Assignment - 2

A1) Original loan $^{(OL)}$ = ₹20,000.

No. of terms (n) = 5 years.

~~Repayment~~ Installment amount (monthly) = ₹427.90.

(i) ~~Interest~~ Total Repayment = 427.90 × 12 × 5

= 25674.

$$\Rightarrow APR = 2 \times F.R.$$

$$= 2 \times \left(\frac{\text{Total repayment} - OL}{OL \times n} \right)$$

$$\Rightarrow APR = 2 \times \left(\frac{25674 - 20000}{20000 \times 5} \right)$$

$$\Rightarrow APR = 0.11348$$

$$\Rightarrow APR = 11.348\%$$

(ii) Their ~~the~~ new ~~total~~ repayment amount = 274.49 × 12 ~~× 5~~ t

= ~~13175.52~~ = 3293.88t.

Loan left to be repaid = 25,674 − (427.90 × 12)

= ~~20000 − 5134.8~~ = 20539.2.

= ~~₹14865.2~~

APR = 11.348%.

APR ~~= 11.348%~~

$$APR = 2\ F.R.$$

$$\Rightarrow \quad 0.11348 = 2\left(\frac{3293.88(t) - 20539.2}{20539.2(t)}\right)$$

$$t(2330.788) = 6587.76(t) - 41078.4$$

$$\Rightarrow \quad \underline{t = 9.649 \text{ years}}$$

(iii) Interest amount for original loan $= 25674 - 20000$
$= ₹5,674$

Interest amount for restructured loan $= (3293.88)(9.649) - 20539.2$
$= ₹11,245.67$

$$11245.67 - 5674$$
$$= \underline{₹5571.67}$$

Ans $\therefore$ The couple has to pay ₹5571.67 more interest amount than the amount they ~~paid~~ were going to pay for the original loan.

A2) (i) a). Discounted payback period is the unique time at which the balance in an investor's account [or net cash flow] changes from negative to positive. It is the smallest value of t such that $A(t) \geq 0$,

$$A(t) = \sum_{s \leq t} c_s (1+j_1)^{t-s} + \int_0^t \rho(s)(1+j_1)^{t-s}\, ds$$

where, j_1 = rate of interest applicable to investers borrowings.

b). The payback period of a project is found by counting the number of years it takes ~~to~~ before the cumulative forecasted cash flow equals to initial investment.

ii). Net Present value is calculated in terms of currency while Payback period and D.P.P. method ~~calc~~ refers to a period of time required for ~~return~~ on ~~on~~ investment to repay ~~of~~ the ~~to~~ initial ~~se~~ investment. NPV would be a superior measure as payback method does not properly account for inflation, risk, financing and other important considerations.

iii). ~~a)~~ Project A -

0	1	2	3
$-170K$	$+20K$ $-20K$	$+20K$ $-10K$	$+200K$

$$N.P.V. = -170K + (0)v^1 + 10K v^2 + 200K(v^3).$$
$$NPV = -170K + 10K(1+i)^{-2} + 200K(1+i)^{-3}.$$

~~Internal Rate of Return~~ Putting NPV = 0.

$$-170K + 10K(1+i)^{-2} + 200K(1+i)^{-3} = 0.$$

Using tables mode of calculator.

$x = 0$	$x = 0.1$
$f(x) = 40{,}000$	$f(x) = -11472.577$
$x = 0.07$	$x = 0.08$
$f(x) = 1993.96$	$f(x) = -2660.16$
$x = 0.074$	$x = 0.075$
$f(x) = 111.67$	$f(x) = -354.5$

$$\therefore IRR = i = 0.074 = 7.4\%$$

Project B -

$-200k$	$+14k$	$+14k$	$+14k$	$+14k$	$+14k$	$+14k$ $+200k$
0	1	2	3	4	5	6

putting NPV=0

$$NPV = -200k + 14k\, a_{\overline{6}|}@i + 200k(1+i)^{-6} = 0$$

$\therefore$ $IRR = i = 0.070 = 7\%$

b) $i = 6\%$ p.a.

For project A,

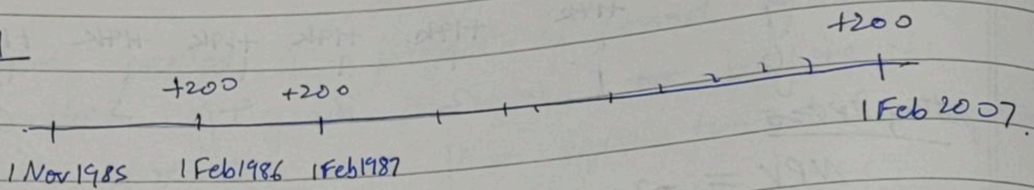
$$NPV = -170K + 10K\, v^2 + 200K\, v^3$$
$$= -170K + 10K(1+i)^{-2} + 200K(1+i)^{-3}$$
$$= -170k + 8,899.9644 + 167,923.8566$$
$$= ₹6823.821006$$

For Project B,

$$NPV = -200k + 14k\, a_{\overline{6}|}@6\% + 200k(1+i)^{-6}$$
$$= -200k + 68,842.54056 + 140992.1081$$
$$= ₹9834.648648$$

c)

A3) Annuity-1

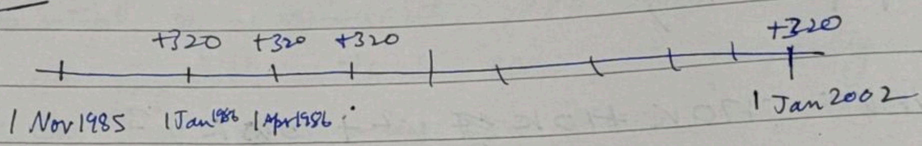


$i = 8\%$.

$$PV_1 = 200\, a_{\overline{21}|} @ 8\% + 200.$$

$$= 2003.360631 + 200$$

Annuity 2



$i = 8\%$.

