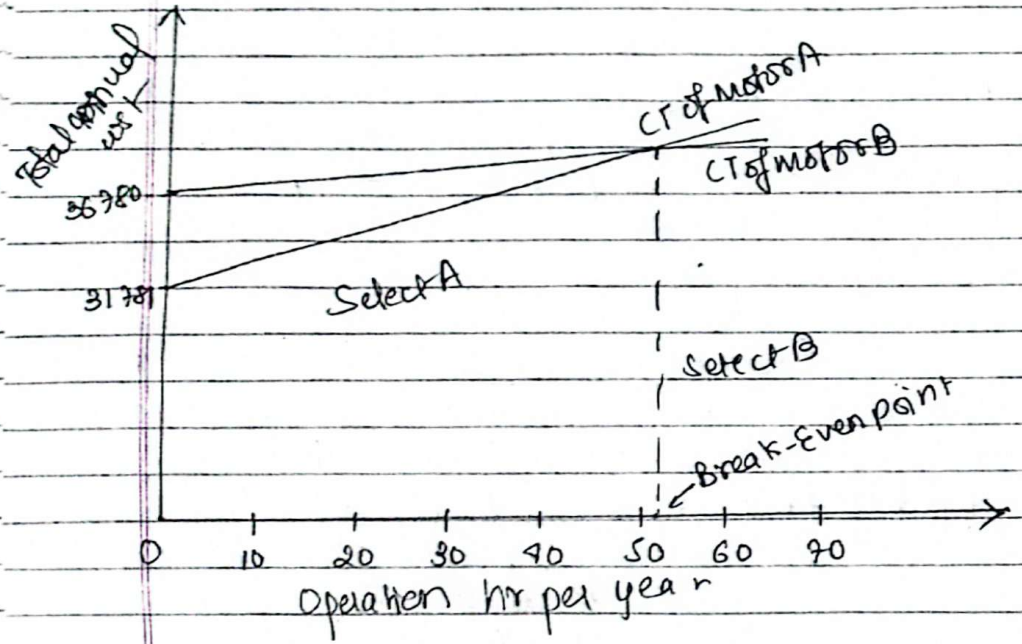
= Rs 31880.33 + Rs 2500 + Rs 2400 + 405.43x

$= 36780.33 + 405.33X$

To get break given pair even point
AW of A = AW of B

~~3781 = 3781.5~~ $36780.33 + 405.33X$

or, $X = \frac{\text{~~1926.83~~}}{\text{~~38~~}}$ 50.4 //



If annual operation is more than 45hrs, Motor B is selected

Chapter-7

Depreciation

Depreciation is the permanent degree in the value of capital asset from any cause

Causes of Depreciation

1) Wear & tear
2) Effusion of time
3) Obsolescence
4) Exhaustion or depletion
5) Accident
6) Fall in market value

Depreciation method

1) Straight line method.
Under this method, the same or equal or fixed amount of depreciation is charged every year throught the life of the asset so that the book value of asset may be reduced to zero.

Annual Depreciation = $\frac{\text{Original cost of asset} - \text{estimated salvage value (if any)}}{\text{estimated life of the asset}}$.

If rate is given, annual depreciation = Total depreci value X rate % by 100.

Amount of depreciation / Total depreciation value $\times 100$

Alternatively, rate of depreciation $= \frac{1}{N} \times 100$

where N = life of asset

[∵ Note: total depreciable value = initial cost + all other expenses − salvage value]

Depreciation formula of 1st line

$$d_k = \frac{B - S}{N}$$

$$D_k^* = \frac{k(B-S)}{N}$$

$$BV_k = B - D_k^*$$

Where d_k = annual depreciation deduction in the year

B = original cost / initial cost

S = salvage value

N = life of the asset

D_k^* = Accumulative depreciation through year K

BV_k = Book value at the end of year K

Q. A machine costing of Rs 1000, assumed to have life of 5 yrs and salvage value is zero find

a) Depreciation amount for any such year

b) Accumulated depreciation throughout life of 5 yrs

c) Book value at the end of year 1

Soln:

a) $d_k = \frac{B - S}{N}$

$= \frac{1000 - 0}{10}$

$= 100$

b) D_k^* = [illegible]

c) $BV_k = B - D_k^*$ = [illegible]

2) Matheson Method

This method is assumed that the constant rate of depreciation is fixed or constant percentage of the book value at the beginning of the year.

[∵ Note: Book value = Original cost − accumulated depreciation]

In order to extract the percentage [rate], following formula is used,

$$R = 1 - \sqrt[N]{\frac{S}{B}}$$

where R = Rate of depreciation
N = life of asset
S = Salvage value
B = Original / initial cost

This formula cannot be applied if the asset has not no any salvage value

We caused following formula, to calculate depreciation of Matheson Method

$$d_K = B(1-R)^{K-1} \cdot (R)$$

$$D_K = B[1-(1-R)^K]$$

$$BV_K = B(1-R)^K$$

Q. A machine cost Rs 7000 is estimated to have life of 10yrs. Find d_6, D_6 & BV_6 if R = 20% if there is no salvage value by using Matheson method

Now,

$$d_6 = B(1-R)^{6-1} \cdot (R)$$
$$= 7000(1-0.2)^{6-1} \cdot 0.2$$
$$= Rs\ 262.144$$

$$D_6 = 7000[1-(1-0.2)^6]$$
$$= Rs\ 5901.824$$

$$BV_6 = 7000(1-0.2)^6$$
$$= 1098.176$$

Sum of Year Digit (SOYD) method

Under this method, depreciation per annum is calculated on the basis of proportion of total number of estimated life of an asset. This method results in larger depreciation charge during the beginning of the asset & smaller depreciation charge as asset gets old.

