Date 2075-02-17

Chapter-1

Introduction:-

Engg Economy & Economics

principles of :
① Engg Economy
② Engg. Economics

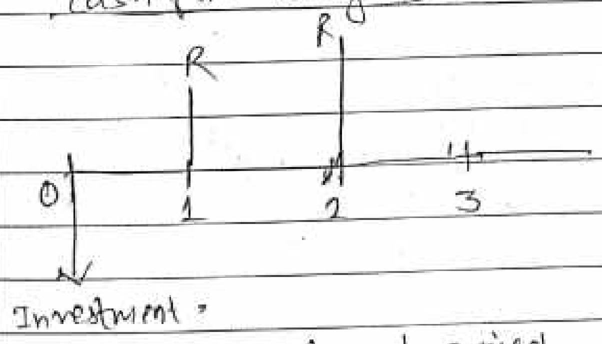
Origin of Engg. Economics

Cash flow diagram

Decision Making Role of an Engineer,

Economics → L L K.
↓ ↓ ↓
land labor Capital

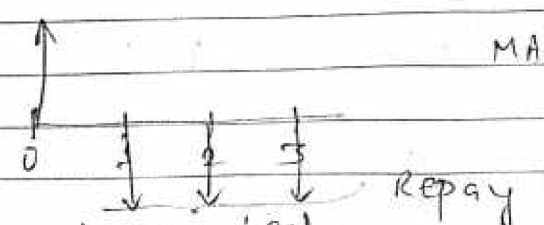
Cash flow diagram



MARR = i = interest

Investment project.

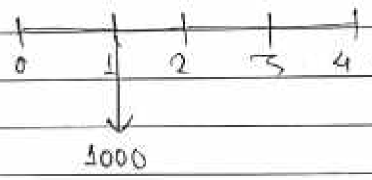
MARR = Minimum Attractive Rate of Return



Loan project.

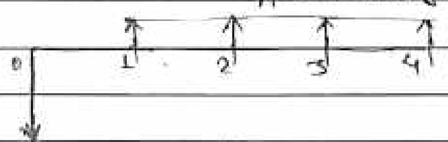
Types of cash flow diagram

1. simple cash flow



A = Annuity

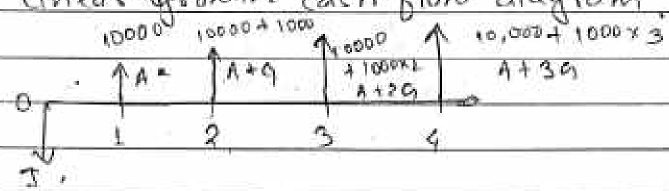
2.



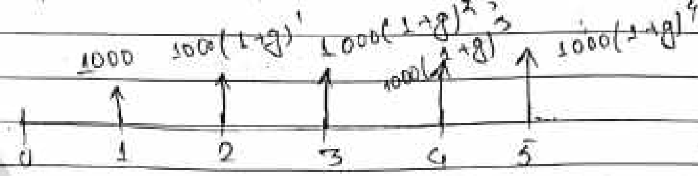
(uniform cash flow)

J = 14,00,000 MARR = 18%.

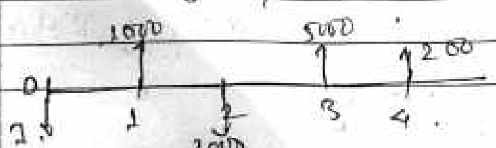
3. linear growth cash flow diagram (सबै type को increment)



4. Geometric Gradiance series (% मा salary increase हुन्छ)



5. Non-uniform / Random cash flow.



V.V. Imp. Ch...

In...

Intere...

- Earning...
- Amount...

Inter...

- simple
- compoun...

V.V. IMP · Chapter-2.

Interest & Time value of money

Interest

- Earnings on your investment
- Amount to be paid on your o/s loan

Interest types

- simple interest — from principal only
- compound " — interest on principal & interest

0 1 2

100 +8 +8

$i = 8\%$

A = 116

0 1 2

100 +8 8.64

= 108

$i = 8\%$

A = 116.64

Interest

Nominal — For A (10%)

Effective — must be annual — For A (10.25 %)

Bank - A

$i = 10\%$ p.a.

compounding half yearly.

Bank B

$i = 10.5\%$ compound Annually

1 year

0 105 110.25

100 10.5 110.5

Interest:-

1. Nominal Interest:- It is that interest which doesn't account the ~~on~~ compounding period.

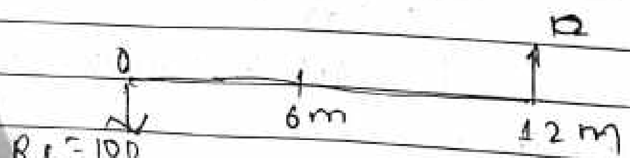
2. Effective Interest:- It is the interest which accounts the compounding period and always designated in per annum basis if otherwise not stated.

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

~~Relation between nonim~~

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

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



interest $= \frac{10\%}{12} = 0.0083.$

1 Relation between nominal and effective interest rate

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

where i_{eff} = effective interest Rate.
r = nominal interest Rate.
m = compounding period.

Q) If a bank has nominal interest rate of 10 % P.A. and has provision of half yearly compounding. then what will be your actual rate of earning.

soln:-
nominal interest rate (r) = 10 % = $\frac{10}{100}$

compounding period (M) = 1/2.
actual rate of earning = ?

$$i_{eff} = \left(1 + \frac{\frac{10}{100}}{2}\right)^{2} - 1$$

$$= \left(1 - \frac{10}{100} \times \frac{1}{2}\right)^{2} - 1$$

$$= (1 - 0.2)^{2} - 1.$$

$$= (0.8)^{1/2} - 1.$$

$= \cancel{0.1055}$
$= 0.1025$ %. $\Rightarrow$ = 10.25 %.

$i_{eff} = r$, if compounding is annually.

Bank-A
interest = 10%.
Compounding
Monthly.

Bank-B
Interest = 10%.
compounding annually

$i_{eff} = 10\%$

$i_{eff} = \left(1 + \frac{0.1}{12}\right)^{12} - 1$

$= 10.25\%$

In previous example compute its effective interest rate. If the compound period is quarter period.

solun:-

$r = 10\% = 10/100 = 0.1$

$m = 1/4$

$i_{eff} = ?$

Now

$i_{eff} = \left(1 + \frac{0.1}{4}\right)^{4} - 1$

$= 10.38\%$

Com
follow

i) Comp
ii)
iii)

i) Com

ii) C

compound the effective interest for the following compounding period,

i) compounding daily
ii) " hourly
iii) " continuously.

i) compounding daily.

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

$$= \left(1 + \frac{0.10}{365}\right)^{365} - 1.$$

$$= 0.1055$$
$$= 10.515\%.$$

ii) compounding hourly.

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

$$= \left(1 + \frac{0.10}{8760}\right)^{8760} - 1.$$

$$= 0.10517$$
$$= 10.517\%.$$

shift

iii) compounding continuously i.e. $m \to \infty$.

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

$$= \left(1 + \frac{0.10}{100 \times \infty}\right)^{\infty} - 1.$$

$$= e^{10/100} - 1.$$

$$= 10.51701\%.$$

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

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

$$= 1 + i_{monthy}.$$

$$(i_{year} + 1)^{1/m} = 1 + i_{monthy}$$

$$\Rightarrow \quad i_{monthly} = (i_{year} + 1)^{1/m} - 1$$

$$= (1.10)^{1/12} - 1$$

$$= 0.797\%.$$

Q) If a bank has nominal interest rate of 10% and compounding per annum basic where you wish to deposite rupee 10 per month for a period of 1 year then what will be the maturity at the end of 1st year.

Solun:-

$i_{eff} = 10\%$

Now,

$$i_{monthly} = (i_{year} + 1)^{1/m} - 1$$

$$= \left(\frac{10}{100} + 1\right)^{1/12} - 1$$

$$= (1.10)^{1/12} - 1 = 0.00797$$

$$= 0.797\%$$

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

$$P = A\left[(1+i)^n - 1\right]$$

↳ Annuity

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

$$F = \frac{10\left[1.00797^{12} - 1\right]}{0.00797}$$

$$= 125.40$$

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$i_{eff} = \left(\frac{10}{100}+1\right)^{1/12} - 1 \quad \frac{10}{100} \times 1/12$

12.

Q) In previous example, if compounding period is in month then what will be the value at maturity.

solun:-

$i_{month} = \frac{10\%}{12} = \frac{10}{100} \times \frac{1}{12} = \frac{10}{100} \times 1/12$

$= 0.833\%$ $\qquad = 0.00833$

$\therefore$ Future value $= \frac{10\left[(1+0.00833)^{12} - 1\right]}{0.00833}$

$=$ Rs 125.65

Generation (development of economic equivalence Formula)

1) $\boxed{F = f(p)}$

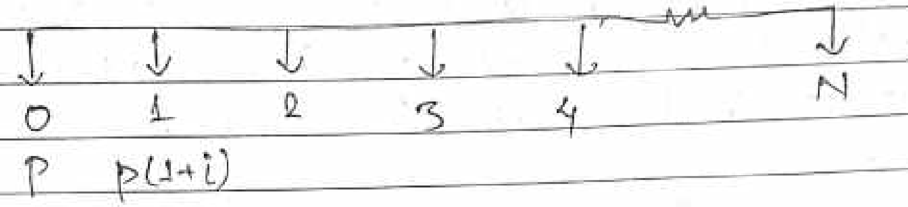
Future Amount ← Present Amount.

End

End

End

1 10 %. 10/12



End of 1st year $= p + (p \times i)$

$= p(i+1)$

End of 2nd year $= p(i+1) + p(1+i) \times i$

$= p(1+i)[1+i)$

$= p(1+i)^2$

End of 3rd year $= p(1+i)^2 + p(1+i)^2 \times i$

$= p(1+i)^2 (1+i)$

$= p(1+i)^3$.

$$\boxed{\begin{array}{l} n\text{th year} = p(1+i)^n \\ \therefore F = p(1+i)^n \end{array}}$$

1210, 1331 1464.10, 1610.51.

Q1 If you deposit Rs.1000 in the present date then what will be your maturity at the end of 5th year.

solun:-

$p = Rs\ 1000$ $i = 10\% = MARR$

$F = p(\cancel{p+1})^n$ $F = p(i+1)^n$

$= \cancel{(1000+1)}^5$

$= \cancel{1000 +}$

For 1st year

$F = \cancel{(p+i)}\ p(i+1)$

$= 1000(0.1+1)$

$= 1000 \times 1.10$

$= 1100$

2nd year $= p(i+1)^2$

$= 1000 \times (1.10)^2$

$= 1210$

3rd year $= p(i+1)^3$

$= 1000 \times (1.10)^3$

$= 1331$.

$F = p(1+i)^n$

$= 1000 \times (1.10)^5$

$= 1610.51$

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

Q) If you required to have Rs 1 lakh after 10 years then what will be equivalent present amount need to deposit in a bank which pays you 12% interest p.a.

soln:-

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

$$\Rightarrow \frac{1,00,000}{(1.12)^{10}} = P$$

$$\Rightarrow P = 32197.32$$

[2075, Baishakh Back
2074 Regular]

Q) If you deposit Rs 1000 in the present date in a bank having 10% interest then ~~after~~ at which period your deposit will be double?

Solun:-

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

$$1000 \times 2 = 1000\left(1 + \frac{10}{100}\right)^n$$

~~2000 = 1000 (1~~

$$\Rightarrow 2 = (1 + 0.1)^n$$

$$\Rightarrow \log 2 = \log(1 + 0.10)\, n.$$

$$\Rightarrow$$

$$\Rightarrow n = 7.27.$$

$$\Rightarrow ((7.27 - 7) \times 12 - 3) \times 30.$$

$$\Rightarrow 0.27 \times 12 = 3.24 \text{ month.}$$

$$\Rightarrow 0.24 \times 30 = 7.6 \text{ days}$$

$$\Rightarrow 0.6 \times 24 = 4. \text{ hrs.}$$

$$\times 60 = 48 \text{ minutes}$$

(1) $F = f(P)$

(2) $F = f(A)$

$\rightarrow F = \frac{A[(1+i)^n - 1]}{i}$

0 1 2 3 4

$i = 10\%$ 3,50,000 60,000

$$FV_4 = \frac{60000[(1+0.10)^4 - 1]}{0.10} + 3,50,000 * (1+0.10)^4$$

$= 278460 + 512435$

$= 7,90,895$

Q) If you wish to have an accumulated fund of 40 lakhs at the end of 50 yrs age and you are now of 20 yrs old, calculate the annual amount to be deposited in a bank which ~~$F = P(1+i)^n$~~ pays you 12% interest;

i) compounded semi-annualy. ii) compounded annually.

$\cancel{F} = \cancel{P}(1+i)^n$

40,00,000 = P

For the periods of 30 years.

Sol^n: -

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

$= \left(1 + \frac{0.12}{2}\right)^2 - 1$

$= 0.1236$

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

$40,00,000 = P(1 + 0.1236)^{30}$

$\Rightarrow \frac{40,00,000}{(1+0.1236)^{30}} = P$

$P = Rs\ 1,21257$

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

$= \left(1 + \frac{0.12}{1}\right)^1 - 1$

$= 0.12$

$P = \frac{40,00,000}{(1+0.12)^{30}}$

$= Rs\ 1,33511.69$

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

$$40{,}00{,}000 = \frac{A[(1+0.1236)^{30} - 1]}{0.1236}$$

$$\cancel{A =} \; 494400 = A[(1+0.1236)^{30} - 1].$$

$$\frac{494400}{31.9876} = A$$

$$A = Rs\ 15455.9892$$

ii)
$$\cancel{A =} \; 40{,}00{,}000 = \frac{A[(1+0.12)^{30} - 1]}{0.12}$$

$$\Rightarrow A = \frac{40{,}00{,}000 \times 0.12}{[(1+0.12)^{30} - 1]}$$

$$= Rs\ 16580.310$$

- monthly deposited, compounding yearly
- semiannual ,, , ,, monthly

Q) If a bank pays 15% interest p.a compute:

i) effective annual interest rate, if compounding is semi-anual.

ii) effective monthly interest rate, if compounded monthly.

iii) monthly interest rate, if compounded annually.

i) solun:-

$$i_{eff} = \left(1+\frac{r}{m}\right)^m - 1 \qquad 0 \downarrow 100 \quad \downarrow 6 \quad \downarrow 12$$

$$= \left(1+\frac{0.15}{2}\right)^2 - 1 \qquad F = 100(1+0.15)^2$$

$$= Rs\,115.56$$

$$= 0.155625$$

$$= 15.56\%$$

ii)

$$i_{eff,monthly} = \frac{15\%}{12} \qquad F = 100 * (1.0125)^{12}$$

$$= Rs.116.075$$

$$= 1.25\%$$

iii)

$$i_{monthly} = (i_{yearly}+1)^{1/m} - \cancel{0}\ 1$$

$$= \left(\frac{15}{100}+1\right)^{1/12} - 1$$

$$= \cancel{0.15}\ 0.0117$$

$$= \cancel{15\%}\ 1.171\% < \frac{15\%}{12}$$

iv) monthly interest rate, if compounded semi-annually.

