

PW gives

n. gives: i. gives

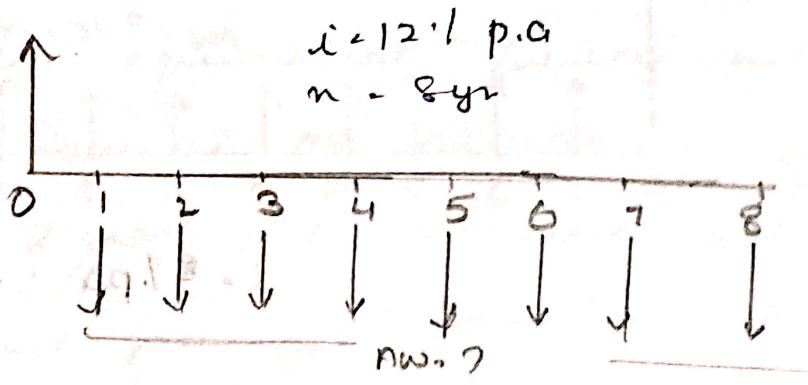
$$AW = PW$$

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

$$AW = PW(A/F, i, n)$$

~~385 next~~

Q: Calculate the annual instalment to be paid if you borrow ₹ 2,00,000 with an interest period of 8 yrs & 12% cost of capital per annum.



$$PW = 2,00,000 \left[\frac{0.12(1+0.12)^8}{(1+0.12)^8 - 1} \right] = 40260.56$$

=====

$$AW = PW(A/F, 12\%, 8)$$

Hastha agencies offer you higher-purchase scheme wherein you can buy a washing machine cost which cost ₹ 40,000 you have to make $\frac{1}{4}$ of the actual price as down payment and the balance will be paid on 10 monthly installments. They will charge 6% rate of interest p.a on higher purchase. What is the EMI you have to pay and what is the actual price you ~~pay~~ pay if go more and above the cost price of you for higher ~~purchaser~~ ^{Purchase} price.

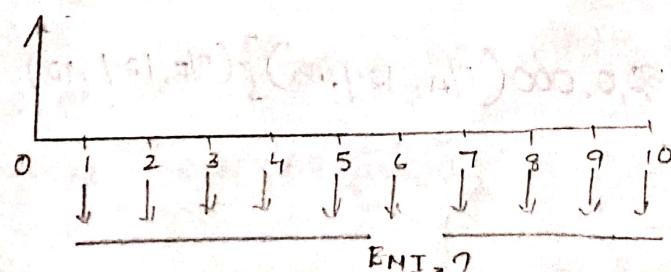
Cost-price
of the washing machine = ₹ 40,000

$$\text{Initial Down payment} = \frac{1}{4} \times ₹ 40,000 \\ = ₹ 10,000$$

Balance to be paid in 10 monthly
installment = ₹ 40,000 - ₹ 10,000
= ₹ 30,000

and, interest @ 6% p.a;

hence, interest rate per month = $\frac{6\%}{12} = 0.5\%$



$$0.10277$$

$$\text{EMI} = ₹ 30,000 (A/P, 0.5\%, 10) = ₹ 3083.1$$

Here, the amount paid over and above
the last price (actual price)

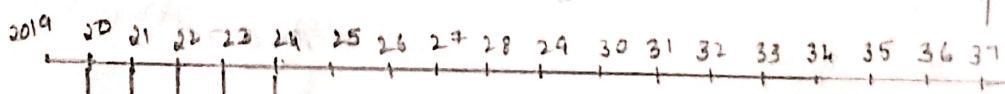
$$= 10,000 + (\text{₹} 3083.1 \times 10) - 40,000$$

$$= \underline{\underline{\text{₹} 831}}$$

~~10% rate~~

Q: A baby is born on 1st Jan 2019 to father. If the baby wants to ensure a return of ~~5%~~ ₹ 5 lakhs on completion of 18, 19, 20, 21st & 22nd year of the child. How much he has to invest at the end of each year from 1st to 5 years of the child's life. Consider 12% rate of return per annum.