SOYD depreciation = $\frac{\text{Remaining useful life at the beginning of particular year}}{\text{SOYD for the total useful life}} \times (I - S)$

Where, I = initial investment, S = salvage value

(1) We have purchased a mini computer at a cost of 10,000 with an estimated salvage value of Rs 500 & projected useful life of 6 years. If interest rate is 10% per year, determine
(a) SOYD depreciation (b) Double rate declining balance depreciation
(c) Sinking fund depreciation

Sol^n:

(a) SOYD depreciation

Given, original cost (I) = Rs 10,000, salvage value (S) = Rs 500
useful life (N) = 6 years

We know, SOYD $= \frac{\text{Remaining useful life}}{\text{Total useful life}} \times (I - S)$

$$SOYD = \frac{N(N+1)}{2} = \frac{6(6+1)}{2} = 21$$

Depreciation charge for particular year will be as follows:

Year	SOYD depreciation
1	$6/21 \times (10,000 - 500) = 2857.14$
4	$3/21 \times (10,000 - 500) = 1928.57$
5	$2/21 \times (10,000 - 500) = 952.38$
6	$1/21 \times (10,000 - 500) = 476.19$
	Total = Rs 10,000

(b) Double rate declining balance depreciation

We know that,

$$R = \frac{1}{N} \times 100 \times 2 = \frac{1}{6} \times 100 \times 2 = 33.33\%$$

B = 10,000

Depreciation charge for particular year will be as follows:

Year	Double rate declining balance depreciation $d_k = B[1-R]^{k-1} \times R$		BV$_k$ $B(1-R)^k$
1	$10,000[1-0.3333]^{1-1} \times 0.3333 = 3500$		7000.35
2	$K=2$	2333	9667.13
3	$K=3$	1556	8111.52
4	$K=4$	1037	2074.07
5	$K=5$	691	1383.04
6	$K=6$	461	922.02

Total = Rs 9,578

(c) Sinking fund depreciation

We know, sinking fund depreciation (A) = $(I - S) \times (A/F, i\%, N)$

$A = (10,000 - 500)(A/F, 10\%, N)$

$\therefore 10,000 (A/F, 10\%, N)$

$= 1296.07$

Year	Fixed depreciation (A)	Net depreciation (d_k)	Book value (BV$_k$)
1	1296.07	1296.07	9203.93
2	1296.07	1425.68	7778.25
3	1296.07	1568.24	6210.01
4	1296.07	1725.07	4484.94
5	1296.07	1898	2587.94
6	1296.07	2087	500
		Total = 10000	

Service output method (Unit of production Method)

All the depreciation methods, discussed above are based on elapse time (year). But, if the decrease in value of an asset is based on total working hour or production unit, then it is called service output method or unit of production method.

Depreciation rate per unit of output / working hour (R)

$$= \frac{(I - S)}{\text{Total working hour (or production unit)}}$$

where I = inital investment
S = salvage value.

Q. A machine costing of Rs 60000 is estimated to have Rs 10000 salvage value when replaced after 30000 hours of use. Find its depreciation rate per hour of use and book value after 10000 hours of use

→

$$R = \frac{60000 - 10000}{30000} = \frac{90000}{30000} = \frac{9}{3} \text{ per hour}$$

Book value after 10000 working hrs

$$= 60000 - 10000\left(\frac{9}{3}\right)$$

$$= 60000 - 18333$$

Chapter. 10

Basic Accounting Procedure

Accounting terminologies

1. Business Transaction

- Those transaction and events which are
a) Financial nature & measured in terms of money
b) Establishing for profit motive purpose
c) Life of business would depend on its availability to make profit and sustain it.

2. Accounting:

- It is often called the language of business because it provides information to managers, owners, customer, an investers and other decision makers inside and outside of an organizations.

3. Assets:

The resource of properties to generate economic benefits is known as asset. Assets provide current & future economic benefits like cash, land, plant & machineries, buildings, etc.

Assets can be tangible and intangible which solely or combinedly contribute in earning

Following are the examples of current asset:

- Cash in hand
- Cash at bank
- Bills receivable
- Prepaid expenses
- Stock in Trade
- Sun dry debtors.
  (A person who recive goods or service from a business in credit or doesnot make the payment immediatly & is liable to pay the business in the future)
- Short term investment
- Acquired income

capacity of the firm. Such assets are acquired by the firm is measurable monetary units.

Assets can be classified into four types - fixed, current, fictious and intangible Assets.

1. Fixed Assets:

They are also said, to be permanent resource or properties because such assets acquired by a business for long last. They are not purchased or resell but used to increase the earning ~~capat~~ capacity of business.

For eg: Land and building, plant and machines, business permises, furniture and fixtures vechicleset

2) Current Assets.

They are also known as floating assets or liquid assets because these are converted into cash in normal course of business.
Generally current asets die not kept by business firm for more than 1 year.

* Fictious Asset

Fictious donot have any real value so they are asset for name sake. They are taken as assest in legal and technical background. Preliminary expenses, advertisment expenses, discount on share and debenture under writing commission, etc.

* Intangable Asset

- This are asset which cannot be touched and donot have any physical form. Pattern, goodwill, copyright & trademark are intangable Asset.

Capital

The amount invested by the trader in his trade is called Capital. Capital means ownership, equity which is changeing due to every transaction in business.

Capital denotes the seed invested in the beginning and surplus on afterward.

Capital or Ownership equity = assest + liabilities.

* Liabilities:- Liabilities are borrowed sum from the third parties to the business.

Liabilities are dept payable in the future by the firm to its creditor. It represents an economic obligation to pay cash or true provides goods or services in future. &

Generally, liabilities are created by borrowing money or purchasing good and services in credit.

Liabilities can be upto two types.

1) Current liabilities
2) Longterm liabilities

1) Current liabilities

→ They are repayable within one year i.e. an accounting period. Current asset are converted into cash to pay current liabilities. following are the examples of current liabilities

i) Sundried Creditors.