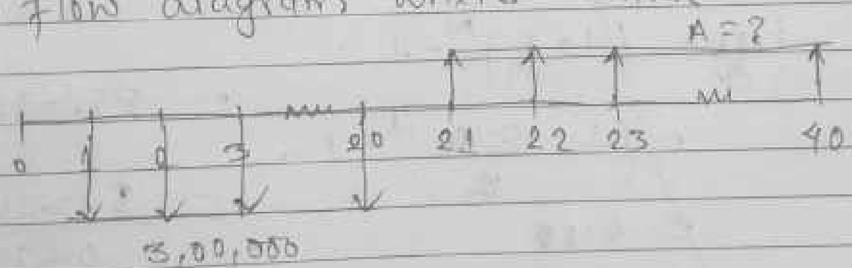
$$i_{monthly} = (1 + i_{yr})^{1/m} - 1$$

$$= \left(1 + \frac{15.56}{100}\right)^{1/2} - 1$$

$$= 0.074$$

$$= 7.4988\ \%.$$

Q) compute the value of A from the following cash flow diagram where MARR = 12%



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

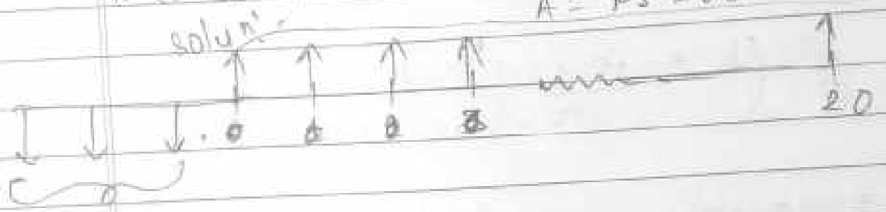
$$F_{20} = 3,00,000\,[$$

$$i_{eff} = \left(1 + \frac{r}{m}\right)^m - 1 = 1 + 0.12$$

Q) What will be the equivalent value of present amount of deposite for withdrawl of Rs 100 per annum for ~~to~~ 20 years where interest rate is 10 %

A = Rs 100

soluⁿ:



$p = ?$

$F = p(1+i)^n$

$P = \dfrac{100}{(1+i)^n}$

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

$= \left(1+\dfrac{0.10}{1}\right)^1 - 1$

$= 0.10$

$P = \dfrac{100}{(1+0.10)^{20}}$

$p = \dfrac{A\left[(1+i)^n - 1\right]}{i(1+i)^n}$

$= \dfrac{100\left[(1+0.10)^{20} - 1\right]}{0.10(1+0.10)^{20}}$

$= \cancel{851.36}$

$= \dfrac{572.2499}{0.6727}$

$= Rs\ 851.36$

For y	Depo...
1.	936... 85...
2.	836... 920...
3.	820... 902...
4.	802... 882...
5.	782... 860...

Eoy	Deposit principal	Interest amount	withdrawl amount	Remaining Balance
1.	936.48 851.35	85.14	100	836.48
2.	836.48 920.12	83.65	100	820.12
3.	820.12 902.24	82.12	100	802.24
4.	802.24 882.464	80.224	100	782.464
5.	782.464 860.710	78.246	100	760.71.

Q) Rs 10 p.a. withdraw, bank interest Rate 10%
कति वर्ष सम्म withdraw गर्न सकिन्छ ।

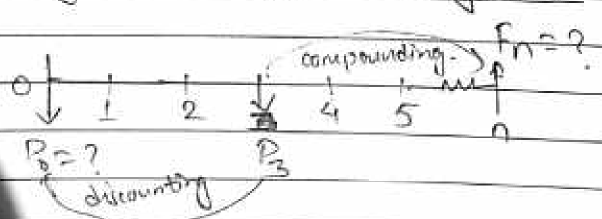
$$P = \frac{A\left[(i+1)^n - 1\right]}{i(1+i)^n}$$

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

$$\boxed{P = \frac{A}{i}}$$

Economic Equivalence formula for different cash flow diagram:-

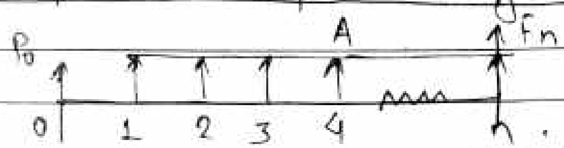
1. single cash flow diagram



$$P_0 = \frac{P_3}{(1+i)^3} \quad \& \quad F_n = P_3 * (1+i)^{n-3}$$

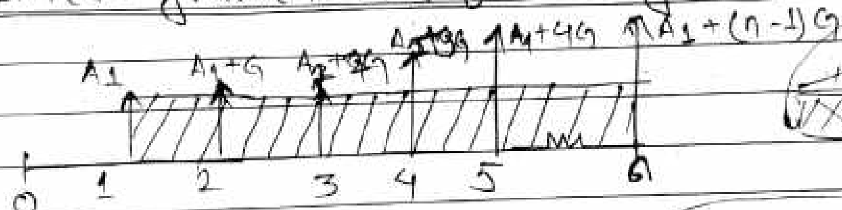
$$\therefore P = \frac{F}{(1+i)^n} \quad \& \quad F = P * (1+i)^n$$

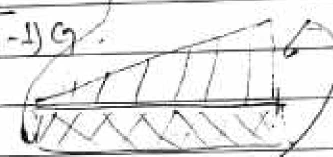
2. Uniform cashflow diagram



$$P_0 = \frac{A[(1+i)^n - 1]}{i(1+i)^n} \quad \& \quad F_n = \frac{A[(1+i)^n - 1]}{i}$$

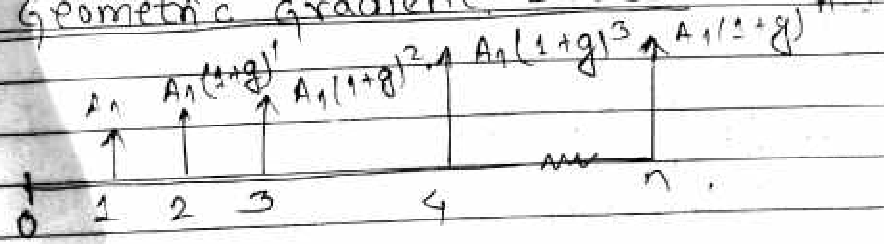
3. Linear gradient cashflow diagram





$$F = \frac{G}{i^2}[(1+i)^n - ni - 1]$$ for upper unshaded part only.

4. Geometric gradient series



where g = growth rate in %

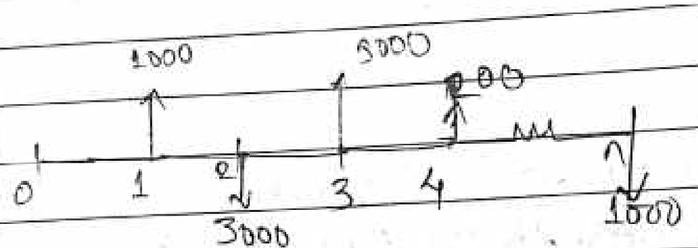
case (i) when $i \neq g$

$$F = \frac{A_1}{(i-g)}[(i+1)^n - (1+g)^n]$$

Case (ii) when $i = g$

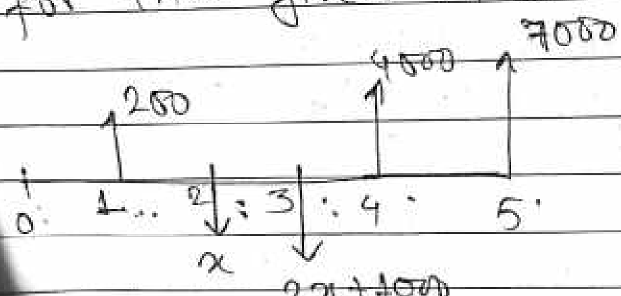
$$F = A_1 n (i+1)^{n-1}$$

5. <u>Random cash flow diagram</u>



Individual cash flow must be treated as single cashflow.

Q) Find the value of 'x' if MARR (Minimum Attractive Rate of Return) = 12% for the given CFD.



$$P_2 = \frac{P_2}{(1+i)^2}$$

$$= \frac{x}{(1+0.12)^2} = \frac{x}{1.2544}$$

$$P_3 = \frac{P_3}{(1+i)^3}$$

$$= \frac{2x+100}{(1+0.12)^3}$$

$$= \frac{2x+100}{1.4049}$$

$$PV\ (C/OF) = \frac{x}{1.2544} + \frac{2x+100}{1.4049}.$$

$$P_5 = \frac{P_5}{(1+i)^5} = \frac{7000}{(1+0.12)^5} =$$

$$P_4 = \frac{4000}{(0.12+1)^4}$$

$P_3 =$

$$PV\ (C/IN) = \frac{7000}{(1.12)^5} + \frac{4000}{(1.12)^4} + \frac{200}{(1.12)^1}$$

$$PV\ (C/OF) = PV\ (C/IN).$$

$$\frac{x}{1.2544} + \frac{2x+100}{1.4049} = \frac{7000}{1.7623} + \frac{4000}{1.5735} + \frac{200}{1.12}$$

2588.8

$\frac{x}{1.2544} + \frac{2x+1100}{1.4049} = \cancel{6514.1855} + \cancel{178.5714}$ 6692.75

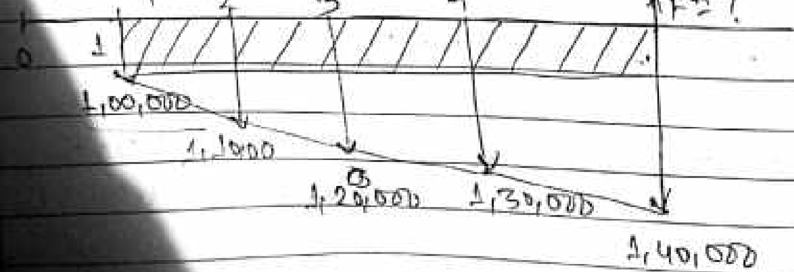
$x \times 1.4049 + (2x+1100) \times 1.2544 = \begin{pmatrix} 6514.1855 \\ + 178.5714 \end{pmatrix} \times 1.76230$

$1.4049x + 2.5088x + \cancel{1.25444} + 1254.4 = \cancel{11479.99184}$ 11658.5205

$= \cancel{11354.55184}$

$\boxed{x = Rs\ 2658.38}$

Q) If you are earning Rs 5 lakh p.a for the present base year which will continuously increases Rs 50,000 p.a for the next five years. out of which only 20% amount will be deposited as sinking fund. then compute the value at maturity if Redemption of capital at the rate of 7%.



$F_5 =$

$=$

$=$

$=$

Alternative way

F_5

$P_0 =$

P

A

$$F_5 = A\left[\frac{(1+i)^n - 1}{i}\right] + \frac{G}{i^2}\left[(1+i)^n - ni - 1\right].$$

$$= \frac{1{,}00{,}000\,(1.07^5 - 1)}{0.07} + \frac{10{,}000}{0.07^2}\left[1.07^5 - 5\times0.07 - 1\right]$$

$$= 575073.901 + \frac{10{,}000}{0.07^2}\left[1.07^5 - 5\times0.07 - 1\right].$$

$$= 682322.331 \,//$$

Alternative way

$$F_5 = 1{,}00{,}000\times1.07^4 + 110{,}000\times1.07^3 + 1{,}20{,}000\times1.07^2 + 1{,}30{,}000\times1.07^1 + 1{,}40{,}000$$

$$= 6{,}82{,}322.331 \,//$$

$$P_0 = \frac{1{,}00{,}000}{1.07} + \frac{110{,}000}{1.07^2} + \frac{1{,}20{,}000}{1.07^3} + \frac{1{,}30{,}000}{1.07^4} + \frac{1{,}40{,}000}{1.07^5}$$

$$= 4{,}86{,}486.39$$

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

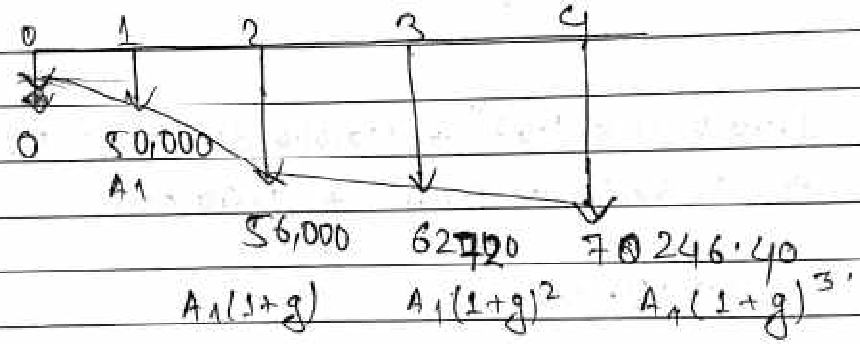
$$A = \frac{P\times i(1+i)^n}{(1+i)^n - 1} = \frac{4{,}86{,}486.39\times0.07(0.07+1)^5}{(1+0.07)^5 - 1}.$$

$$= 11864.40184$$

Q) If you deposited Rs 50,000 at the end of 1^{st} year which will intented to increase by 12% p.a. for next 4 years in a bank which has following interest rates.

i) 8% p.a.
ii) 12% p.a
iii) 14% p.a

evaluate the matured value.



i) case 1.

$i = 8\%$, $g = 12\%$

where $i \neq g$.

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

$$= \frac{50{,}000}{(0.08 - 0.12)}\left[\cancel{(0.12)^4} = ((1.08)^4 - (1.12)^4\right]$$

$= 266{,}288$

checking :- $50{,}000 \times (1+i)^{4-3} + 50{,}000(1+i)^{4-2} + 50{,}000(1+i)$ $+ 50{,}000$

$= 2{,}66{,}288$

74, 75 back

ii) 12 % p.a.

$i = \cancel{12}\%$, $g = 12\%$. $i = g$.

$$F = \frac{A}{\cancel{(i-g)}} \cancel{\left[(1+i)^n - (1+g)^n\right]}.$$

$$= \frac{50,000}{(0.12 - 0.12)} \left[(1+0.12)^4 - (1+0.12)^4\right].$$

$= 0 //.$

$F = A n (i+1)^{n-1}$.

$= 50,000 \times 4 (0.12 + 1)^{4-1}$.

$= 2,80,985.60$

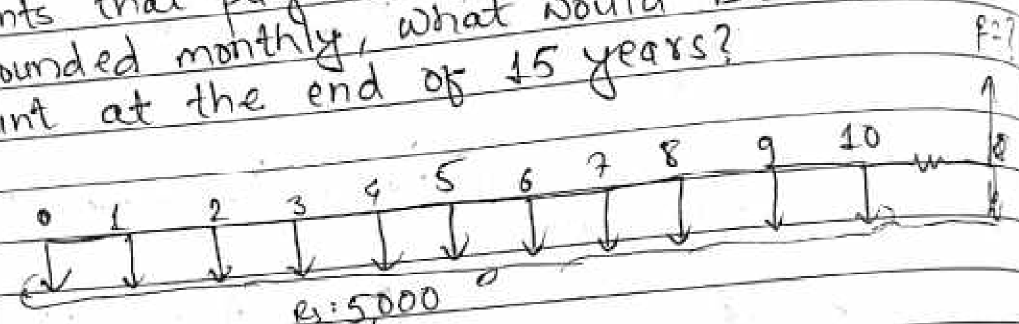
iii) 14 % p.a.

$$F = \frac{50,000}{(0.14 - 0.12)} \left[(1.14)^4 - \cancel{1+0}(1.12)^4\right].$$

$= 2,88,602$

2074 Bhadra (Regular)

2a) If you make equal monthly deposits of Rs 5000 into the bank for 10 years, saving accounts that pays interest rate of 6% compounded monthly, what would be the amaint at the end of 15 years?



$$i_{monthly} = (i_{yearly} + 1)^{1/m} - 1$$
$$= \left(\frac{6}{100} + 1\right)^{1/12} - 1$$

Given $A = 5000$
$i = 6\%$ compounded monthly

$$i_{monthly} = \frac{6}{12} = 0.5\%$$

The future amount at 10 years

$$F_{10} = A\left[\frac{(1+i_m)^n - 1}{i_m}\right]$$

$$= 5000\left[\frac{(1+0.005)^{120} - 1}{0.005}\right]$$

$$= 8,19,396.73$$

The future amount at 15 years,

$$P_{10} = 819396.73$$

$$F_{15} = P_{10} * (1+i)^n$$

$$= 8,19,396.73 * (1 + 0.005)^{5 \times 12}$$

$$= 11,05,243.40$$

~~At the end of~~ 10 years.