$$i = 12\% \text{ p.a}$$



$$AW = \left[\left\{ \text{₹} 5,00,000 (P/A, 12\%, 5) \right\} (P/F, 12\%, 17) \right] (A/P, 12\%, 5)$$

$$= \underline{\underline{\text{₹} 22,016.730}}$$

q

$$= \underline{\underline{\text{₹} 72820.14}}$$

$$AW = \left[\left\{ \text{₹} 50,0,000 (P/A, 12\%, 15) \right\} (P/F, 12\%, 12) \right] (A/F, 12\%, 5)$$

$$= \underline{\underline{\text{₹} 72823.76}}$$

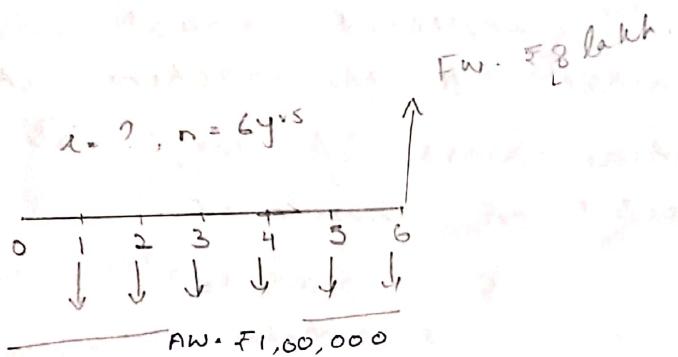
$$P = \left[\left\{ \frac{25,00,000}{(F/A, 12\%, 5)} \right\} (P/F, 12\%, 17) \right] (A/F, 12\%, 5)$$

$$= ₹ 714,323$$

-OR-

$$FW = \left[\left\{ \frac{25,00,000}{(F/A, 12\%, 5)} \right\} (P/F, 12\%, 22) \right] (A/P, 12\%, 5)$$

A financial agency promises you to pay ₹ 8,00,000 if you deposit ₹ 1,00,000 annually for 6 years. What rate of return (interest rate) is implied in this offer?



$$FW = AW (F/A, i\%, n)$$

$$8,00,000 = 1,00,000 (F/A, i\%, 6).$$

$$(F/A, i\%, 6) = \frac{8,00,000}{1,00,000} = 8.00000$$

-OR-
 It can be 11% or 12% . taking one upper value one lower value

$$AW = FW (A/F, i\%, n)$$

$$1,00,000 = 8,00,000 (A/F, i\%, 6).$$

$$d \left[\begin{array}{l} c \\ i - 8.00000 \\ u - 7.91286 \end{array} \right] b$$

$$c = \frac{a}{b} \times d.$$

$$a, 8.11519 - 8.00000$$

$$= 0.11519$$

$$b, 8.11519 - 7.91286$$

$$= 0.20233$$

~~Answer~~

a. O. 11519

b. O. 20233

$$\frac{12-i}{12+i} = \frac{0.11519}{0.20233} \times 1$$

\overline{i}

$$12-i = 0.56931$$

$$i = 12 - 0.5693$$

$$= 11.43\%$$

- Q. A machine was purchased at ₹ 8 lakh with an expected annual income ₹ 1,25,000 for what life the machine should the machine work if 12% rate of return is expected on investment.

$$i = 12\%, p.a; n=?$$

$$\underline{\text{₹}1,25,000 - \text{Aw}}$$



$$PW = ₹ 8,00,000$$

$$PW = AW(P/A, i, n)$$

$$₹ 8,00,000 = ₹ 1,25,000 (P/A, 12\%, n)$$

(P/A) = OR

$$AW = PW (A/P, i, n)$$

$$1,25,000 = 800,000 (P/A 12\%, n)$$

$$(P/A, 12\%, n) = \frac{800000}{125000} = 6.4000$$

$$\begin{array}{c} a \quad d \\ \hline b \\ \uparrow \rightarrow 6.19437 \\ n \rightarrow 6.4000 \\ \downarrow \rightarrow 6.42355 \end{array}$$

$$d \left[c \left[n - \frac{6.4000}{6.42355} \right] a \right] b \\ = 11 - 5.93770$$

$$13-n = \frac{6.42000 - 6.40000}{6.42000 - 5.93770} (13-11)$$

$$13-n \Rightarrow 0.08293$$

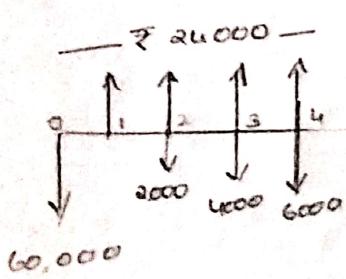
$$\underline{n = 12.917}$$

$$n \rightarrow 12 \times 0.917 = 11.004 = 12 \text{ yrs } 11 \text{ months} \\ (0.004 \times 30) \quad 12 \text{ days}$$

12 yrs 10 months 2nd day

A machine is available for investment of ₹ 60,000 with an expected annual income of ₹ 24000 for next 4 years. The annual maintenance cost of the machine is 0 at the end of 1st year and increases by ₹ 2000 each year thereafter. Calculate the equivalent PW, and annual worth and decide is the investment justifiable or not. Interest is given at 8% p.a.