A person who gives goods or services to the business in credit or doesn't recieve the payment immediately from the business and is liable to recieve the payment from the business in future is called sundried creditors

ii) Bill payable.
iii) Bank overdraft
iv) Outstanding expenses
v) Advance Income.
vi) Short term loan vi) Provision

2) Long term liabilities
- They are also known as permanent liabilities which are raised for more than one year i.e. they are the obligation or ~~date repay~~ debt repayable for more than one accounting period. Following are examples of it
i) Debenture
Debenture is a written document of loan, issued by the company.
ii) Bank loan
iii) Bond :- It is similar to debenture. Bond is issued by government or corporation ~~acqu~~ acknowledging that money has been lent to it & will be payed back with interest
iv) Mortgage

Fundamental equation of accounting
→ Assest, liabilities ~~are 3 basic~~ and capital are 3 basic element of every business transaction. Here assest denotes resources and capital and liabilities are source of financing. The value of resource and source must be equal. ~~Asses~~

Assest = capital + liabilities.

Capital = Assest - liabilities
Liabilities = Assest - capital.

Imp

Q. ~~Period~~ Prepare accounting equation on the basis of following transition.
i) Commenced business with cash ~~with~~ Rs 1,00,000
ii) Purchase goods for cash : Rs 50,000 &
~~iii)~~ Credit Rs 30,000
iii) ~~Payed~~ Paid rent in advance = Rs 1000
iv) ~~Showed~~ sold good for cash for = Rs 40,000 costing of Rs 30000
v) Paid salary - Rs 1000

Sol^{n}:-

Transaction	Assets (=)		Liability + Capital	
1) Commenced business with cash Rs 100000	Cash	100000	Liability + capital	0 100000
2) Purchase goods for cash Rs 50000 & Credit Rs 30,000	Cash + Stock	50000 +30000 80000	Liabilities + capital	0 +10000 10000
3) Paid rent in advance Rs 1000	Cash + rent payment + stock	49000 1000 +80000 130000	Liabilities + capital	80000 +10000 120000
4) ~~Paid salary Rs 1000~~ Sold good for Cash Rs 40000 costing Rs 30000	cash + rent prepaid + stock	89000 1000 +50000 140000	Liabilities + capital	30000 +110000 140000
5) Paid salary Rs 1000	cash + rent prepaid + stock	89000 1000 +50000 139000	Liabilities + capital	30000 +109000 139

Therefore, new equation cash + rent + stock = liabilities + Capital

88000 + 1000 + 80,000 + = 170000 + 180000 + 109000

⇒ 189000 = 189000

Debit & Credit

The account the recieves the benefit is called as Debit & The account that gives the benefit is called as Credit. The learn debit & Credit are originate from alit latin word 'debeo' & 'credeo' respectively. The Debit is denoted by Dr & Credit is by Cr

Rules for Debit & Credit:

→ There are 2 approaches for the rules of debit & Credit.

1) Traditional approach
2) Transaction approach.

1) Traditional approach (Golden rule for debit & Credit).

→ There are 3 types of account like personal, real, and nominal account.

a) Personal account

⇒ It is related to natural and artifical person like Ram's account, firm's account, Company's account, institution account, capital account, trade creditor account, drawing account.

The person who recieves of benefit is debited and the person who gives of benefit is credited.

The rules for personal account are

"Debit is the reciever, Credit is the giver"

b) Real account.

It is related to all the properties and assets which are tangible and intangible. Cash, furniture, inventory, machinary, land, buildings, etc are eg of tangible real account. And Patterns, trademark, goodwill are the examples of intangible real account.

The rule for real account are "what comes in it debited" and what goes out is credited".

c) Nomial account

All such accounts which are related to income, gains, expenses and loses of the business are prompt as nomial account. Its examples are wages, salaries, rent, carriage, advertisment, interest, discount, commissions, etc.

The rule of for debit & Credit for nomial accounts are "All expenses and loses are debited, all incomes and gains are credited."

e) Transaction approach

→ The transaction approach for debit and credit is based on accounting equation. So, it is known as accounting equation approach. It can be turned as modern rule or american approach.

Assets : Capital + Liabilities.

Assets = (capital + profit) + Liabilities

Assets = (Capital + revenue - expenses) + Liabilities

∴ Assets + expenses = Capital + revenue + Liabilities

Therefore, the modified accounting equation can be expressed as $A+E = C+R+L$

Rules of debit & credit on the basis of accounting equation will be as follows:-

A + E	=	C + R + L
Increase is debited	:	Increase is det credited.
Decrease is credited	:	Decrease is debited

Financial statement

At the end of accounting year, an income statement accompained by a balance sheet is prepared in order to find out profit earned or loss suffered by an business organization. These two statements i.e. Income statement & balance sheet are jointly called financial statement or position statement or final account

Hence, it is clear that financial statement are those statement which provide regarding the information about the result of operation and state of affairs ~~f y~~ years of certain business organization at the end of given period. It is very important statement because it contains the information like profit earned (or loss suffered) the list of resource utilized to earn such profit and source of fund (money) to acquire resource.

Income stable is the first part of financial statement. Incase of trading business, it is prepared in two steps:

1) Trading account
2) Profit & loss account

1) Trading account

→ Trading account is the first step of financial statement (final account) of trading organization. The objective of preparing trading account is to ascertain gross profit or earned or gross loss suffered during the given accounting period (year). Gross profit is acertained by trading accounting is also called as overall profit. Whot stand for difference bet sales proceed of goods and cost of good actually sold. In equation, gross profit

gross profit = Sales - cost of goods sold.

formate:

Preparation and formate of trading account:-

Trading account is a special account which is prepared at the end of accounting year. It is prepared in 'T' form as other accounts. But get an date and folio year are not provided. columns

Date of trading account is mentioned on the top of the formate in the second line. All the direct expenses are debited and all direct incomes are credited to trading account. Begin a special nomial account. After posting all related direct incomes and direct expenses, gross profit (or gross loss) is acertained. If the total debit is less than total of credit the difference will be gross profit and vice-versa:

The general formate of trading account is given below.

Trading Account of - - - - - - -
For the year ending - - - - - -

Dr Cr

Particular	Account (Rs)	Particulars	Account (Rs)
To Opening stock		By Sales	
To Purchases		less: Sales returns	
less: Purchase return		By closing stock	
To wages			
To Customs & import duty			
To carriage expenses			
To Royalty			
To Manufacturing expenses			
To Packing expences			
Total:		Total:	
To gross profit transferred to profit and loss account		By gross loss transferred to profit & loss account	

Either a gross profit or gross loss shall appear in trading account, it should transfer to profit & loss account. If there is gross loss appeared in trading account, it should be transfer to debit side of profit and loss account and if there is gross profit, it should be transfer to profit side of profit & loss account.