1. Define term engineering economy. Explain principles of engineering economy.

⇒ The study that deals with the concepts and techniques of analysis useful in evaluating the worth of systems, products and services in relation to their costs is known as engineering economics.

The principles of engineering economy are:-

i. Develop the alternatives.
ii. Focus on the differences.
iii. Use a consistent viewpoint.
iv. Use a common unit of measure.
v. Consider all relevant criteria.
vi. Make uncertainty explicit.
vii. Revisit your decisions.

2073 Bhadra (Regular)

1. Define engineering economics. Write down the principle of engineering economic analysis.

⇒ Engineering economics is the application of economic techniques for the evaluation of design and engineering alternatives to assess the appropriateness of given project, estimate ~~the~~ it's value, justify it from

2073 Bhadra (Regular)

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a an engineering point of view.

The four principles of engineering economics are:-

i) An instant dollar is worth more than a distant dollar.

ii) Only the relative (pair-wise) difference among the considered alternative counts.

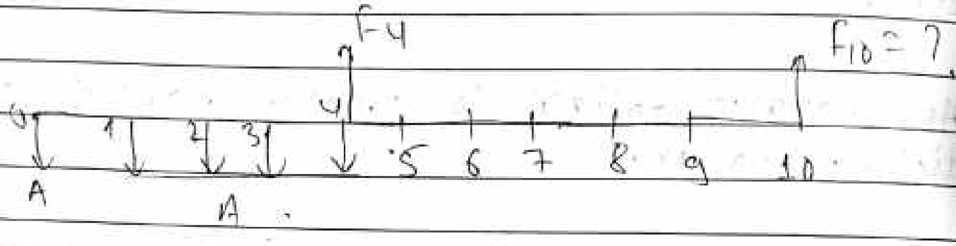
iii) Marginal revenue must exceed marginal cost, in order to carry out a profitable increase in operations.

iv) Additional risk is not taken without an expected additional return of suitable magnitude.

2. What is nominal and effective interest rate? Evaluate FW at the end of 10 years with 12% interest rate compounded monthly of a cash flow of Rs 40,000 at the beginning of each year ~~$~~for 5 years.

→ · Nominal interest is that interest which do not account the compounding period.
Effective interest is that interest which accounts the compounding period and always designated in per annum basis if otherwise not stated.

Evaluate FW at the end of 10 years with 12% interest rate compounded monthly of a cash



Given $A = Rs\ 40{,}000$

$r = 12\%$ compounded monthly

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

$$= \left(1 + \frac{0.12}{12}\right)^{12} - 1$$

$$= 0.1268$$

$$= 12.68\%$$

At the end of 4th year,

$$F_4 = A(1+i)^n + A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 40{,}000(1.1268)^4 + 40000\left[\frac{(1.1268)^4 - 1}{0.1268}\right]$$

$$= 64483.31 + 193086.07$$

$$= 2{,}57{,}569.37$$

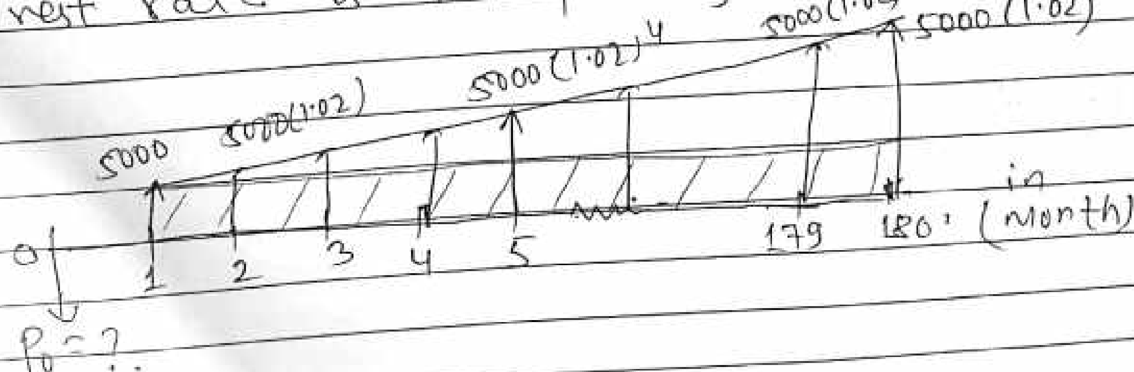
At the end of 10 year,

$f_{10} = P_4 (1+i)^n$

$= 257569.37 \times (1.1268)^6$

$= 5,27,199.81$

2 b) How much rupees should you deposit now so that you will be able to draw Rs 5000 at the end of this month which increases by 2% per month for 15 years. Bank interest rate is 5% per year.



Given,

$A_1 = 5000$

growth rate $(g) = 2\%$

$i_{yr} = 5\%$ compounding annually

$i_{monthly} = (i_{yr} + 1)^{1/m} - 1$

$= (0.05 + 1)^{1/12} - 1$

$= 0.00407$

$= 0.407\%$

$$F_n = \frac{A_1}{(i-g)}\left[(1+i)^n - (1+g)^n\right]$$

$$= \frac{5000}{0.00407-0.02}\left[(1.00407)^{180} - (1.02)^{180}\right]$$

$$= 1,04,34,224.58$$

$$P_0 = \frac{F}{(1+i)^n}$$

$$= 50,22,752.23$$

2075 Baishakh

classmate

chapter-3

Basic Methodologies of Economic Evaluation

1. Paybackperiod
   - simple.
   - Discounted

   If greater than standard PBP ⇒ rejected.

2. Net Equivalent worth Method
   - NPW/NPV — if $i > 0$ accept, $i < 0$ reject, $i = 0$ indifferent
   - NFW/NFV — if > 0 accept; ~~worth~~ → accept; cost → reject
   - NAW/NAV — if $i < 0$ reject

3. Rate of Return
   - Internal (IRR) — $i = IRR > MARR$ accept
   - External (ERR) — if $> MARR$
   - Modified
     - $E = R.I.R$ (Re interest Rate) lies betwn IRR & MARR or ~~more than IRR.~~

4. B/C Ratio
   - Simple
   - ~~Comp~~ Conventional
   - Modified

   Benefit > cost

2075/03/31 Chapter-4

2075 Baishakh.

Numericals

Compare the following two projects by IRR method when $i = 10\%$ per year.

Project-A	Project-B
I = 5,00,000 (Rs)	I = 7,00,000
R = 2,00,000 (Rs)	R = 3,00,000
ORM = 50,000 (Rs)	ORM = 1,00,000
Life = 7 yrs	Life = 7 yrs
SV = 80,000 (Rs.)	SV = 1,50,000 (Rs.)

R - ORM = 1,50,000

R - ORM = 2,00,000

B - A (R - ORM) = 50,000

SV = 150,000 - 80,000 = 70,000

To find IRR of 'A'

Net annual worth = 0.

$$-5,00,000 \times \frac{i(i+1)^n}{(i+1)^n - 1} + 2,00,000 - 50,000 + 80,000 \times \frac{i}{(i+1)^n - 1}$$

or, $$-50 \times \frac{i(i+1)^n}{(i+1)^n - 1} + \cancel{20}\,15 + \frac{8i}{(i+1)^n - 1} = 0$$

or, $$-50 \times \frac{i(i+1)^7}{(i+1)^7 - 1} + 15 + \frac{8i}{(1+i)^7 - 1} = 0$$

$i = IRR_A = 24.31\% > MARR\ (10\%)$

Accepted i.e. feasible.

To find IRR of 'B'

NAW = 0.

$$7,00,000 \times \frac{i(i+1)^7}{(i+1)^7 - 1} + 3,00,000 - 1,00,000$$

$+ 1,50,000 * \frac{i}{(i+1)^7 - 1}$

$\therefore \; IRR_B = 23.08\% > MARR\ (10\%)$

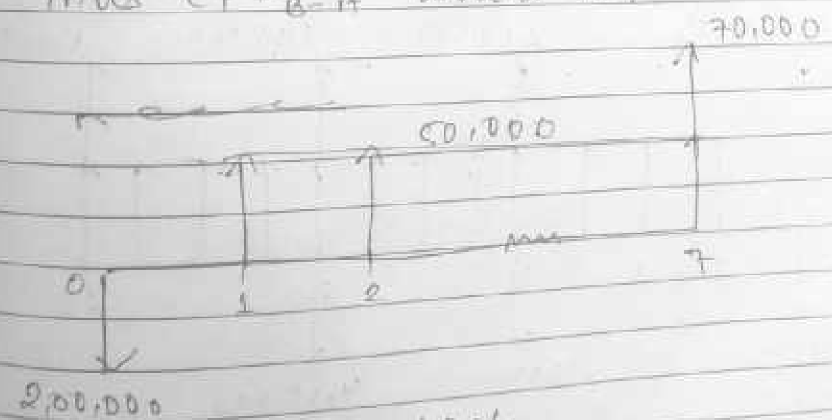
Accepted i.e. feasible

Hence, both projects are comparable to each other.

Now,

performing the incremental analysis between project A and B where project A is the base project.

Thus CFD_{B-A} would be,



MARR = 10%

$$-20 * \frac{i(1+i)^7}{(i+1)^7 - 1} + 5 + \frac{2 * i}{(i+1)^7 - 1} = 0$$

$IRR_{B-A} = 19.96\% > MARR$

Hence select project B as it can be produce mire benefits than project A

4 b) Select the best project using repeatability assumption.

project X

I = 4,00,000

R_p = 1,25,000

O&M = 50,000

n = 4 yrs

Sv = 1,00,000

project Y

I = 7,00,000

R = 2,50,000

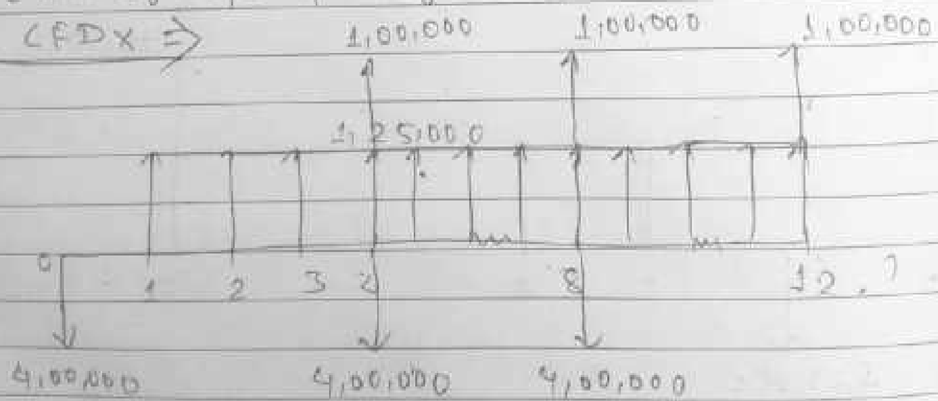
O&M = 70,000

n = 6 yrs

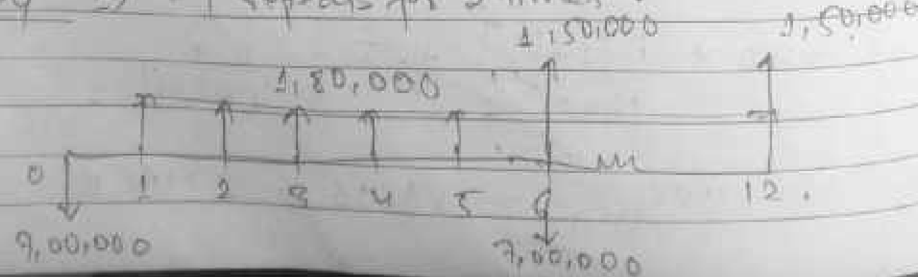
Sv = 1,50,000

L.C.M of life span of = 12 yrs So, X repeats for 3 times

CFDx ⟹



CFDy ⟹ Y repeats for 2 times.



(present value via current gate...

$$NPV_x = \frac{-4,00,000}{1.10^0} - \frac{3,00,000}{1.10^4} - \frac{3,00,000}{1.10^8} + \frac{1,00,000}{1.10^{12}}$$

$$NAW_x = \frac{0.10 * 1.10^{12}}{1.10^{12} - 1} * \left(\frac{-4,00,000}{1.10^0} - \frac{3,00,000}{1.10^4} - \frac{3,00,000}{1.10^8} + \frac{1,00,000}{1.10^{12}} \right) + 1,25,000$$

$= 20358.75889$ (Rs)

~~$NPV_y =$~~

$$NAW_y = \frac{0.10 * 1.10^{12}}{1.10^{12} - 1} * \left(-7,00,000 - \frac{5,50,000}{1.10^6} + \frac{1,50,000}{1.10^{12}} \right)$$

$+ 1,80,000$

$=$ ~~38,751~~ 38,715.94 (Rs)

Alternative. ($(A|P; i = 10\% \; n=4yrs)$

$$NAW_x = \left\{ 4,00,000 * \frac{0.10 * 1.10^4}{1.10^4 - 1} \right\} + 1,00,000 * \frac{0.10}{1.10^4 - 1}$$

$+ 1,25,000$

$= 20,358.76$ (Rs)

$$NAW_y = -7{,}00{,}000 * \frac{0.10 * 1.10^6}{1.10^6 - 1} + \frac{1{,}50{,}000 * 0.10}{1.10^6 - 1} + 1{,}80{,}000$$

$$= 38{,}715.94 \text{ (Rs.)}$$

$\therefore NAW_x = 20{,}358.76 < NAW_y = 38{,}715.94$

Select project y.

2074 Bhadra 6 marks.

4a) choose the best project among the given alternatives using IRR, if MARR = 15% & study period 10 yrs, ~~salvalue~~ salvage value is 20%.

project	A	B	C	D	S.value
First cost (I)	900	1500	2500	4000	180
Annual revenues	150	276	400	925	
IRRs	—	—	—	—	
SV	180	300	500	800	

(CRD)

20% of 4,000

To find IRR of A.

$$4{,}000 * \frac{i(1+i)^{10}}{(1+i)^{10}-1} + 925 + 800 * \frac{i}{(i+1)^{10}-1}$$

For C

$2600 * i(i+1)^{10} + 480(1+i)^{10} - 1 + 80 * i = 0$

16.25% > MARR

For D

$4,000 * i(i+1)^{10} + 925(1+i)^{10} - 1 + 800 * i = 0$

20.05% > MARR

For A.

$$900 * i(i+1)^{10} + 150(1+i)^{10} - 1 + \frac{180 * i}{(i+1)^{10} - 1} = 0.$$

12.13% < MARR

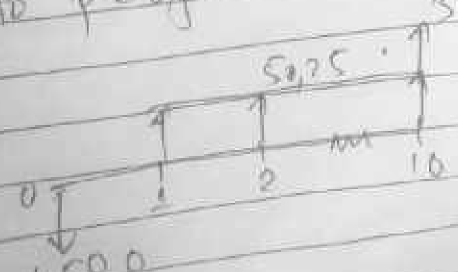
For B:

$$1500 * i(i+1)^{10} + 276(1+i)^{10} - 1 + \frac{500 * i}{(i+1)^{10} - 1} = 0.$$

14.32% < MARR.