$$i = 8\% \text{ pa}$$



$$\begin{aligned} \text{N.P.W.} &= -60,000 \text{ (Initial Investment)} \\ &\quad - 2000(P/F, 8\%, 1) \text{ (Year 1)} \\ &\quad - 4000(P/F, 8\%, 2) \text{ (Year 2)} \\ &\quad - 6000(P/F, 8\%, 3) \text{ (Year 3)} \\ &\quad + 24,000(P/A, 8\%, 4) \text{ (Annual Income)} \\ &= -60,000 - 1714.68 - 3175.32 - 4410.18 \\ &\quad + 17640.72 \\ &= 10,190.94 \end{aligned}$$

$$= 10,190.94$$

$$= 10,190.94$$

$$\begin{aligned}
 \text{NAA} &= 60,000 \left(A/P, 8\%, 4 \right) - \left[2000 \left(P/F, 8\%, 2 \right) + 4000 \left(P/F, \right. \right. \\
 &\quad \left. \left. 8\%, 3 \right) + 6000 \left(P/F, 8\%, \right. \right. \\
 &\quad \left. \left. 4 \right) \right] * \left(A/P, 8\%, 4 \right) + 24,000 = \cancel{\left[2000 \left(F/P, 8\%, \right. \right.} \\
 &\quad \left. \left. 2 \right) + 4000 \left(F/P, 8\%, 1 \right) + 6000 \right] \left(A/F, 8\%, 4 \right) \\
 &= 3076.889
 \end{aligned}$$

DR.

$$\begin{aligned}
 \text{NAA} &= -6000 \left(A/P, 8\%, 4 \right) - \left[2000 \left(F/P, 8\%, 2 \right) + 4000 \left(\right. \right. \\
 &\quad \left. \left. F/P, 8\%, 1 \right) + 6000 \right] \left(A/F, 8\%, 4 \right) + \\
 &\quad 24000
 \end{aligned}$$

Q:- A machine was purchased with a life of 8 years an alternative machine is available to replace the earlier machine which costs ~~is~~ ^{50%} ~~more~~ ^{costlier} than the earlier machine. If you consider 10% rate of interest p.a., how long the alternative machine should work to make it comparable with other machine

$$\text{M/C A} = 8 \text{ yrs}$$

$$PVA = AW_B$$

$$\text{M/C B} = 1.5$$

$$i = 10\% \text{ p.a.}$$

$$AW_B = 1.5 AW_A$$

Two alternatives and their cost details are given in the table below, after which alternative would you like to recommend if MARR is 8%?

Parameters	Alternatives	
	A	B
Initial cost	2,50,000	3,50,000
Annual opex per year	90000	70000
Salvage value	20000	35000
Life	5 yrs	5 yrs

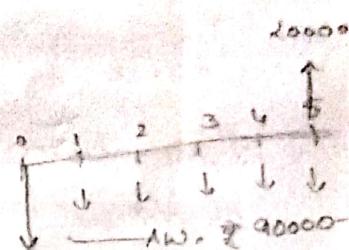
BOTH \rightarrow highest

One -ve & One +ve

\rightarrow Then +ve

-ve & -ve \rightarrow lower

How method is
not specified



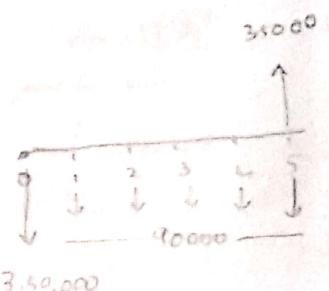
Using AW method:

$$NPA_A = -2,50,000 \left(A/P, 8\%, 5 \right) \\ - 90,000 + 20,000 \left(A/F, 8\%, 5 \right)$$

$$= -149205.8$$

$$0.25046$$

$$NPA_B = -3,50,000 \left(A/P, 8\%, 5 \right) - 70,000 \\ + 35,000 \left(A/F, 8\%, 5 \right)$$



however negative
will be the
choice.

Using PW method:

$$NPW_A = -2,50,000 - 90,000 \left(P/A, 8\%, 5 \right) + 20,000 \left(P/F, 8\%, 5 \right)$$

$$= -595737.3$$

$$0.68058$$

$$NPW_B = -3,50,000 - 70,000 \left(P/A, 8\%, 5 \right) + 35,000 \left(P/F, 8\%, 5 \right) \\ = -605669.4$$

~~Present FW Method~~

1.46933

5 36660

$$NPWA = -2,00,000 (F/P, 8\%, 5) - 90000 (F/A, 8\%, 5) + 20000 \\ = -875326.5$$

$$NPWB = -3,50,000 (F/P, 8\%, 5) - 70000 (F/A, 8\%, 5) + 35000 \\ = -889927.4$$

Choice is A.