Q. Prepared trading account of ~~right~~ a Hi and tech company for the year 2011 considering the following information.

Wages = Rs 60000

(Opening) Stock = 1-1-2011 = Rs 125000

Purchase = Rs 370000

Sales = Rs 570000

Carriage = Rs 10,000

Return inward = Rs 5000

(Closing) Stock. 30-12-2011 = Rs 75000

Goods loss by accident = Rs 20,000

Return outwards = Rs 4000

Duty & clearing charge = Rs 5000

Soln:-

Trading Account of Hi and Tech company
For the year ended 30th December, 2011

Dr

Particular		Account (Rs)	Particular	Account
To Opening stock		125000	By sales 5,70,000	
To Purchase	375,000		less	
less return outward	4,000		less return inward 5000	565
To carriage		10,000	By closing stock	75
To duty and clearing charges		5000	By goods lost in	
To wages		60000	accident	20
To gross profit transfered to P/L account		5,65,000		
		99,000		
		6,60,000		6,60

(2) Profit & loss account

→ Profit & loss account is prepared after the ~~com~~ completion of trading accounting. In this us trading account is just a part of income statement and without profit & loss account, inco statement remains incomplete.

Sep Debit & credit account formate,

Profit & loss account is also a nominal account. After posting, all related accounts to profit and loss account, net profit or loss is ascertained.
if ~~trading~~ is credit total is greater than debit total of profit & loss account, there will be net profit. and vise versa.

Balance sheet is the final step of final Account. It is prepared at a given date (point of time). To show financial position of a business concern. Balance sheet is not an account but a statement of assets & liabilities & Capital of the business enterprise in a given date. It is an important statement with the help of which management of the concerned & third parties can obtain valuable information that matters. Balance sheet provides information, ~~on~~ not only of total assets but also the composition of fixed assets, investment, current & fictious assets. In liability side, it also shows owner shipibility & borrowed from third parties

General format of Balance sheet:

In the balance sheet, assets & liabilities are arranged in certain order. Arranging assets & liabilities is called marshalling of assets & liabilities. Mainly assets & liabilities are arranged in two ways namely permanency order & liquidity order. The way of arranging assets & liabilities in order of long run existence followed by short run is called permanency order of marshalling. On the other hand, the way of arranging assets & liabilities in order of convertibility into cash are called liquiding order of ~~mar~~ marshalling. Hence, liquiding marshalling is just opposite of permanency marshalling.

Balance sheet of - - - - - company
As on - - - - -

Liabilities & Capital	Amount (Rs)	Assets	Amount (Rs)

Q. Prepare a balance sheet on 30th December 2009 of Santosh ~~for~~ from the following information

Land & building - 50,000	Reserve - 6,000
Plant & Machinery - 30,000	outstanding Expense - 500
Debtors - 10,000	prepaid insurance - 1,000
Cash in hand - 5000	Good will - 10,000
Investment - 20,000	Creditors - 20,000

Sol^n:-

loan - 15,000	Inventories - 25,000
Patent - 15000	Furniture - 9,000
Advance Income - 500	Capital - 1,18,000

Liabilities & Capital	Amount (Rs)	Assets	Amounts
Capital	1,18,000	land & Building	50,000
Reserve	6,000	plant & Machinery	30,000
Outstanding Expenses	500	Debtors	10,000
Creditors	20,000	Cash in hand	5000
loan	15,000	Investment	20,000

Initial capital	Amount(Rs)	Assets	Amount(Rs)
Advance income	5000	Prepaid insurance	1,000
		Good will	10,000
		Inventories	25,000
		Patent	5,000
		Furniture	4,000
	160000		16000

MACRS method (Modified Accelerated Cost Recovery System)

The MACRS scheme totally abandon above practice of depreciation method & simpler guidelines were set which created several classes of assets each with more or less arbitary life called recovery period.

The MACRS scheme includes 8 categories of asset: 3yrs, 5 years, 10 year, 15yrs, 20yrs, 27.5yrs and 39 years.

The salvage value of property is always treated as zero

Half-year Convension

The MACRS screen uses the half year condition that is it is assumed that all assets are placed in service at mid year and they acts as zero salvage value.

Only half year depreciation is allowed for the first year of the asset placed in service.

With half year depreciation being taken in service, a pool year depreciation is allowed in its of the remaining years of the assets recovery period.

Finally the remaining half year depreciation in the year following the end of recovery period.

Switching from bigline balance to straight line method

-> The MACRS asset is depreciated first by declining balance (DB) method

We adapts the switching condition as discussed in the previous section

Q. A tax payer owned in a service of Rs 10000 asset i.e. assigned to the five year class compute the MACRS & and depreciation amount for the asset.

Sol?:

MACRS deduction & beginning with the 1st taxable year and ending with 6th year are computed as follow

Straight line rate $= \frac{1}{N} = \frac{1}{5} = 0.20$

Double declining balance rate (α) $= \frac{1}{N} \times 100\% \cdot K$

$= \frac{1}{5} \times 200\%$

$= 40\%$.

Under MACRS, salvage value = 0

Year	Calculations	Value	Decision
1	½ year DDB dep = 0.5 × 0.4 × 100% = 20%	80%	
2	DDB dep = 0.4 (80% − 20%)	80%	Do not switch
	SL line dep = 1/2.5 × (80% − 20%)	19.98%	
3	DDB dep 0.4 × (100 − 5 %)	38.2%	Do not switch
	SL line dep = 1/2.5 × [100 − 5 %]	38.2%	
4	DDB dep 0.4 × (100) − 91.2%)	11.52%	Switch to SL
	SL line dep = 1/2.5 × [100% − 91.2%]	11.52%	
5	SL line dep = 1/2.5 × (100% − 82.72%)	11.52%	
6	½ year SL line dep = 0.5 × 11.52	5.76%	

In the year 4, SL line depreciation is greater or equal (≥) to DDB depreciation and we switch to SL line.