As MARR is given with 15% p.a. and by computing of IRR of all 4 alternatives we came to know that only two projects are found to be feasible between which we have to perform incremental analysis as

C & D → D−C



$$IRR_{D-C} = 1500 \frac{0.10 * 1.10^{10}}{1.10^{10} - 1} * \left(1500 - \frac{300}{1.10^{10}}\right) + 525$$

$IRR_{D-C} = 1500 * \frac{i(1+i)^n}{(1+i)^n - 1} + 525 + 300 * \frac{i}{(1+i)^n - 1}$

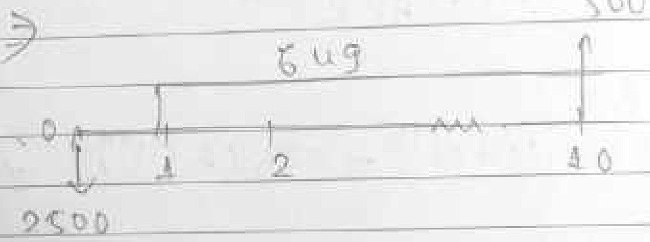
$= 9.49\% < MARR$

Since all project are found to be feasible except D

select D.

Q) If MARR is given as 14% then choose the best alternative.

$CFD_{D-B} \Rightarrow$



$IRR_{D-B} = 23.34\% > MARR$

Thus select project D.

Q) consider the following to mutually exclusive alternatives, recommend the best alternatives using repeatability assumption.

project X

$I = 1,00,000$
O&M = 25,000
SV = 40,000
n = 6 yrs

project - B.

$I = 1,50,000$
O&M = 12,000
SV = 50,000
n = 10 yrs

NAW B

$\Rightarrow - 1,50,000 * \frac{0.10 * 1.10^{10}}{1.10^{10} - 1} + 50,000 * \frac{0.10}{1.10^{10} - 1}$

$- 12,000$

$\Rightarrow \cancel{-9274.5394}$

$= -30137.26974$

$NAW X = -1,00,000 * \frac{0.10 * 1.10^{6}}{1.10^{6} - 1} - 25,000$

$+ 40,000 * \frac{0.10}{1.10^{6} - 1}$

$= -42,776.44$

~~NAC~~ $NAC_X = 42776.44 > NAC_B = 33274.83$

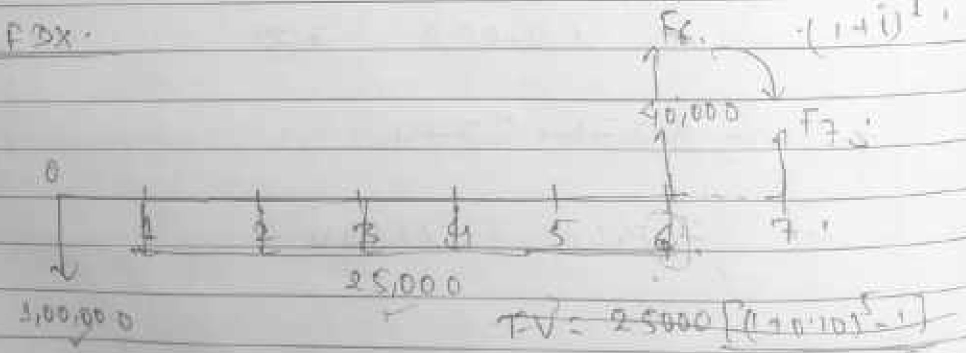
∴ select project B.

Q1. Select the best alternative using net present worth method in previous example if planning horizon is i) 7 yrs.
ii) 6 yrs.
iii) 3 yrs.
iv) 10 yrs
v) 12 yrs

Study period = 7 yrs
↳ co-terminated
Assumption.

~~CFDx.~~

CFDx.



$$FV = 25000\left[\frac{(1+0.10)^5 - 1}{0.10}\right]$$

$$PV_x = \left[\frac{(FV_6) * (1+i)^1}{(1+i)^7}\right] = -186302.56$$

~~$FV = 1,00,000(1+0.10)^6 =$~~

$FV_6 = -1,00,000(1+0.10)^6 + 25000\left[\frac{(1+0.10)^5 - 1}{0.10}\right]$

~~$FV_{6} = -1,00,000 * (1+i)^7 * (1+i)^1$~~ $= \frac{}{(1+i)^7}$ = ~~11000X~~ = 1??

=

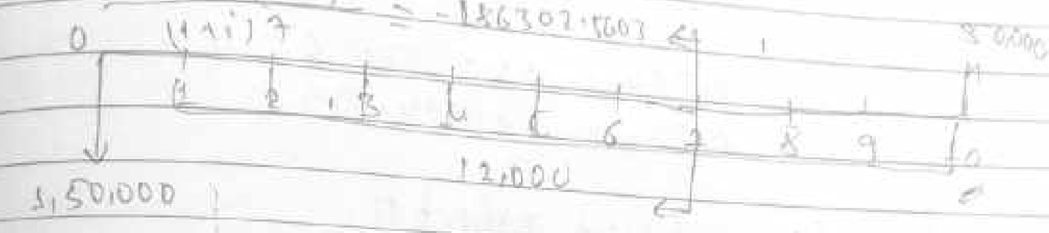
$FV_7 = FV_6 * (1+i)^2$

$= -1{,}00{,}000(1+0.10)^6 - 25000\left[\frac{(1+0.10)^6 - 1}{0.10}\right] + 40{,}000$

$= -177156.1 - 192890.25 + 40{,}000$

~~CFDB~~ $= -330046.35$

$PV_x = \frac{FV_6 * (1+i)^1}{(1+i)^7} = -186302.5003$



$CR_B = ?$.

CF DB

PV_7 (VCR)

NOW

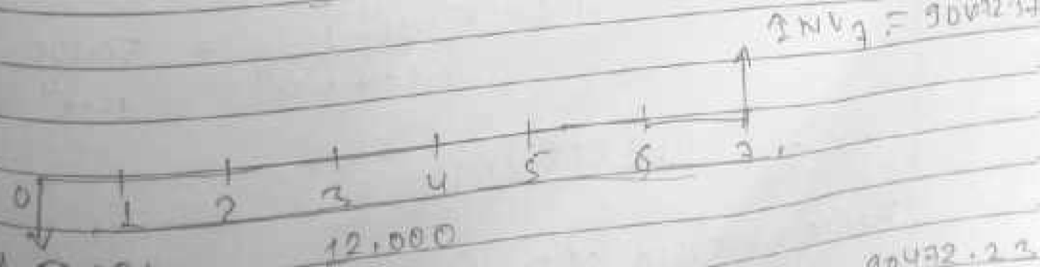
$CR_B = 150{,}000 * \frac{0.10 * 1.10^{10}}{1.10^{10} - 1} - 50{,}000 * \frac{0.10}{1.10^{10} - 1}$

$=$ Rs 21274.54

$PV_7(VCR) = CR_B * \frac{1.10^3 - 1}{0.10 * 1.10^3} = 52906.64$

$\therefore (INV_7)_B = PV_7(VCR) + \frac{50{,}000}{1.10^3}$

$= 90472.37$



$\therefore PV_B = -1{,}50{,}000 - 12000 * \frac{1.10^7 - 1}{0.10 * 1.10^7} + \frac{90472.22}{1.10^7}$

$= -161994.39$ //

$\therefore NPC_X = 186302.56$

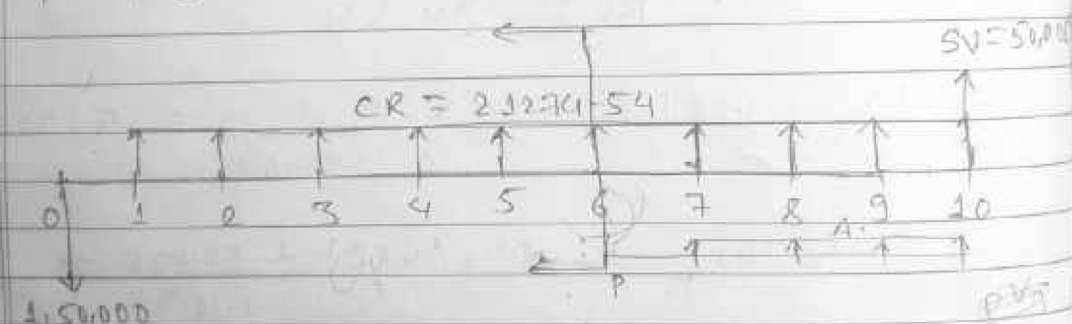
& $NPC_B = 161994.39$

Select project B.

ii) If study period = 6 yrs,

No need to curtail or expansion of CFD for project X since its lifespan and study period are exactly same.

But, we need to curtail the CFD for project B as computed below;



$$IMV_6 = 21274.54 * \frac{1.10^4 - 1}{0.10 * 1.10^4} + \frac{50{,}000}{1.10^4}$$

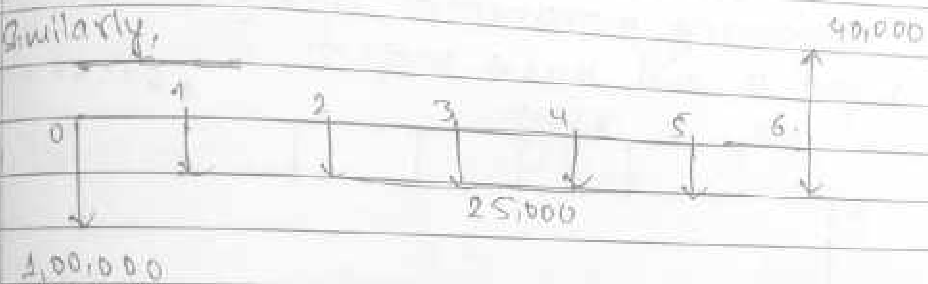
$$= 101588.102$$

Hence modified CFD for project B is

IMV = 101588.10

CFD - B

Similarly,



CFD - X

Now, Modified $BCR_B = \dfrac{R - O\&M}{AW(I) - AW(SV)}$

$$= \frac{-12{,}000}{\left(\dfrac{1{,}50{,}000 * 0.10 * 1.10^6}{1.10^6 - 1}\right) - \left(\dfrac{101588.10 * 0.10}{1.10^6 - 1}\right)}$$

$= -0.56405 < 1$ (infeasible)

Modified $BCR_X = \dfrac{R - O\&M}{AW(I) - AW(SV)}$

$$= \frac{-25000}{\left(\dfrac{1{,}00{,}000 * 0.10 * 1.10^6}{1.10^6 - 1}\right) - \left(\dfrac{40{,}000 * 0.10}{1.10^6 - 1}\right)}$$

$= -1.40655 < 1$ (infeasible)

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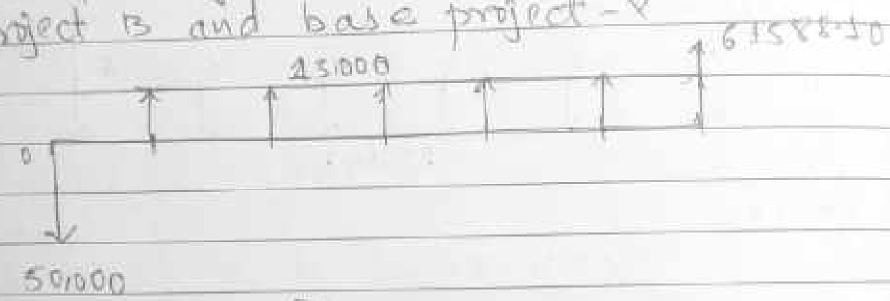
least investment - base project.

Hence, Both the projects are comparable to each other which requires the incremental analysis,

Now,

performing incremental analysis between project B and base project - X



CFD_{B-X}

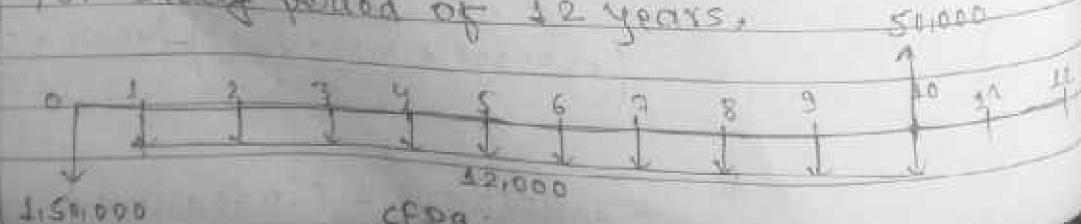
$$\Rightarrow BCR_{B-X} = \frac{\cancel{13000}\ R - O\&M}{I - SV}$$

$$= \frac{13,000 - 0}{50,000 * \frac{0.10 * 1.10^6}{1.10^6 - 1} - \frac{61588.10 * 0.10}{1.10^6 - 1}}$$

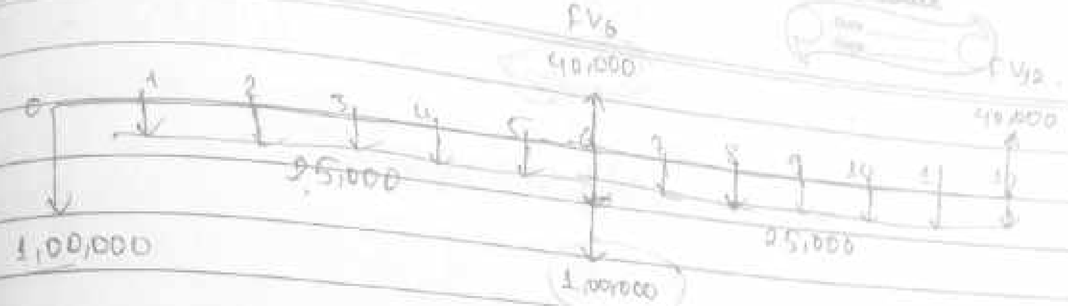
$$= 3.716 > 1.$$

Hence select project B.

v) For study period of 12 years,



CFD_a



CFDx.

Two projects → Project x can be repeat for one more time.

→ project x will terminate after 6 yrs and then for next 6 yrs, interest from bank can be realized by depositing the revenues.

For B.

$$FV_{10} = A \left[\frac{(1+i)^n - 1}{in} \right]$$

~~= 50,000~~

$$= -12{,}000 \left[\frac{(1+0.10)^{10} - 1}{0.10} \right] \times 1{,}50{,}000\,(1+0.10)^{10} + 50{,}000$$

$$= -191249.0952 - 389061.369$$

$$= -580310.4642 + 50000$$

$$= -530310.4642$$

$$FV_{12} = FV_{10} \times (1+i)^2$$

~~= -6,41,675~~

$$= 530310.4642 \times 1.10^2$$

$$= -641675/-$$

$-1{,}00{,}000 \times \frac{1.10^6 - 1}{0.10 \times 1.10^6} \cancel{+} 25000 - 40{,}000$

$F_6 = -435526.0699 - 25000 - 40{,}000 = -500526.0899$

$= 2{,}42{,}156.1$

For X :

$FV_{12} = -914743.55$

$=$

$FV_{12} = (40{,}000 - 1{,}00{,}000) - (1{,}00{,}000 \times 1.10^6) - \cancel{@}$

$- \left(\frac{25000 (1.10^6 - 1)}{0.10} \times \cancel{1.10^6} \right)$

$-60{,}000 - 177156.1 - 341716.8442$

$= 7{,}61{,}856.34 \qquad 578872.9442$

$FV_{12} = \cancel{761856.34 \times 1.10^6}\ 9{,}48{,}833.39$

So, select project B.