Since both are -ve our choice is the lower negative

Q: You have ₹ 5 lakhs to invest the following alternatives are available

Alternatives	Initial Investment	Annual Income
A	190,000	30,000
B	3,50,000	60000
C	5,20,000	85000
D	4,50,000	82,000
E	5,00,000	84,000

Alternative ~~(C)~~ as a salvage value of ₹ 30,000 at the end of useful life. The alternative last for 10 years. Choose the best alternative using Present Worth method. Consider 10% i_{eq}

$$NPWA = -190000 + 30,000 (P/A, 10\%, 10) = -5662.9$$

$$NPWB = -350000 + 60000 (P/A, 10\%, 10) = 18674.2$$

$$NPWC = -520000 + 85000 (P/A, 10\%, 10) + 30000 (P/F, 10\%, 10)$$

= 13854.65

$$6,00,000 + 80000 (P/F, 10\%, 10) = 58256.76$$

6.1447

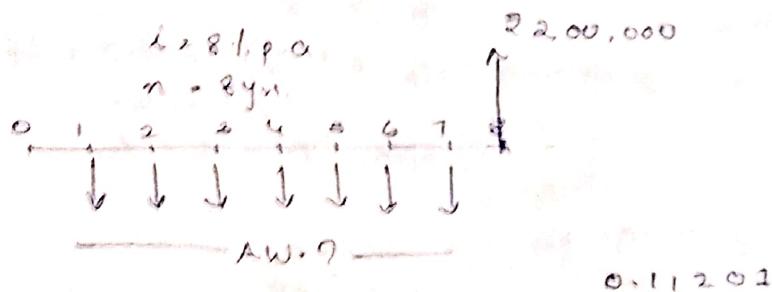
$$6,00,000 + 80000 (P/F, 10\%, 10) = 16143.88$$

so going to be the choice as alternative, even it has highest PW.

will not be a choice for investors even the maximum investment is 500000 (for it is 5,20,000)

If that happens a situation of c having highest PW then also we cannot choose choice C due to exceeding Initial Investment.

If you expect ₹2,00,000 , 8 years from now. calculate the equivalent annual worth (EAW) as investment at the end of each year for 7 years consider 8% rate of return p.a

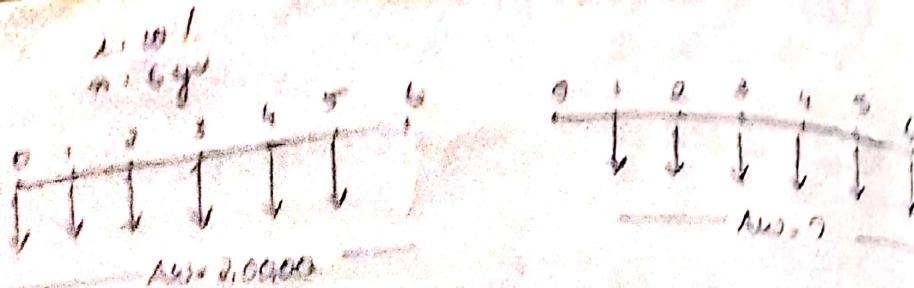


$$AW = \left[₹2,00,000 (P/F, 8\%, 1) \right] (A/F, 8\%, 7)$$

0.92593

2 20753.7

Q Calculate the year end payment of ₹20,000 made at the beginning of each year for 6 yrs. Consider 10% rate of interest p.a



	Prefects	
	A	B
Initial Investment	2,10,000	1,80,000
AOC	5000	8500
Annual Revenue	48,000	40,000
Salvage value	12,000	8000
Life in years	6	9
Interest Rate per annum	8%	

$$\begin{aligned}
 & \text{AOC} = [20,000 + \\
 & \quad 5000(P/A, 8\%, 6) \\
 & \quad + 8000(P/F, 8\%, 9)] \\
 & \quad (A/P, 8\%, 15) \\
 & = 240000 - 20 \\
 & \quad + 220,000 \\
 & \quad = 220,000
 \end{aligned}$$

AOC \rightarrow Annual Operational cost
 Choose the best project using

(i) EUAW method

(ii) PW method.

$$0.21632$$

$$\begin{aligned}
 (i) \text{ EUAW}_A &= -2,10,000(A/P, 8\%, 6) - 5000 + 48,000 + \\
 &\quad 0.13632 \\
 &\quad 12000(A/F, 8\%, 6) \\
 &= -791.36
 \end{aligned}$$

$$0.16008$$

$$\begin{aligned}
 (ii) \text{ EUAW}_B &= -180000(A/P, 8\%, 9) - 2500 + 40000 + \\
 &\quad 0.08008 \\
 &\quad 8000(A/F, 8\%, 9) \\
 &= 7966.9326.24
 \end{aligned}$$

(ii) Find Icm first for using PW & FW.