Q. Calculate the depreciation amount from the %.

Sol:-

Year	Value	Depreciation	Depreciation
0	20		
1	32		
2	19.2		
3	11.5		
4	6.9		
5	5.76		
6	11.52 + 5.76		

Case of terminated assumption

- The CO terminated was a time and decision study period for alternatives. Two cases involved in the CO terminated assumption.

Case 1
- Study period longer than the useful life

Case 2
- Study period shorter longer than the useful life.

* Case 1 Study period longer than the useful life

→ A common example of project lives that longer than the analysis period occurs in construction industry, where a building may have a relatively short completion ti

but the car equipment purchase has a much longer useful life. Two assumptions are considered.

1) Cashflow accumulated at the end of useful life will be re-invested for the estimated period.
2) Replacement / Re-investment is necessary for remaining period (study period − useful life) and economic consequences that are estimated to happen in an alternatives life span will also happen in all succeeding lifespan (as in repeatability assumption)

Q. Consider the following mutually exclusive projects. MARR = 10%.

i	Project A	Project B
1. Initial Investment	Rs 3,50,000	Rs 5,00,000
2. Annual Revenue	Rs 1,90,000	Rs 2,50,000
3. Annual Cost	Rs 69500	Rs 138300
4. Useful life	4yrs	8yrs
5. Salvage value	0	0

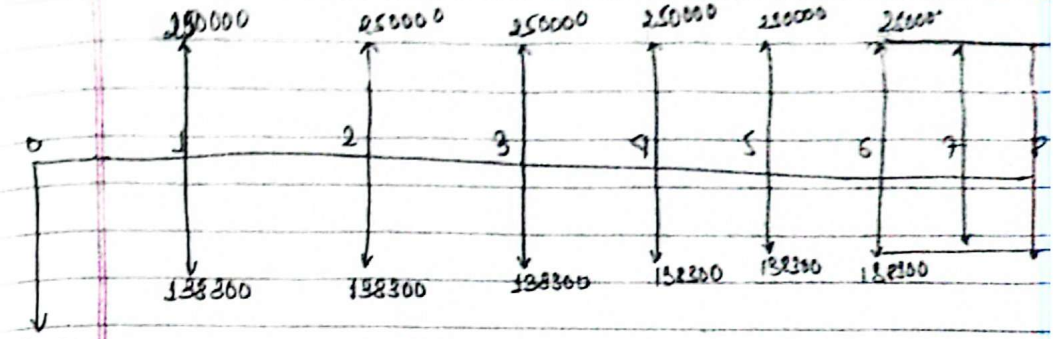
Which alternative is more desirable based on co-terminated assumption?

Soln-

Taking analysis period as 8yrs (The value should be taken in such a way that, the study period is either equal to or greater than useful lives of all the alternatives) If lesser useful life is taken then we have to cutoff down the cashflow to the end end of study period and suitable market value should be assigned to the alternatives.

Considering assumption 1:

There is no adjustment required for a alternative B for adjustment is required incase of A, which study period is 4yrs & greater than its useful life.



for B, $FW_B = -500000(F/P, 10\%, 8) + (250000 - 138300)(F/A, 10\%, 8)$

$= Rs\ 205594.2958$ /-

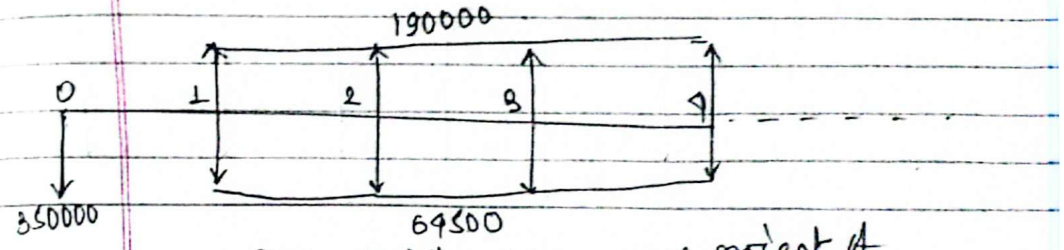


fig:- cashflow diagram of project A

$FW(10\%) = \{350000(F/P, 10\%, 2) + (190000 - 69500)(F/P, 10\%, 4)\}\{(F/P, 10\%, 4)\}\{F/P, 10\%, (8-4)\}$

$= \{350000(1.1)^2 + 105500\left[\frac{(1.1)^4 - 1}{0.1}\right]\}\{(1.1)^4\}$

$= \{5,19435 + 5,82,495\}(1.1)^4$

$FW_A(10\%) = 102502.37$

$FW_B(10\%) > FW_A(10\%)$, select alternative B'

Test Considering Assumption 2:

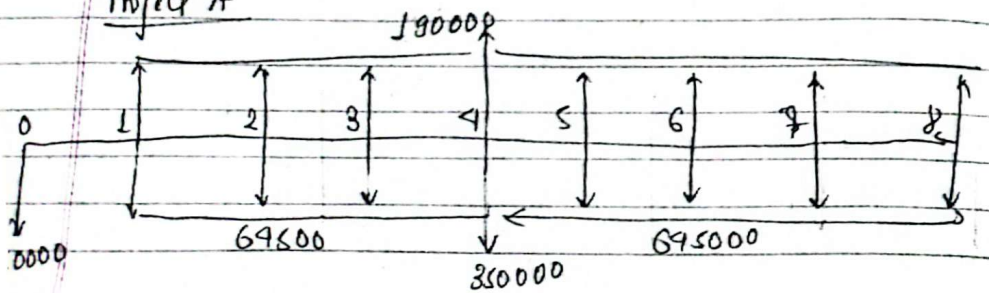
Using Repeatability assumption;

Study point: ~~LCM of 4 & 8 = 8~~

$FW_B(10\%) = Rs\,205594.2958$

As the total year = 8 yrs

Project A



$FW_A(10\%) = -350000(F/P, 10\%, 2) + (190000 - 69500)(F/A, 10\%, 2) + (350000)(F/A, 10\%, 4)(F/A, 10\%, 4) + (190000 - 69500)(F/A, 10\%, 4)$