~~80~~

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(b) Select the best project by using repeatability assumption from the following data when MARR 13%. Use capitalized worth method to evaluate the

Project X

$I = 4,00,000$

$R = 1,75000$

$O\&M = 50,000$

$n = 4$ yrs

$SV = 1,00,000$

Project Y

$I = 70,000$

$R = 2,50,000$

$O\&M = 70,000$

$n = 6$ yrs

$SV = 1,50,000$

$$NAW_X = \underbrace{1,25,000}_{(R - O\&M)} + 1,00,000 \times \frac{0.13}{1.13^4 - 1} - 4,00,000 \times \frac{0.13 \times 1.13^4}{1.13^4 - 1}$$

$$= Rs\ 11141.79$$

$$NAW_Y = 1,80,000 + 1,50,000 \times \frac{0.13}{1.13^6 - 1} - 70,000 \times \frac{0.13 \times 1.13^6}{1.13^6 - 1}$$

~~= Rs 180512.2586~~

$= Rs\ 22915.72$

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Thus, capitalized value of project x is

$$CV_x = \frac{NAW_x}{i}$$

$$= \frac{11,141.74}{0.13} = 85,705.69$$

$\therefore CV_x = 85705.69$

Similarly capitalized value of project y is

$$CV_y = \frac{NAW_y}{i} = \frac{22915.72}{0.13} = 1,76,274.77$$

$\therefore CV_y > CV_x$

select project Y.

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4) Use IRR method to select the best project. Use MARR = 12%. select the best project combination if A, B and C are mutually exclusive.

		A	B	C	D
Given	I	10,000	15,000	27,000	20,000
	R	5000	7000	12,000	9,000
	n (yrs)	4	4	4	4
	Sv	2,500	5000	8000	10,000
	MARR (%)	15	15	15	15
Computed	IRR	39.34%	36.87%	33.63%	37.34%
	NAW	2230.70	3207.65	4784.54	4507.05

Find IRR of 'D' use annual worth formulation.

Net annual worth = 0.

$$-20{,}000 * \frac{i*(1+i)^4}{(1+i)^4-1} + 9{,}000 + 10{,}000 * \frac{i}{(i+1)^4-1} = 0$$

$$\Rightarrow -20{,}000 * i*(1+i)^4 + 10{,}000 i + \left(9{,}000((1+i)^4-1)\right) = 0$$

77.

$$\Rightarrow i = IRR_D = 37.74\ \%$$

For A = 39.34 %

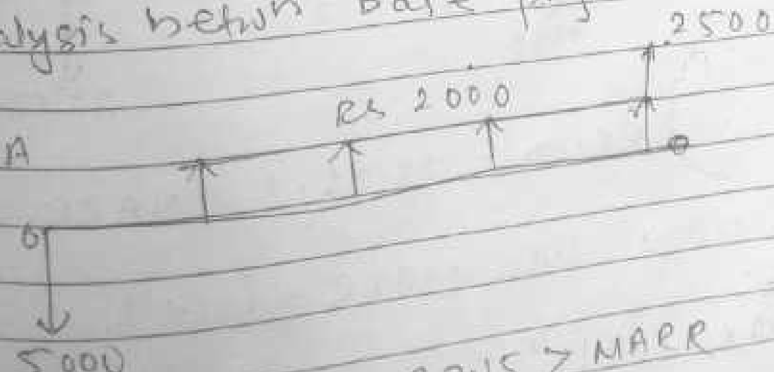
For B = 36.87 %

For C = 33.63 %

For D = 37.74 %

As per calculated values of IRR for given alternatives all of them are found to be feasible. Hence Now performing incremental analysis betwn base project A & project B.

CFD_{B-A}

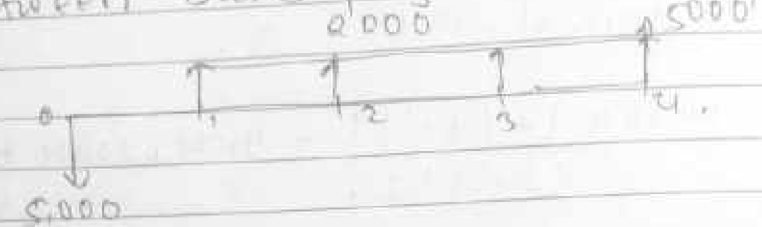


IRR_{B-A} = 32.15 > MARR

Select - project B.

Again, performing incremental analysis between base project B and project D.

CFD$_{D-B}$ →



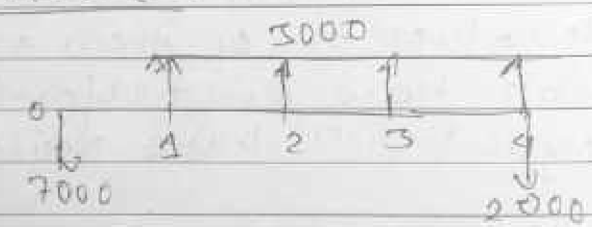
$$\cancel{IRR = -5{,}000 +} \; 2000 + 5{,}000 * \frac{i*(i+1)^4}{(1+i)^4-1}$$

$$+ 5000 * \frac{i}{(1+i)^4-1} = 0$$

$\therefore IRR_{D-B} = 0.4$
$= 40\% > MARR$ select - D.

~~select B D and C.~~

CFD$_{C-D}$ ⇒



$\therefore IRR_{C-D} = 18.31\% > MARR$ select C.

Compute NAW (use MARR = 12%) $i = 0.12$

for A.

$$-10{,}000 * \frac{i(1+i)^4}{(i+1)^4-1} + 5{,}000 + 2500 * \frac{i}{(1+i)^4-1}$$

NAW = 2230.79

For B.

NAW = 3107.65

For C.

NAW = 4784.54

For D

NAW = 4507.65

combinations	1	2	3	4	5	6	7	8
pro - A	✓	✓	X	X	X	X	X	X
pro - B	X	X	✓	✓	X	X	X	X
pro - C	X	X	X	X	✓	✓	X	X
pro - D	X	✓	X	✓	X	✓	✓	X
combinations	A	A,D	B	B,D	C	C,D	D	None
NAW of combination	2230.74	6738.39	3107.65	7615.30	4784.54	9292.19	4507.65	0
						Greatest value		

Remarks:

Select the combination of project C & D.

3) In previous example if project A and D are mutually exclusive and project B is contingent on C then select best combination.

B is contigent on C means → B+C are ~~equity~~

Combinations	1	2	3	4	5	6	7	8	9
pro - A	✓	X	✓	✓	X	X	X	X	X
pro - B	X	X	✓	X	X	X	✓	✓	X
pro - C	X	X	✓	✓	✓	✓	✓	✓	X
pro - D	X	✓	X	X	X	✓	✓	X	X
Combinations	A	D	A,B,C	A,C	C	C,D	B,C,D	B,C	None
NPV of comb.	2230.70	4507.05	8122.89	5015.24	4784.54	9291.59	12,339.[illegible]	7852.[illegible]	0
Remarks							Greatest value		

Task 4: select the combination of project B, C, D.

chapter: 5

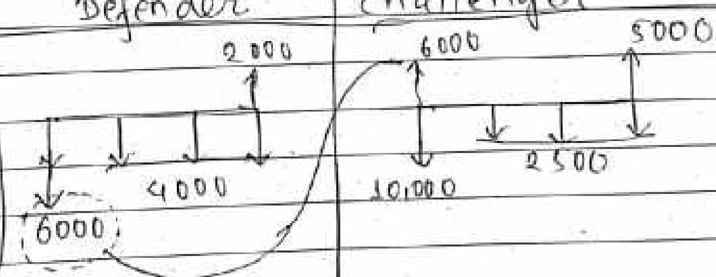
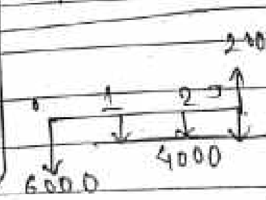
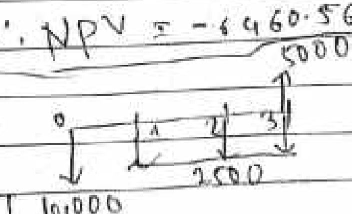
Replacement Analysis

Approach of Replacement Analysis;

1) cash flow Approach (selling of old machine can use to purchase new machine)

2) Opportunity cost Approach (Holding an old machines costs anually that needs to expend).

example -

	Defender	challenger
1. cash flow Approach (MARR = 10%)		
	$\therefore$ NPV = $-4000 * \frac{1.10^3 - 1}{0.10 * 1.10^3} + \frac{2000}{1.10^3}$	NPV = $-4000 - 2500 * \frac{1.10^3 - 1}{0.10 * 1.10^3} + \frac{5000}{1.10^3}$
So replace the defender by a challenger	$\therefore$ NPV = -8844.78	$\therefore$ NPV = -6460.56
2. opportunity cost Approach.		
	$\therefore$ NPV = $-6000 - 4000 * \frac{1.10^3 - 1}{0.10 * 1.10^3} + \frac{2000}{1.10^3}$	$\therefore$ NPV = $-10{,}000 + \frac{5000}{1.10^3} - 2500 * \frac{1.10^3 - 1}{0.10 * 1.10^3}$

NPV = 49
= -12444.78

NPV = 12460.56
→ so replace the defender ~~defendio~~, by challenger.

Defender - old/existing Machine

challenger - new Machine

ESL ⇒ Economic service Life

AEC or EUAC ⇒ Annual equivalent cost or Equivalent uniform cost

planning Horizon (or study period) → finite / Infinite

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5 b) An old machine can sell it now for \$ 5,000. If repaired now, can be used for another six years. It will require an immediate \$1200 for overall overhaul to restore it to operate in future use. future market values are expected to decline by 25% each year, over the previous year value. Operating cost are estimated at \$2000 during the 1st year and these are expected to increase by \$1500 thereafter. Determine the economic service life.

soluⁿ:

Market value = \$ 5000

Remaining life = 6yrs

overhaul = \$ 1200

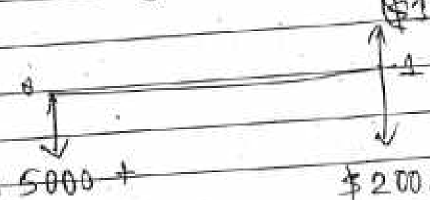
Sv = Decline by 25%.

operation = \$ 2000 for 1st year

& increases by \$1500/year

1. n = 1yr

(\$5000 * 0.75)



\$ 5000 + \$ 1200.   \$2000

$AEC_1 = \$6200 \times 1.10^1 + \$2000 - 5000 \times 0.75$

$= 5070$

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2. $n = 2$ yrs.

$5000 (1 - 0.25)^2

0 — 1 — 2

$5000 + $1200 $2000 $3500

$AEC_2 = \$6200 \times 1.10^2 + \$2000 \times 1.10^1 + 3500 - 5000 \times 0.75^2$

$= 10389.5 \times \frac{0.10}{(1.10)^2 - 1} = 4947.380.$

3. $n = 3$ yrs.

$5000 × 0.75^3

0 — 1 — 2 — 3

$5000 + $1200 $2000 $3500 $5000.

$AEC_3 = 5260.67.$

$(AEC)_3 = [6200 \times 1.10^3 + 2000 \times 1.10^2 + 3500 \times 1.10 + 5000 - 5000 \times 0.75^3] \times \frac{0.10}{1.10^3 - 1}$

$= 17412.825 \times \frac{0.10}{1.10^3 - 1}$

$= 5260.67.$ //

4. $n = 4$ yrs.

$5000 × 0.75^4

0 — 1 — 2 — 3 — 4.

$5000 + $1200 $2000 $3500 $5000 $6500

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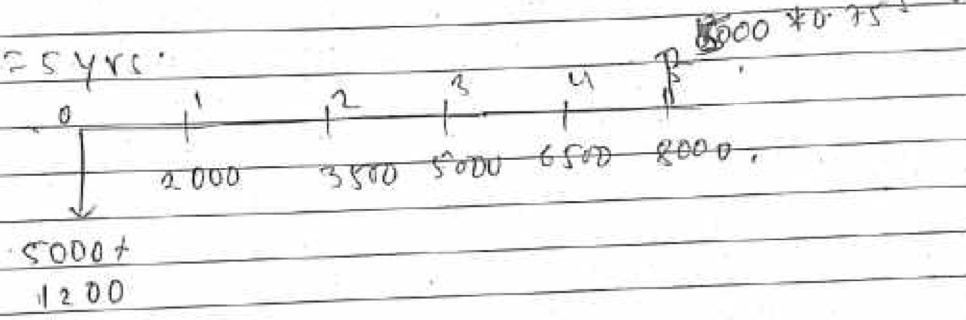
$AEC_4 = 5686.78$

$$(AEC)_4 = \left[6200 \times 1.10^4 + 2000 \times 1.10^3 + 3500 \times 1.10^2 + 5000 \times 1.10^1 + 6500 - 5000 \times 0.75^4\right] \times \frac{0.10}{1.10^4 - 1}$$

5. $n = 5$ yrs.

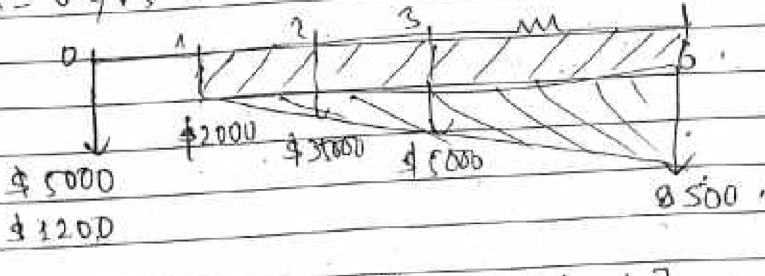


$AEC_5 = 6156.38$

$$(AEC)_5 = \left[6200 \times 1.10^5 + 2000 \times 1.10^4 + 3500 \times 1.10^3 + 5000 \times 1.10^2 + 6500 \times 1.10 + 8000 - 5000 \times 0.75^5\right] \times \frac{0.10}{1.10^5 - 1}$$

$= 6156.383771$

6. $n = 6$ yrs.



$$FV = \frac{G}{i^2}\left[(1+i)^n - ni - 1\right]$$

$$= \frac{1500}{(0.10)^2}\left[(1+0.10)^6 - 6 \times 0.10 - 1\right]$$

$= 25734.15$

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~~AEC6~~

~~$F_n = A\left[\frac{(1+i)^n - 1}{i}\right]$~~

$=$

$AEC_6 = \$2000 + [\$6200 \times 1.10^6 - 5000 \times 0.75^6 + \ldots$

$\times \frac{0.10}{1.10^6 - 1}$.

$= \$ 6643.56$ //.