Assume both the projects last for 18 yrs (I_{cm} value)

$$6x3 \rightarrow 18$$

$$9x2 \rightarrow 18$$



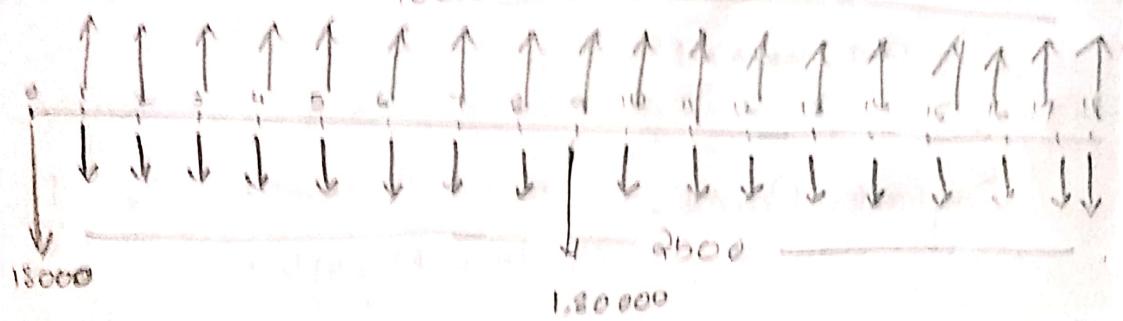
PVA = $\frac{1 - (1 + r)^{-n}}{r}$

$$PVA = -1/10,000 \cdot \frac{1 - (1 + 8\%)^{-12}}{8\%} = 1/10,000 (P/F, 8\%, 12) = 1/10,000 (P/F, 8\%, 12)$$

$$8\%(12) = 8000 (P/A, 8\%, 12) + 48000 (P/B, 8\%, 12)$$

$$+ 12000 (P/F, 8\%, 12) + 12000 (P/F, 8\%, 12) + 12000 (P/F, 8\%, 12)$$

$$\therefore = 366,664.618$$



$$PVA = -180000 - 180000 (P/F, 8\%, 9) - 4500 (P/F, 8\%, 9) + 4000 (P/A, 8\%, 9)$$

$$+ 8000 (P/F, 8\%, 9) + 8000 (P/F, 8\%, 9)$$

Payback Period (PB) Method

Given the details of alternative for project

Year	Cashflows(₹)	
	N/C-A	N/C-B
0	80,000	1,10,000
1	20,000	40,000
2	40,000	40,000
3	20,000	40,000
4	20,000	40,000
5	15,000	40,000
Salvage value	- NIL -	12,000
Interest	10% p.a.	

Rank the alternatives using

- Payback period method.
- PVs method

$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Annual cashflow}} = \frac{I}{C}$$

PB _{Method} :	Year	Initial Investment	Cashflow	PB
	0	80,000		
	1	50,000	30,000	1
	2	10,000	40,000	1
	3	$\frac{10000}{30000} \times 12$	30,000	4

Uniform Cashflow

$$\text{Payback Period} : \frac{1,10,000}{40,000} = 2.75$$

$$0.75 \times 12$$

\rightarrow 2 years 9 months

$$\begin{aligned}
 \text{NPW}_{M/C-A} &= -80,000 + 30,000 \left(P/F, 10\%, 1 \right) + 40,000 \left(P/F, 10\%, 2 \right) \\
 &\quad + 30000 \left(P/F, 10\%, 3 \right) + 20000 \left(P/F, 10\%, 4 \right) \\
 &\quad + 25000 \left(P/F, 10\%, 5 \right) \\
 &= \$32053.2
 \end{aligned}$$

$$\begin{aligned}
 \text{NPW}_{M/C-B} &= -1,10,000 + 40,000 \left(P/F, 10\%, 5 \right) + 40000 \\
 &\quad \left(P/F, 10\%, 3 \right) + 12000 \left(P/F, 10\%, 2 \right) \\
 &= 49082.64
 \end{aligned}$$

Rank	M/C-A	M/C-B
PB	1	2
NPW	2	1

As per PB M/C-A is
ranked 1st
As per NPW M/C-B is
ranked 1st

Controlling

Characteristics of effective control system