$= Rs\,153510$

Since $FW_B(10\%) > FW_A(10\%)$. Hence, Project B is selected

Q. Write short notes on:-
1) Taxes law
2) Co-operative income tax
3) Depreciation rate
4) Personal tax
5) Co-operate tax
6) Vate

Q. Write a definition of following terms.
1. Debt Ratio
2. Current Ratio
3. Quick Ratio - Acid test Ratio
4. Inventory Turnover Ratio
5. Price Earning Ratio

$P/A = \frac{(i+1)^n - 1}{i(1+i)^n}$

Tutorial - 3

Q1. Following are two independent projects, determine which project is worthful by using benefit-cost ratio and AW formulation

	Project A	Project B
Initial Investment (Rs)	3,50,000	4,50,000
Annual revenue (Rs)	1,50,000	1,75,000
Annual cost (Rs)	30,000	40,000
Salvage value	50,000	75,000
MARR	15%	15%
Useful life (year)	4	5

Soln:-

By BCR,

Project A, BC ratio = $\frac{\text{Pw(15\%) of benefit}}{\text{Pw (15\%) of cost}} = \frac{150000(P/A,15\%,4)}{}$

(150000 - 30000)

$= \frac{150000(P/A,15\%,4) + 50000(P/F,15\%,4)}{350000}$

$= \frac{120000 \times 2.854978 + 50000 \times 0.571850658}{350000}$

$= 2.03937$

Project B, BC ratio = $\frac{\text{Pw(15\%) of benefit}}{\text{pw(15\%) of cost}} = \frac{135000(P/A,15\%,5) + 75000(P/F,15\%,5)}{450000}$

$= \frac{135000 \times 3.352155 + 75000 \times 0.497176}{450000}$

$= 1.088509$

Since, BC ratio of project A is greater than BC ratio of project B. Thus, project A is worthful using BC ratio.

By AW formulation.

Project A,

$AW(15\%) = -350000(A/P,15\%,4) - 30000 + 50000(A/F,15\%,4)$

$= -350000\left(\frac{0.15(1+0.15)^4}{(1+0.15)^4-1}\right) - 30000 + 50000\left(\frac{0.15}{(1+0.15)^4-1}\right)$

$= -192579.6055$

Project B,

$AW(15\%) = -450000(A/P,15\%,5) - 90000 + 75000(A/F,15\%,5)$

$= -450000\left(\frac{0.15 \times 1.15^5}{1.15^5-1}\right) - 90000 + 75000\left(\frac{0.15}{1.15^5-1}\right)$

$= -163118.3322$

Since, $AW_A(15\%) > AW_B(15\%)$ Thus, project A is more worthful than project B.

By using BC ratio & AW, project A is more worthful than project B.

Q2. Find (B/C ratio of following project by both methods and using PW and AW formulation.

initial investment (Rs) = 90,000

Annual revenue (Rs) = 50,000

Salvage value (Rs) 20,000

Annual cost (Rs) = 2,000

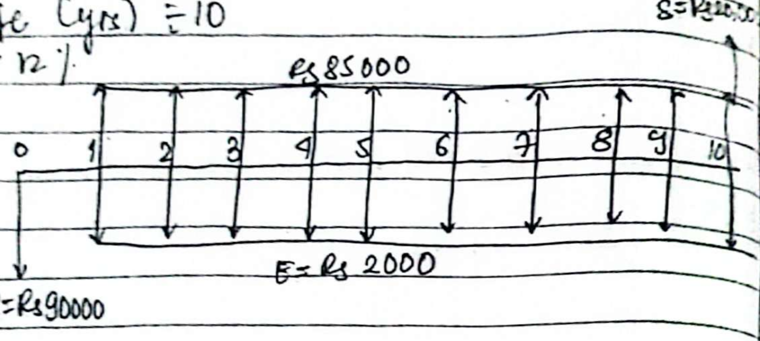
useful life (yrs) = 10

Sol^n- MARR = 12%

I = Rs 90000

B = 50000

O&M = .



PW formulation:

PW(I) = Rs 90000

PW(B) = 50000 (P/A, i%, 10)

= 50000 (P/A, 12%, 10)

= 50000 × 5.65

= Rs 2,82,500

PW(S) = 20000 (P/F, 12%, 10)

$= 20000 \times (1.12)^{-10}$

= Rs 6439.5

PW(O and M) = 2000 (P/A, 12%, 10)

$= 2000 \times \left[\frac{(1+0.12)^{10}-1}{0.12(1.12)^{10}}\right]$

= Rs 11800.45

Now,

$\text{conventional BCR} = \frac{PW(B)}{PW(I) - PW(S) + PW(O\&M)}$

$= \frac{282500}{80000 - 6439.5 + 11300.45}$

= 2.98 > 1 (justified)

$\text{Modified BC ratio} = \frac{PW(B) - PW(O\&M)}{PW(I) - PW(S)} = \frac{285510 - 11800.4}{90000 - 6440}$

= 3.24 > 1 (justified)

AW formulation:

$AW(I) = 300000\,(A/P, 12\%, 10) = 300000 \left[\frac{0.12(1+0.12)^{10}}{(0.12+1)^{10} - 1}\right]$

→ ~~300000 ×~~ Rs 53095.25

$AW(S) = S(A/F, i\%, N) = 20000 \times \left[\frac{0.12}{(1+0.12)^{10}-1}\right]$ = Rs 1139.

PW(B) = Rs 50000

AW(O&M) = Rs 2000

Now,

$\text{conventional BCR} = \frac{AW(B)}{AW(I) - AW(S) + AW(O\&M)}$ = 0.92 < 1 (not justi

$\text{Modified BCR} = \frac{AW(B) - AW(O\&M)}{AW(I) - AW(S)}$

$= \frac{50000 - 2000}{53095.25 - 1139.7}$

= 0.924 < 1 (not defined.

2082-9-7

Case 2: Study period shorter than the useful life..

The imputed market value:
An assumed value given to an item when the actual value is not known or available.