Hence AECs for old machine are summarized in the table below

Life (n)	Annual equivalent cost (AEC / EUAC)	Remarks
1	5070.00	
2	4947.38	Least AEC
3	5260.67	
4	5686.78	
5	6156.38	
6.	6643.56	

Hence ~~A~~ ESL = 2yrs.

a) In
(ne
men

1) Sug
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2) Sugg
hori

To

1. n =

AEC_1

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Q) In previous example consider a challenger (new Machine) which acquired an investment of \$15000

$I = \$15000$

$O\&M = \$700$ for 1st year and increases by 15% p.a. thenafter

SV = Reduced by 20% per annum

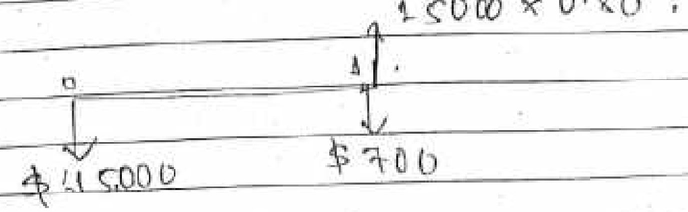
$n = 9$ yrs.

1) suggest best replacement strategy if planning horizon is infinite

2) suggest best replacement strategy if planning horizon is accounted as i) 8 yrs
ii) 12 yrs

To calculate AECs for challenger.

1. $n = 1$ yr



$AEC_1 = \$15000 \times 1.10^1 + \$700 - 15000 \times 0.80$

$= 5200$

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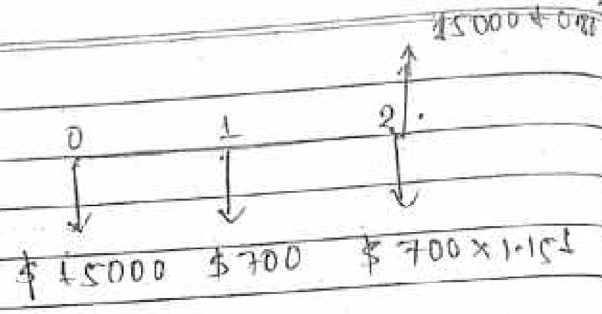
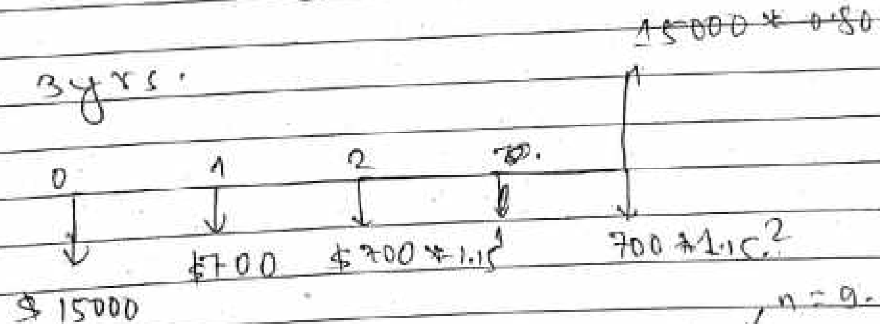
2. $n = 2$ yrs.



$$AEC_2 = \left[15000 \times 1.10^2 + 700 \times 1.10^1 + 700 \times 1.15^1 - 15000 * 0.80^2\right] * \frac{0.10}{(1.10)^2 - 1}$$

$= \cancel{9639}$
$= 4821.43$

3. $n = 3$ yrs.



$n = 9$.

$$\Rightarrow AEC_n = \left[\$15000 \times 1.10^n + 700 * \frac{(1.10^n - 1.15^n)}{0.10 - 0.15} - 15000 * 0.80^n\right] * \frac{0.10}{1.10^n - 1}$$

$AEC_9 = 3652.198$.

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$$AEC_3 = \left[15000 \times 1.10^3 + 700 * \frac{1.10^3 - 1.15^3}{0.10 - 0.15} - 15000 * 0.80^3 \right] * \frac{0.10}{1.10^3 - 1}$$

$= 4514.57$

Hence AECs for a challenger are summarized in the table below:-

Line (n)	AECs	Remarks.
1	5200	
2	4821.43	
3	4514.58	
4	4267.65	
5	4071.07	
6	5917.02	
7	3799.16	
8	3712.29	
9	3652.20	least AECs.

$ESL_c = 9yrs.$

~~ESL_c = 5~~

4) soln:- Replacement strategy for infinite planning horizon.

$AEC_{c, ESL = 9yrs} = 3652.20$

is less than

$AED_{D, ESL = 2yrs} = 4947.38$

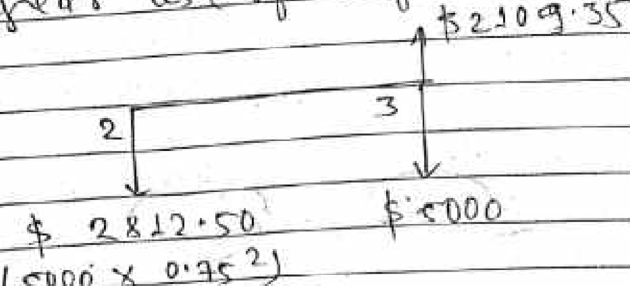
Replace defender by challenger right now ~~use~~ and use for 9 yrs.

Note:-

$$\left.\begin{array}{l} \text{If } AEC_{C, ESL = 9yrs} = 4947.38 \\ \text{is greater than} \\ AEC_{D, ESL = 2yrs} = 3652.20 \end{array}\right\} \text{Assume}$$

conversly,
~~If $AEC_{C, ESL = 9yrs} = 4947.38$~~

then use defender for its ESL duration i.e. upto 2 yr. then performing the $\boxed{\text{marginal analysis}}$ for 1 more year use of defender.



$$AEC = 2812.50 \times 1.10^{1} + 5000 - 2109.35$$

$$= 5984.4 > AEC_{D, ESL = 9yrs}.$$

AEC

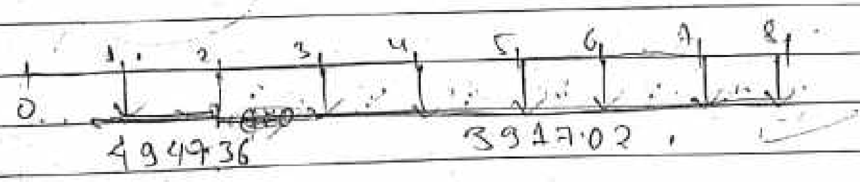
so, replace defender by a challenger at the end of 2nd year.

5) ~~What~~

2) Replacement strategy for finite planning horizon (i.e. for 8 years study period.)

For finite planning horizon we must perform the combinational analysis as mentioned below.

1.



D = 2 yrs , C = 6 yrs.

NPV = ~~$-4947.36 \times (1.10)$~~

$$= -4947.36 \times \frac{1.10^2 - 1}{0.1 \times 1.10^2} - \left[3917.02 \times \frac{1.10^6 - 1}{0.1 \times 1.10^6} \right]$$

$$\times \frac{1}{1.10^2}$$

= ~~19742.18~~

= 22685.101

2. $D = 4$ yrs, $C = 4$ yrs.

0 1 2 3 4 5 6 7 8

~~4267.65~~ 5686.78 . 4267.65

$$NPV = -5686.78 \times \frac{1.10^3 - 1}{0.1 \times (1.10)^3} - \left[\frac{4267.65 \times 1.10^5 - 1}{0.1 \times (1.10)^5}\right] \times \frac{1}{(1.10)^3}$$

NPV = 27126.05

3. $D = 0$ yrs, $C = 8$ yrs

NPV = 19804.79

4. $D = 1$ yrs, $C = 7$ yrs

NPV = 21423.54

5. $D = 6$ yrs, $C = 2$ yrs

NPV = 33657.83

6. $D = 2$ yrs, $C = 4$ yrs, $C = 2$ yrs NPV = 24489.81

7. $D = 3$ yrs, $C = 5$ yrs. NPV = 24673.21

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Hence replace the defender right now and use challenger for 8 yrs of study period.

For 15yrs planning Horizon

1. D=0, C= 9yrs, C=6yrs = ~~37645.65~~ 28,268.39

2. D=1, C= 9yrs, C=5yrs = 29,268

3. D= 2, C= 9yrs, C= 4 yrs = 32,287.30

4. D = 3, C= 9yrs C= 3yrs = 32,462.80

5. D = 4, C= 9 yrs, C= 2yrs = 34816.62

6. D= 5 C= 9yrs, C= 1 yr = 37642.98

7. D= 6 yrs C= 9yrs = 40,807.07

Hence, the combination of challenger for 9yrs of it's use and then again for next 6yrs use same type of challenger. i.e. replace defender right now

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5) Q) The annual equivalent cost of defendor and challenger are given in table below. What is the best replacement strategy? Use MARR = 12 % and planning horizon = 8 yrs

	1	2	3	4	5	6
AEC (Rs, D)	5300	5100	5400	5800	6000	6500
AEC (Rs, C)	7500	6000	5600	5500	5650	5800

ESL for D = (5100) 2 yrs, | ESL_D = 2yrs

ESL for C = (5500) 4 yrs. | ESL_C = 4yrs

1. D = 2yrs , C = 4yrs , C = 2yrs
2. D = 1yr , C = 4yrs , C = 3yrs
3. D = 1yr , C = 5yrs , C = 2yrs
4. D = 0 , C = 4yrs , C = 4yrs
5. D = 3yrs , C = 5yrs.

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

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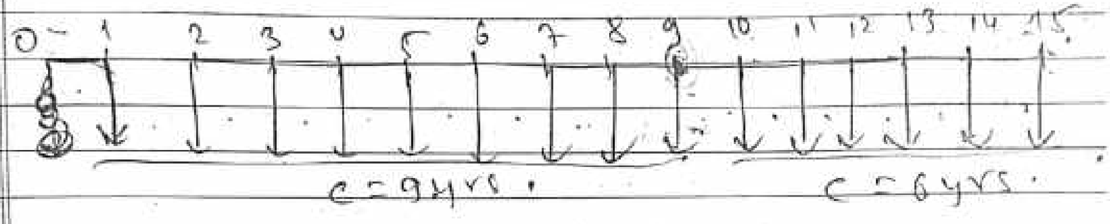
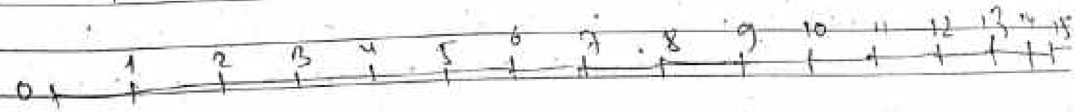
1. $D = 0, \quad C = 9, \quad C = 6.$



$$NPC = \left[3652.20 * \frac{1.10^9 - 1}{0.10 * 1.10^9} + \left[3917.20 * \frac{1.10^6 - 1}{0.10 * 1.10^6} \right] \times \frac{1}{1.10^9} \right]$$

$= 37645.8586.$

6. $D = 5, \quad C = 9, \quad C = 1.$



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Chapter-6

Risk Analysis (10-14) marks

1. Sensitivity Analysis

2. Break Even Analysis
   - i) for single Alternative
   - ii) for two Alternatives.

3. probability Approach (Decision Tree diagram)

4. Scenario Analysis

5. Risk Adjusted MARR method.

suppose

Sensitivity Analysis

consider the following information regarding a project to examine the least and most sensitivity parameter among

i) Investment (I)
ii) Net Annual Revenues (NAR)
iii) salvage value (SV)
iv) life of project (n)
v) MARR (interest rate).

Use Modified BCR. Draw sensitivity diagram too.

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$AW(I) = 2,00,000 \times \frac{0.15 \times 1.15^6}{1.15^6 - 1}$

$= 52847.38$

$AW(SV) = 10,000 \times 0.15 / 1.15^6 - 1 = 1142.37$

Investment = Rs. 2,00,000.

Net Annual Revenue = Rs 6500

SV = 10,000

MARR = 15%.

life (n) = 6yrs.

suppose standard range = ± 30% . (with 10% incremental)

$M \cdot BCR = \frac{NAR}{AW(I) - AW(SV)}$

$= \left(\frac{65000}{x \times 52847.38 - 1142.37} \right)$

$M \cdot BCR_{+0\%} = \frac{65000}{1 \times 52847.38 - 1142.37}$

$= 1.257 > 1.$

$(M BCR)_{+10\%} \; \frac{65000}{1.1 \times 52847.38 - 1142.37}$

$= 1.140$

$(MBCR)_{+20\%} = \frac{65000}{1.2 \times 52847.38 - 1142.37}$

$= 1.044$

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$$M.BCR_{+30\%} = \frac{65000}{1.3 \times 52847.38 - 1142.37}$$

$= 0.962$

$$M\ BCR_{-10\%} = \frac{65000}{0.9 \times 52847.38 - 1142.37}$$

$= 1.40$

$$M.BCR_{-20\%} = \frac{65000}{0.8 \times 52847.38 - 1142.37}$$

$= 1.580$

$$M\ BCR_{-30\%} = \frac{65000}{0.7 \times 52847.38 - 1142.37}$$

$= 1.813$

ii) Sensitivity for NAR.

$$M.BCR = \frac{NAR}{AW(I) - AW(SV)}$$

$$= \frac{65,000 * x}{52847.38 - 1142.37}$$

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$MBCR_{+10\%} = \frac{65000 \times 1.10}{52847.38 - 1142.37}$

$= 1.38$

$MBCR_{+20\%} = \frac{65000 \times 1.20}{52847.38 - 1142.37}$

$= 1.50$

$MBCR_{+30\%} = \frac{65000 \times 1.30}{52847.38 - 1142.37}$

$= 1.63$

$MBCR_{-10\%} = \frac{65000 \times 0.9}{52847.38 - 1142.37}$

$= 1.13$

$MBCR_{-20\%} = 1.01$

$MBCR_{-30\%} = 0.88$

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iii) sensitivity for SV.

$$M.BCR = \frac{65000}{52847.38 - 1142.37 \times x}$$

$$M.BCR_{+10\%} = \frac{65000}{52847.38 - 1142.37 \times 1.10}$$

$$= 1.259$$

$$M.BCR_{+20\%} = \frac{65000}{52847.38 - 1142.37 \times 1.20}$$

$$MBCR_{+30\%} = 1.262$$

$$MBCR_{-10\%} = 1.27$$

$$MBCR_{-20\%} = 1.251$$

$$M.BCR_{-30\%} = 1.248$$

iv) sensitivity for 'n'

$$M.BCR = \frac{65000}{\frac{2,00,000 \times 0.15 \times 1.15^{6x}}{1.15^{6x}-1} - \frac{10,000 \times 0.15}{1.15^{6x}-1}}$$

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$$M.BCR_{+10\%} = \frac{65000}{\dfrac{2,00,000 \times 0.15 \times 1.15^{6\times1.10}}{1.15^{6\times1.10}-1} - \dfrac{10,000 \times 0.15}{1.15^{6\times1.10}-1}}$$

$$= 1.331$$

$$M.BCR_{+20\%} = \frac{65,000}{\dfrac{2,00,000 \times 0.15 \times 1.15^{6\times1.20}}{1.15^{6\times1.20}-1} - \dfrac{10,000 \times 0.15}{1.15^{6\times1.20}-1}}$$

$$= 1.400$$

$M.BCR_{+30\%} = 1.463$

$M.BCR_{-10\%} = 1.175$

$M.BCR_{-20\%} = 1.086$

$M.BCR_{-30\%} = \cancel{1.175}\ 0.989$

v) Sensitivity for MARR

$$M.BCR = \frac{65,000}{\dfrac{2,00,000 \times 0.15 \times (1.0.15x)^6}{(1+0.15x)^6-1} - \dfrac{10,000 \times 0.15x}{(1+0.15x)^6-1}}$$

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M. BCR 0% = 1.257

M. BCR +10% = ~~1.257~~ 1.205

M. BCR +20% = 1.158

M. BCR +30% = 1.113

M. BCR -10% = 1.311

M. BCR -20% = 1.370

M. BCR -30% = 1.434

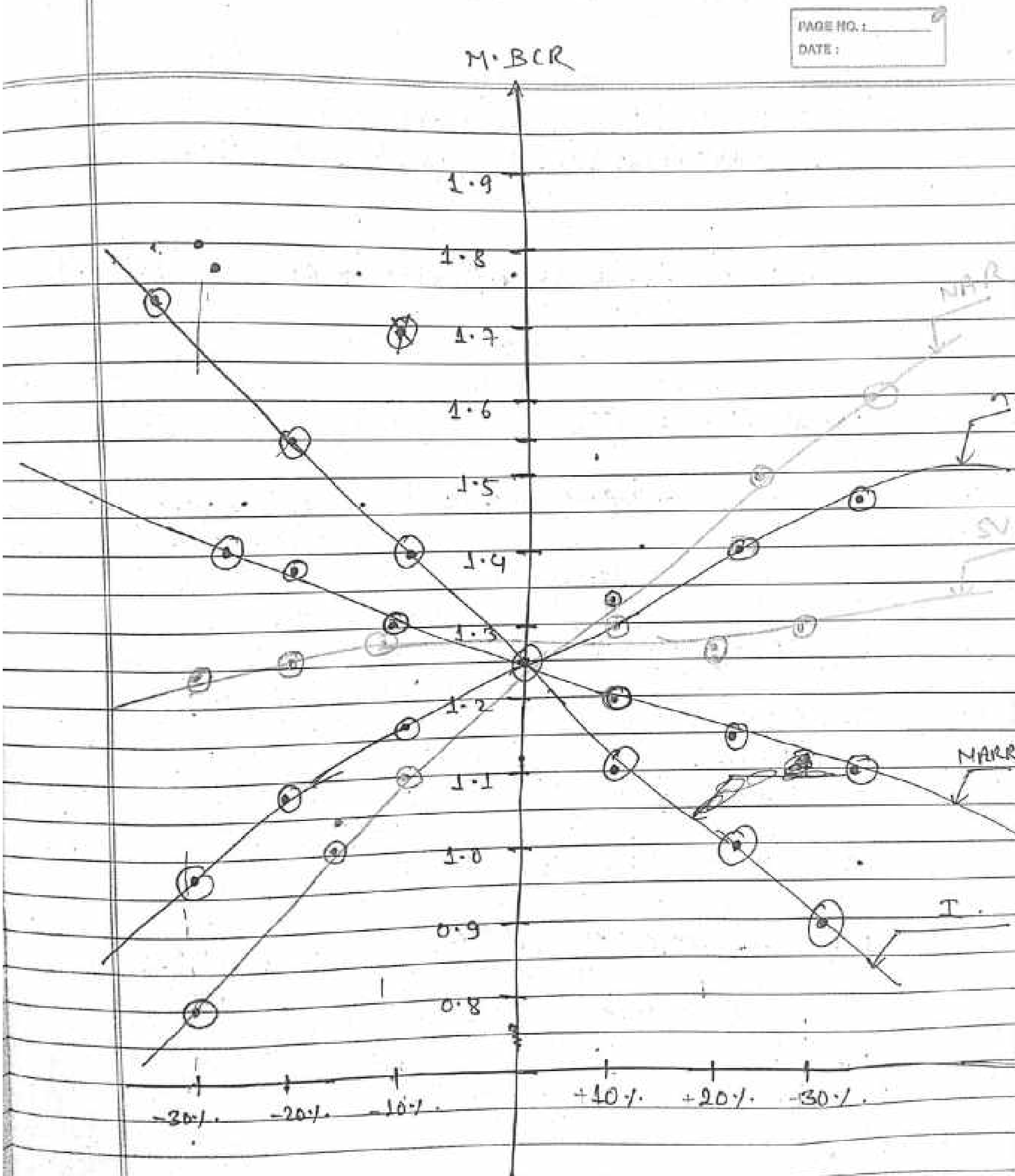

Fig:- sensitivity Diagram

Government project - M.BCR
private " - IRR.

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Most sensitive parameter is investment and least sensitive parameter is SV.

$$NFV = -2,00,000 * (1+i)^6 + 65,000 \times \frac{(1+i)^6 - 1}{i} + 10,000$$

i) sensitivity for I.

$$NFV = -2,00,000 * x (1.15)^6 + 65000 \times \frac{1.15^6 - 1}{0.15} + 10,000$$

$$y = mx + c$$

NFV 0% =
NFV -30% =
NFV +30% =

ii) sensitivity for 'n'.

$$NFV = -2,00,000 (1.15)^{6x} + 65,000 \times \frac{1.15^{6x} - 1}{0.15} + 10,000$$

-10%. 30%.
-20%.
-30%.
0%.
+10%.
+20%.

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Sensitivity Analysis using IRR..

(i) Investment (I)

NAW = 0

$\Rightarrow -2,00,000 * x \cdot \frac{i(1+i)^6}{(1+i)^6-1} + 65,000 + 10,000 \times \frac{i}{(i+1)^6-1} = 0$

(i) $IRR(x=1)_{0\%} = 22\%$

(ii) $IRR(x=1.10) + 10\% =$

$IRR(x=1.20) + 20\% =$

$IRR(x=1.30) + 30\% =$

$IRR(x=0.90) - 10\% =$

$IRR(x=0.80) - 20\% =$

$IRR(x=0.70) - 30\% =$

Sensitivity	-30%	-20%	-10%	0	+10%	+20%	+30%
IRR	22%	22%	22%	22%	22%	22%	22%
MARR	10.5%	12%	13.5%	15%	16.5%	18%	19.5%
% Marginal IRR	11.5%	10%	8.5%				

plot 3rd

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2072 Ashwin

Breakeven Analysis for single Alternative

FC = Fixed cost

VC = variable cost

TC = Total cost = FC + VC

VCPU = variable cost per unit

SPPU = selling price per unit

BEP = Break even point

To find BEP,

Net Revenues = 0 = Net profit

i.e. Total sales Revenues − Total cost = 0

or, $SPPU * x - (FC + VCPU * x) = 0$

$\Rightarrow$ x = BEP (volm / Quantity)

2072 Ashwin

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6 a) A company produces an electronic ~~time in~~ timing switches i.e. used in consumer and commercial product made by several other manufacturing forms. The FC and TC are Rs, 40,000 and Rs 85,000 respectively. The, total sales are, Rs 1,05,000 and sales volum is 15000 for this situation.

i) find the BEP interms of number of units.

ii) what should be the output if the profit desired is Rs 50,000?

Here,

we have,

$$TC = FC + VC$$

$$\text{or, } 85,000 = 40,000 + VC$$

$$\Rightarrow VC = Rs\ 45,000$$

Total sales Revenues = Rs 1,05,000

and selling unit = 15000 unit

$$SPPU = \frac{1,05000}{15000} = Rs\ 7.$$

$$VCPU = \frac{Rs\ 45000}{15000} = Rs\ 3.$$

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To find BEP.

let us suppose 'x' be the BE quantity

Total profit = 0

Total sales Revenues − Total cost = 0

or, $x * Rs\,7 - (FC + vcpu * x) = 0$

$\Rightarrow 7x - 40{,}000 - 3x = 0$

$\Rightarrow 4x = 40{,}000$

$\Rightarrow x = 10{,}000$ unit.

2069 poush Q) 5 b)

ii) ~~Here,~~ Interms of sales Revenues = 10,000 × Rs 7
= 70,000 (Rs)

iii)

To have 50,000 (Rs) profit,
we have let, 'y' be the quantity
to be produced.

∴ Total profit = 50,000

$Rs\,7 \times y - 40{,}000 - Rs\,3 \times y = 50{,}000$

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$\Rightarrow 7y - 40{,}000 - 3y = 50{,}000$

$\Rightarrow 4y = 90{,}000$

$y = \frac{90{,}000}{4}$

$y = 22{,}500$ units

Break Even Analysis for Two alternatives:-

Break Even point is that situation at which there is no significant differences between both the alternatives.

2069 poush Q)

5 b) If the cost of 25watt CFL bulb is Rs 260 whereas the cost of 100watt filament bulb is Rs 35 but these bulbs have equal lighting power. Which bulb do you prefer in your use and why? When electricity cost is Rs 11 per unit.

CFL Bulb	Filament Bulb
25 watt	100 watt
I = Rs 260	I = Rs 35
n = 3yrs	n = 2yrs
y = 80 %	y = 70 %

MARR = 10 %

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$AC(CFL) = AC(I) + A(O\&M)$

$$= 260 * \frac{0.10 \times 1.10^3}{1.10^3 - 1} + \frac{25}{1000} \times \frac{x \times 11 \times 365 \text{ days}}{0.80}$$

$$AC(CFL) = 104.54 + 125.46x$$

$$AC(\text{filament}) = 35 * \frac{0.10 \times 1.10^2}{1.10^2 - 1}$$

$$+ \frac{100}{1000} \times \frac{x\,hr \times Rs\,11 \times 365 \text{ day}}{0.70}$$

$$AC(\text{filament}) = 20.1667 + 573.57x$$

Thus for BEP, we have.

Equating the equations above

$$AC(CFL) = A.C(\text{Filament})$$

$$104.54 + 125.46x = 20.1667 + 573.57x$$

$$104.54 - 20.1667 = 573.57x - 125.46x$$

$$\Rightarrow \cancel{x = 4} \quad \cancel{x = 0.232}$$

$$448.11x = 0.188 \text{ hrs}$$

$$= 11 \text{ min}$$

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$AC(CFL) = AC(I) + A(O\&M)$

$$= 260 * \frac{0.10 \times 1.10^3}{1.10^3 - 1} + \frac{25}{1000} \times \frac{x \times 11}{0.80} \times 365 \text{ days}$$

$AC(CFL) = 104.54 + 125.46x$

$$AC(\text{filament}) = 35 * \frac{0.10 \times 1.10^2}{1.10^2 - 1} + \frac{100}{1000} \times \frac{x\,hr \times Rs\,11}{0.70} \times 365 \text{ days}$$

$AC(\text{filament}) = 20.1667 + 573.57x$

Thus for BEP, we have.
~~Equating the equations above~~

$AC(CFL) = A.C(\text{filament})$

$104.54 + 125.46x = 20.1667 + 573.57x$

$104.54 - 20.1667 = 573.57x - 125.46x$

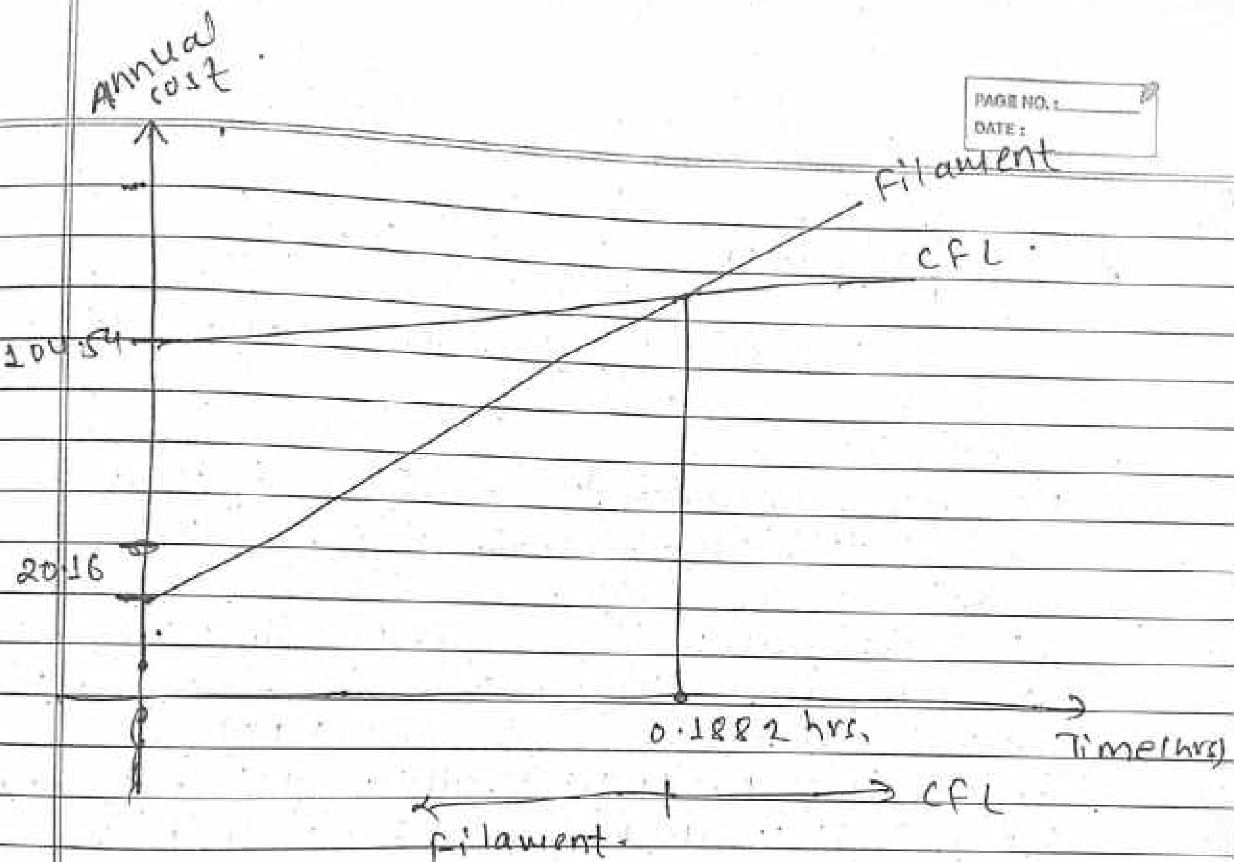
$\Rightarrow \cancel{x = 4} \quad \cancel{x = 0.232}$

$448.11x = \cancel{0.11}\ 0.188 \text{ hrs}$

$= 11 \text{min}$

104.54

20.16



One can use CFL bulb instead of filament bulb if he/she wants to lightening for 0.1882 hrs per day.

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ndra

Q (a) Decision Tree Diagram

probability Approach of Risk Analysis

6a) For the improvement of the manufacturing plant, following three alternatives have been considered. The estimated investment and the corresponding increment in income are also given as below. Draw a decision tree diagram and decide the best alternative using NFV. MARR = 15% and the project life is 6 yrs.