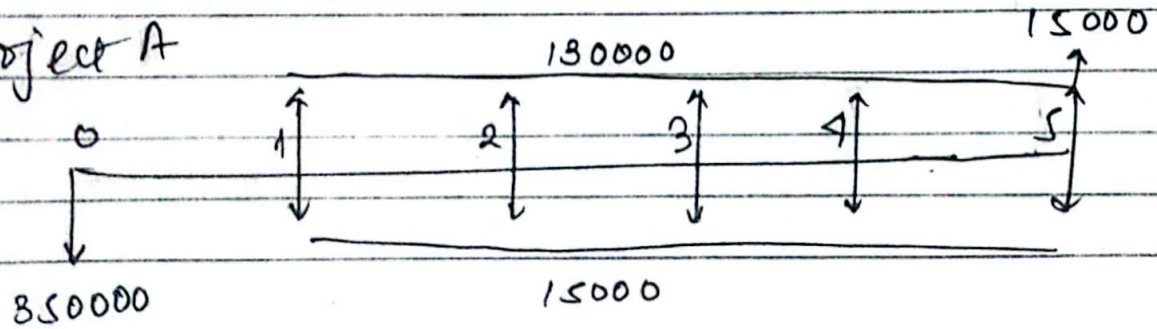
MV_T = (PW at the end of year T of remaining capital recovery amounts + [PW at end of year T of original market value at end of useful life).

Q. Using co-terminated assumption recommend the best project taking study period as 5yrs.

Project	A	B
Initial investment (Rs)	850000	500000
Annual Revenue (Rs)	130000	145000
Annual cost (Rs)	15000	25000
Salvage value (Rs)	35000	50000
Useful life.	5yrs	8yrs.

Sol'n:-

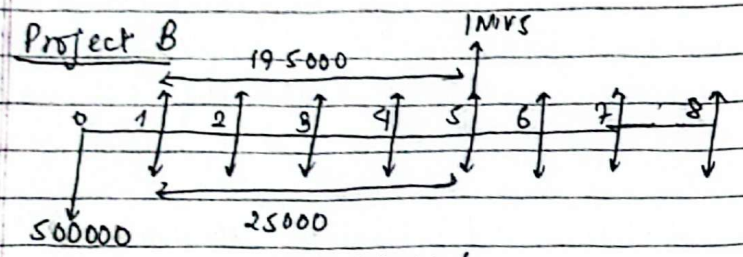
Project A



$FW_A(10\%) = -350000(F/P, 10\%, 5) + (130000 - 15000)(F/A, 10\%, 5) + 155000$

$= -85000(1.15) + (115000)\left[\frac{1.1^5 - 1}{0.1}\right]$

$= 178908$



MARR = 10%.

fig: Cashflow diagram of project B

Applying imputed Market value Calculation

$CR(10\%) = 500000(A/P, 10\%, 8) - 50000(A/F, 10\%, 8)$

$= 997.22 - 4972$

$= Rs\ 89350$

Present worth (at years) of CR of remaining 3yrs

$PW_c(10\%) = 89350(P/A, 10\%, 5)$

$= Rs\ 222200$

Present worth (at yrs 5) of Market value (MV) for remaining 3yrs.

$PW_{MV}(10\%) = 50000(P/F, 10\%, 3)$

$= Rs\ 37565$

Market value at the study Period i.e. year 5.

$MV_c = PW_{CR}(10\%) + PW_{MV}(10\%)$

$= 222200 + 37565$

$= Rs\ 259765$

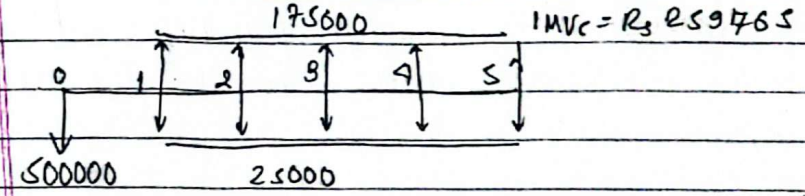


fig:- Revised cash flow diagram of project B

$FW(10\%)$

$= -500000(F/P, 10\%, 5) + (175000 - 25000)(F$

$+ 259765$

$= 370275$

Since, the FW of B is greater than FW of A thus, Project B is selected.

Chapter-9

Enterprise Financing and Capital Investment.

- Equity financing:

→ Equity Financing involves selling a portion of companies equity in return for capital.
For example :- IPOs (Initial Public offering)

- Depth Financing:

→ It involves the borrowing of money and paying it back with interest. The most common form of depth financing is a loan.

Equity Financing Vs Depth Financing

To raise a capital for business needs, companies primarily have two types of financing as an option: Equity Financing and Depth Financing. Most company use a combination of depth & equity financing, but there are some distinct advantage to both. Principle, among them is that, Equity Financing carries no repayment obligation and provides extra working capital that can be used to grow a business.

Depth financing on the other hand doesnot require giving up a portion of ownership

* What is EIRR (Economic Internal Rate of Return)

→ An EIRR is also commonly calculated which is similar decision faster to the financior IRR. The EIRR indicates the rate of return at which the present value of the economic cost & benefi of the project are equal.

* What is FIRR (Financial Internal Rate of return

→ The FIRR is an indicator to measure the finan return on investment of an income generation project and is used to make the investment The general approach to calculating, the F has long been discussed and seems well established in such a way that the cash fl analysis induces uniformly the FIRR.

* What is return on Equity (ROE)

→ ROE is a major of financial performance calculated by dividing net income by share holders equity because share holders equity is equal to a company's asset minus its depts.
ROE is considered the return on net asset. ROE is considered a gauge of a ~~for~~ co-operation profitability and how efficient it is in generating profit

$$ROE = \frac{\text{Net income}}{\text{Average Shareholders Equity}} \times 100\%$$

* What is Capital structure?

→ It is a particular combination of dept & equity used by a company to finance its overall operation and growth.

Equity capital arises from ownership shares in a company and claims to its future cashflow and profit. Debt comes in the form of bond issues or loan. While equity may come in the form of common stock, preferred stock or retained earning

Tutorial 4

Stock:

Stock or share is the capital of the company and has been arranged to finance its operating activities it is also called share capital because it is raised by issuing companies share

Types of stock:

1) Common stock

A common stock is also called ordinary or equity stock (share). The holders of common stock are called share holders or share holders which are legal owner of the company. Common stock are source of permanent capital since they donot have a maturity date.

2) Preferred stock

Preferred or preferance stock is often considered to be a hybrid security since it consists the feature of both common stock and debenture (bond). It is similar to Bond, because fixed divident a paid to prefer stock holders which is similar to interest on bond. Some times preferred stock has no maturity dare which makes it similar to common stock Similarly divident to preferred stock is not paid du

insufficient earning which make it similar to common stock

Bond

A bond (debenture) is a return instrument acknowledging a debt and containing a contract for the payment of the principles sum at a specified date and for the payment of interest at a fixed rate periodically.

Cost of Equity:

It is the return that a company requires to decide if an investment meets capital return requirement firm often use it as a capital budgeting threshfold for the ~~equ~~ required rate of return.

Cost of Debt:

The cost of debt is the effective interest rate that a company pays on its debt such as bond and loar

Calculating cost of capital.

Cost of capital = weightage of debt into cost of debt + weightage of preference x cost of preference share + ~~sto~~ weightage of equity x cost of equity.

MIRR (Modified Internal Rate of Return)

The MIRR assumes that positive cashflows are reinvestment at the firms cost of capital and that the initial outlays are finance at the firms financial cost. It more accurately reflect the first and profitability of a project

$$MIRR = \sqrt[n]{\frac{FV(\text{Positive cash flows} * \text{cost of capital})}{PV(\text{initial outlays} * \text{financial cost})}} - 1$$

where

FVCF(C) = Future value of positive cash flows at the cost of capital for the company.

PVCF(f_c) = The present value of negative cashflow at the financing cost of the company.

n = number of periods.

Project Funding Mechanism

1) Government Budget
2) Public Private Paternship
3) Private Investment

Types of Business Organization:

- Sole proprietorship
- Partnership
- Joint stock company

WACC (weighted average cost of capital)

→ The weighted average or composite cost of capital is the weighted average of after tax component cost of date, prefered stock and common equity. In another words, weighted average cost of capital is workout by weighting the cost of each components of capital by its proportion in the capital structure.

The various step involve in the calculation of WACC are:

1. Calculation of the after tax component cost.
2. Find the weighted of each source of financing.
3. Multiply the after tax cost of each sources by its weight / proportion in the capital structure.
4. At the weighted component cost to get the form WACC

Symbolically, we can given the following equation.

$$WACC = K_{dt} * W_d + K_{ps} \times W_{ps} + K_s \times W_s + K_e \times W_e$$

where,

K_{dt} = cost of debt after tax.
W_d = weights of debt
K_{ps} = cost of prefered stock
W_{ps} = weight of prefered stock

K_s = cost of detailed earning / internal epity.
W_s = weight of detailed earning / internal epity.
K_e = cost of external (new issued epity)
W_e = weight of external (new issued epity)

Chapter-7

Economical Theory and Economic Development

Economic Theory:

Economic theory is a way to explanation of economic activites and its impact on various ground. Most of traditional concept of economic is based on micro behaviour by explaining effect of individual economic event. Micro economic theory focus on efficient use of scarc resource for the satisfying unlimited wants. Morden economic theory has tended to overlook about the importa of eco-system, the use of land and environment for balancing ecological constraint that refers ecological economy. It is a new academy field that attends to correct critical environment, social and economic problems over time.

Ecology:

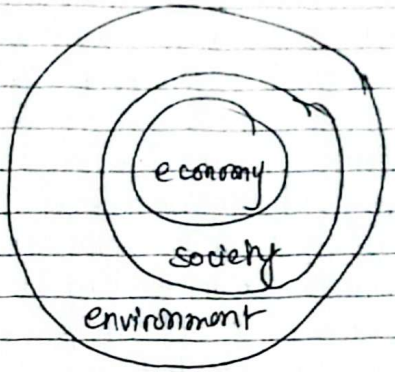
Ecology is the study of the relationship bet living organism including human and their physical environment. It seeks to understand th vital connection bet plants and animals and the w around them.

Q. What does ecological limit tells us?

→ The result of growing ~~activi~~ economic activity has been empleasly felt in many areas of economy like atmosphere, environment, minerals, use of land, forest, water and so on. There are limits to the capacity to act as source of material inputs. feeding for the economic system and sink for the waste products. Hence, functioning ecological mechanism of the earth to keep economic development with sustainable manner there must be limit in (minimum) availability of ~~minimal res~~ natural resource that technically refers ecological limit

Concept of sustainable development

Sustainable development is a art of resource management that fulfills the need of present generate and also garantes the fulfilment needs of future ~~present~~ generation. Sustainable development is the organizing principle for meeting human development goals while simulaneously sustaining the availability of natural system to provide the natural resource and economic system supaces baised upon which the economy and society depend.



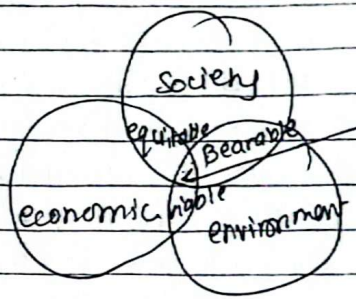


Fig:- Sustainability venn-Diagram.

Ecological footprint

Ecological footprint is the major of how much area of biologically ~~tea~~ productive land and wate and individual, population or activity requires t

product all the resource, it consumes and to absorb the waste it generate using prevailing technology and resource management practices.

* Overcoming ecological limit
→ If, fast pace technology and human value can play a significant role in creating space for economy development by relaxing the current constraint. Hence, ecology overcoming ecological limit points out the scope maintaining both economic growth and environment through the development of renewable energy source, decarburization, recycling of waste, taking organic view of technology and resource development. Hence, each and every development activities should follow the implementation policy of sustainable development by realizing the relationship both economic growth and natural environment.