Alternatives	Investment cost	Sales Criteria	Sales Probability	Annual Income
A	10,00,000	HS	0.4	5,00,000
		MS	0.5	3,00,000
		LS	0.1	125500
B	600,000	HS	0.2	4,00,000
		MS	0.5	2,50,000
		LS	0.3	1,00,000
C	4,00,000	HS	0.5	2,00,000
		MS	0.1	1,25,000
		LS	0.4	50,000

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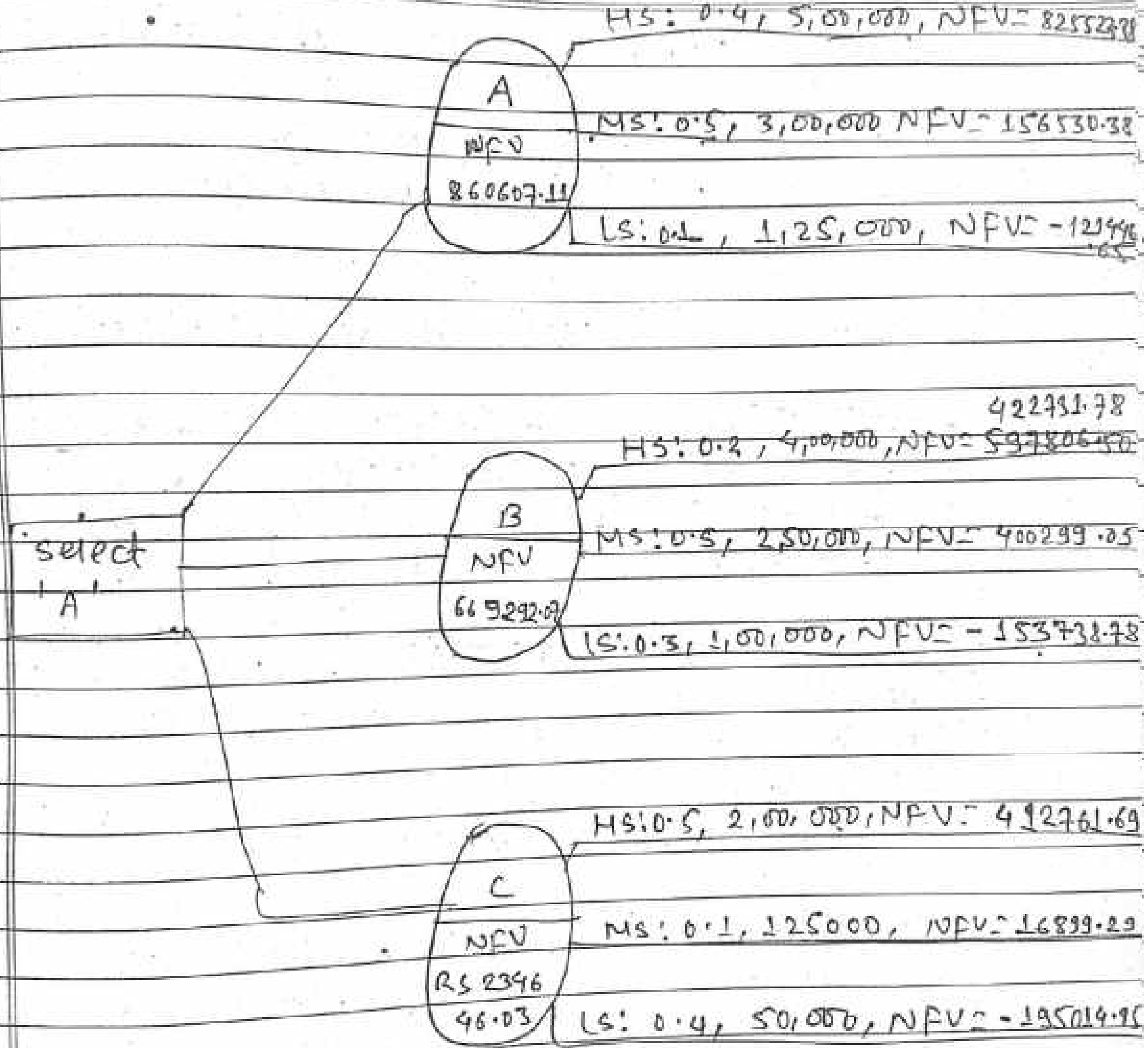

Sample calculation:

NFV for HS for alternative 'A' is

$$= \left[-10,00,000 \times 1.15^6 + 5,00,000 \times \frac{1.15^6 - 1}{0.15} \right] \times 0.40$$

= Rs 8,25,523·38

∴ Alternative A is the best alternative

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

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Scenario Analysis for Risk Assessment

Consider the following three different scenes of a project to evaluate the Risk.

Optimistics	Most likely	Pessimistic
I = 2,00,000 (Rs)	I = Rs 2,50,000	I = Rs 3,00,000
SV = 20,000 (Rs)	SV = 20,000 (Rs)	SV = 10,000 (Rs)
n = 4 yrs	n = 3 yrs	n = 3 yrs
NAR = 90,000 (Rs)	NAR = Rs 85,000	NAR = Rs 80,000
NPV = 98948.16	~~98948.16~~ 23891.28	-93538.69
NFV		
NAW		

Risk Adjusted MARR

Consider the following projects to evaluate the Riskness of the portfolio.

	Investment	O&M	R (Rs)	n (Life)	SV (Rs)	MARR
Project A	1,00,000	2,00,000	25000	8 yrs	20,000	15%
Project B	2,00,000	3,00,000	45000	12 yrs	30,000	14.5%

MARR → Pr-A
Risk Adj. जोखिम
→ Pr-B

$F = A \frac{(1+i)^n - 1}{i}$, f.

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$NAW_A = \cancel{1,00,0} - \frac{1,00,000 \times 0.18 \times (1+0.18)^8}{(1+0.18)^8 - 1}$

$+ \frac{2,000 \cancel{\times 0.18}}{\cancel{(1+0.18)^8 - 1}} + \frac{25000 \cancel{\times 0.18}}{\cancel{(1+0.18)^8 - 1}} + \frac{20,000 \times 0.18}{(1+0.18)^8 - 1}$.

$= 3729.06$

ARR → pr-A.

% Risk Adjust
समायोजित MARR

5% → Pr-B "

Chapter-7

Depreciation and corporate Income Tax -12 marks

2073 Bhadra

Methods of charging depreciation

1. Straight line Depreciation (SLD).

2. ~~Diminishi~~ Diminishing / Declining Balance Dep. (DB)

- 100% declining (single)
- 150% declining
- 200% (Double) declining

3. Sum of years Digit (SOYD)

4. Sinking fund

5. Modified Accelerated cost Recovery system (MACRS)

2073 Bhadra

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Q) If a machine costing Rs 1,00,000 is purchase by expecting salvage value of Rs 20,000 at the end of 6th year. Calculate depreciation amount for each year by SOYD and straight line method.

Solun:-

$I = Rs.\ 1,00,000$

$SV = Rs.\ 20,000$

$n = 6yrs.$

Using SLD

$$\text{Annual depreciation} = \frac{I - SV}{n}$$

$$= \frac{Rs\ (1,00,000 - 20,000)}{6yrs}$$

$$= 13,333.33 \text{ per year.}$$

Book values and depreciations are presented in table below:

EOY (n)	previous year's Book value B_{n-1}	Depreciation D_n	Book Value B_n
1	1,00,000	13,333.33	86,666.67
2	86,666.67	13,333.33	73,333.33
3	73,333.33	13,333.33	60,000
4	60,000	13,333.33	46,666.67
5	46,666.67	13,333.33	33,333.33
6	33,333.33	13,333.33	20,000 = SV

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Depreciation charging by Diminishing Balance (DDB) method.

we have,

$$DDB\% = \frac{1}{n} \times 200\%$$

$$= \frac{1}{6} \times 200\%$$

$$= 33.33\%$$

Thus, Book values and Depreciations are presentend in table below.

EOY	B_{n-1}	D_n	B_n	SLD	Remark:
1	1,00,000	33330	66670		
2	66670	22221.1	44448.88		
3	44448.88	14814.8	29634.06		
4	29634.06	~~9877.03~~	~~19757.03~~ 26422.950	3211.11	switch to SLD
5	26422.95	—	23211.48	3211.11	
6	23211.48	—	20000 = SV	3211.11	

case (i) $DDB\ (BV_6) = 8781.77 < SV$

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consider the previous example if

SV = 5000 Rs. | only case of BV > SV.

~~EOY~~ EOY	B_{n-1}	Depreciation SLD	DDB	B_n	Remarks
1	1,00,000	15833.33 <	33330	66670	
2	66670	12334 <	22221.11	44448.88	
3	44,448.88	9862.22 <	14814.8	29,634.06	
4	29,634.06	8211.35 <	9877.03	19757.03	
5	19757.03	7378.52 <	6585.02	12378.51	switch to SLD
6	12378.51	7378.52	—	5000 = SV.	

Hence optimal year is 5th year

Depreciation charging by SOYD method,

we have,

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

Where, $SOYD = \frac{N(N+1)}{2} = \frac{6 \times 7}{2} = 21$

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Thus $D_1 = \frac{6-1+1}{21} * (1,00,000 - 20,000)$

Similarly,

$$D_2 = \frac{6-2+1}{21} * 80,000$$

The book values and depreciations are mentioned in below table.

EOY	B_{n-1}	$D_n = \frac{N-n+1}{SOYD} * (I-SV)$	B_n
1	1,00,000	22857.14	77142.86
2	77142.86	19047.61	58095.25
3	58095.25	15238.09	42857.16
4	42857.16	11428.57	31428.59
5	31428.59	7619.05	23809.54
6	23809.54	3809.52	20,000 = SV

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Depreciating

Depreciation by sinking fund Method

we have.

Total depreciation = 80,000 in 6 years use of an asset.

Thus, Annual sinking Fund (A) is,

$$= f * \frac{i}{(1+i)^n - 1} \quad (\text{net } i = 10\%)$$

$$\therefore A = 80{,}000 \times \frac{0.10}{1.10^6 - 1} = 10368.59$$

Thus, Book values and depreciations are given in table below,

EOY	B_{n-1}	constant SF	compounded SF = D_n	B_n
1	1,00,000	10368.59	10368.59 $10368.59(1+i)^0$	89631.41
2	89631.41	″	11405.45 $10368.59(1+i)^1$	78225.96
3	78225.96	″	12545.99	65679.97
4	65679.97	″	13800.59	51879.38
5	51879.38	″	15180.65	36698.73
6	36698.73	″	16698.72	20,000

$DDB\% = \frac{1}{n} \times 200\%$

$= 33.33\%$ $(i+1)^{n-1}$

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2072 Magh

Depreciation charging by MACRS

S.N.	Description regarding	MACRS%	B_{n-1}	D_n	B_n
1.	$\frac{1}{2}$ yr DDB% = 16.67% $\left(\frac{33.33}{2}\right)$	16.67%	100,000	16666.67	83333.33
2	1 yr DDB% = 27.77% (100−16.67) = (83.33×0.333)	27.77%	83333.33	27777.77	55555.56
	1 yr SLD% = 15.14% (100−16.67) = 83.33/5.5				
3	1 yr DDB% = 18.51%	18.51%	55555.56	18510	37045.56
	1 yr SLD% = 12.34%				
4	1 yr DDB% = 12.34%	12.34%	37045.56	12340	24705.56
	1 yr SLD% = 10.58%				
5	1 yr DDB% = 8.23%	9.88%	24705.56	9880	14825.56
	1 yr SLD% = 9.88%	SW to SLD			
6	1 yr DDB% = 4.94%	9.88%	14825.56	9880	4945.56
	1 yr SLD% = 9.88%				
7.	$\frac{1}{2}$ yr SLD% = 4.94%	4.94%	4945.56	4940	0 = 5.56
		100%		100,000	

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2072 Magh

After Tax Cash flow Analysis

A machine is expected to cost Rs. 5,00,000 and will generate Revenues of Rs. 1,50,000 per yr. for 5 yrs. It's salvage value is 2,00,000. calculate after tax cash flow and corresponding NPV if tax rate is 30% and depreciation is on sum of year digit method MARR=15%.

After Tax cashflow Analysis steps.

1. first find the revenues (net) in each year (R_n)
2. Calculate depreciation of each year using given method. (D_n).
3. Find the Taxable income i.e. $(R_n - D_n) = TI$.
4. Change the tax @ of given % for $TI = T$.
5. Calculate ATCF in each year by,

$$ATCF = (R_n - T).$$

$$\frac{N-n+1}{SOYD} \times (I-SV)$$

$$\frac{-5+6}{2}$$

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After Tax cash flow Analysis

	EOY	1	2	3	4	5
	Revenues	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000
	Dn (SOYD)	1,00,000	80,000	60,000	40,000 $\frac{2}{15}(I-S_v)$	20,000 $\left(\frac{1}{15}(I-S_v)\right)$
(R − SOYD)	Taxable income	50,000	70,000	90,000	1,10,000	1,30,000
(30% of TI)	Tax @ 30%	15,000	21,000	27000	33000	39000
(R − Tax @30)	ATCF	1,35,000	1,29,000	1,23,000	1,17,000	1,11,000

Thus, $NPV(ATCF) = -5,00,000 + \frac{135000}{1.15}$

$$+ \frac{129000}{1.15^2} + \frac{1,23,000}{1.15^3}$$

$$= + \frac{117000}{1.15^4} + \frac{111000}{1.15^5}$$

$$= + \frac{200000}{1.15^5}$$

$= 158977.5652$

Chapter-8

Inflation

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Inflation is decrease in purchasing power of money'

In 2044 B.S. Now in 2075 B.S.

Gold price = Rs. 6,000/tola Gold price = Rs 56000/tola

Thus

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

AD, CD

$$\Rightarrow 56,000 = 6000(1+i)^{31}$$

$$\Rightarrow i = f = \% \text{ inflation} = 7.47\%.$$

Thus, annual inflation over 31 yrs = 7.47% pa

Terminologies:

constant Dollar ⇒ Today's Money
(Having no consideration of inflation)

Actual Dollar → future Money
(Having consideration of inflation)

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i' ⇒ inflation free interest Rate
i ⇒ Inflation adjusted Interest Rate (MARR)
f ⇒ inflation Rate in %

$$\boxed{i = i' + f + i' * f} \Rightarrow i' = \frac{i - f}{(1 + f)}$$

Use 'i'' if cashflows are given in constant dollar.

Use 'i' if cashflows are given in Actual dollar.

2072 Magh — Compute the equivalent present worth using deflation method.

$10\% = i$
$10\% = i'$

Take $f = 5\%$ & $i = 10\% = MARR$

EOY	0	1	2	3	4	5
Cash inflows		5,00,000	5,60,000	6,20,000	6,80,000	7,40,000
Cash outflows	100,0000	1,00,000	2,00,000	3,00,000	4,00,000	5,00,000

Given cashflows are in Actual dollar.

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By using Adjusted MARR method

yo method nagarne

$$NPV = -1{,}00{,}000 + \frac{4{,}00{,}000}{1.10^1} + \frac{3{,}60{,}000}{1.10^2} + \frac{3{,}20{,}000}{1.10^3} + \frac{2{,}80{,}000}{1.10^4} + \frac{2{,}40{,}000}{1.10^5}$$

$$= 241842.6461$$

using Deflation method:

1st step. deflate Actual Dollar cashflow in constant dollar cashflow

EOY	Actual Dollar (x)	constant dollar $= \frac{x}{(1+f)^n}$ where $f = 5\%$
0	-10,00,000	-10,00,000 $n=0$
1	4,00,000	380,952.38 $n=1$
2	3,60,000	326530.61
3	3,20,000	276428.03
4	2,80,000	230356.69
5	2,40,000	188046.28

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2nd step:-

Discounting all the constant dollar cash flows @ i'%.

Where, $i' = \left(\frac{i-f}{1+f}\right) = \frac{0.10-0.05}{0.10+0.05} = 4.76\%$.

EoY	Constant dollar cashflows (x)	Discounting factor @ 4.76% (y)	PV of cash flow (xy)
0	-10,00,000	1	-10,00,000
1	380,952.38	0.956	364190.48
2	326530.61	0.912	297795.92
3	276428.03	0.8695	240409.45
4	230356.69	0.8302	191242.12
5	1,88046.28	0.7925	149026.67

Sum = 242664.64

$\frac{1}{1.046} = 0.956.$

$\frac{1}{(1.046)} \times \left(\frac{1}{1.046}\right) = 0.912$