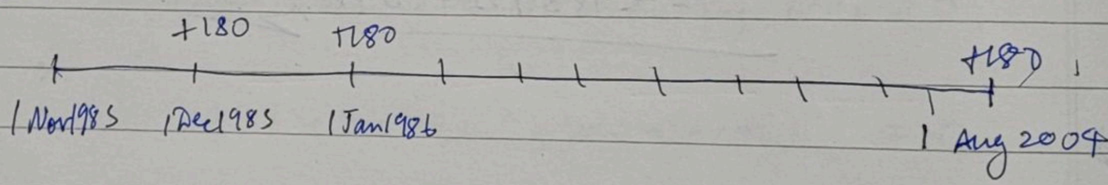
$i^{(4)} = 7.7706188\%$.

$$PV_2 = 320\, a^{(4)}_{\overline{16}|} + 200$$

$$= 320 \left(\frac{1 - v^{16}}{i^{(4)}} \right) + 200$$

$$= 2916.048982 + 200$$

Annuity 3



$i = 8\%$,

$i^{(12)} = \cancel{0.07}\, 7.7208361\%$.

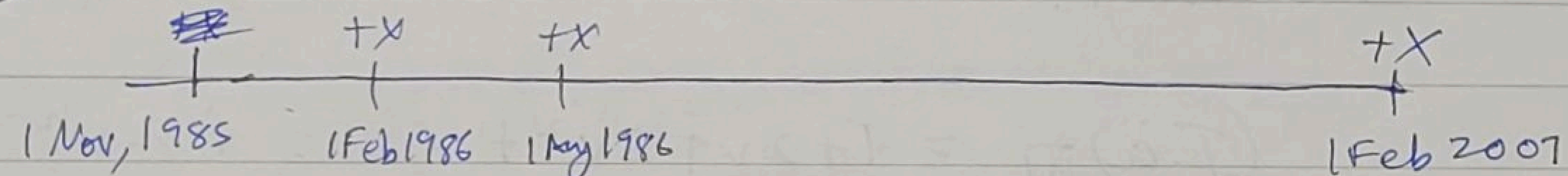
$$PV_3 = 180\, a^{(12)}_{\overline{18.75}|}$$

$$PV_3 = 1780.656667$$

PV of New Annuity $= PV_1 + PV_2 + PV_3$

$= ₹6700.066280 + 400 = ₹7100.066280.$

Revised annuity



~~$i^{(2)} =$~~

$i^{(2)} = 7.8460969\%$

$$P.V_{(new)} = \left(X\, a^{(2)}_{\overline{21}|}\right) + X$$

$$\Rightarrow 7100.06628 = X\left(a^{(2)}_{\overline{21}|} + 1\right)$$

$\Rightarrow$ ~~7100.06628 =~~

$$\Rightarrow X = \frac{7100.06628}{a^{(2)}_{\overline{21}|} + 1}$$

$$\Rightarrow X = ₹633.18342$$ Ans

A4). The notation $(I\ddot{a})_{\overline{n}|}$ is used to denote the present value of an increasing annuity due payable for n time units, the nth payment (of amount n) being made at time n-1.

$$(I\ddot{a})_{\overline{n}|} = 1+2v+3v^2+ \ldots + nv^{n-1} \rightarrow \mathrm{I}$$

Multiplying both sides by v,

$$v(I\ddot{a})_{\overline{n}|} = v+2v^2+3v^3+ \ldots + (n-1)v^{n-1}+nv^n \rightarrow \mathrm{II}$$

$\mathrm{I} - \mathrm{II}$,

$$(I\ddot{a})_{\overline{n}|}(1-v) = 1+v+v^2+v^3+ \ldots v^{n-1} \cancel{+} - nv^n$$

$$\Rightarrow (I\ddot{a})_{\overline{n}|}(d) = \ddot{a}_{\overline{n}|} - nv^n$$

$$\Rightarrow (I\ddot{a})_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{d}$$ (for $i>0$)

Ans

A5). i).

For P.F.

$$\text{T.W.R.R.} = \frac{13.1}{12.4} \times \frac{14.8}{13.1} \times \frac{15.8}{14.8} \times \frac{16.4}{15.8} = (1+i)^{(n=1)}$$

~~TWRR~~ $\Rightarrow$ ~~1.322~~ $i = 32.25806\%$ Ans

For E.F.,

$$\text{TWRR.} = (1+i)^1 = \frac{9.2}{12.1} \times \frac{10.3}{9.2} \times \frac{13.1}{10.3} \times \frac{15.5}{13.1}.$$

$$i = 28.09917\%$$

Ans

ii) a). Let number of units be bought be X,

~~For P.F.~~,

$$\text{Yield } (y_1) = \frac{X(12.4+13.1+14.8+15.8) - X(16.4)}{X(12.4+13.1+14.8+15.8)}$$

$$y_1 = 70.7664884\%$$

b). Let total amount invested be C.

~~For E.F.~~

$$Y_2 = \frac{C/(12.4+13.1+14.8+15.8) - C/(16.4)}{C/(12.4+13.1)+14.8+15.8)}.$$

$$Y_2 = -2.4207317$$

$$Y_2 = -242.07317\%$$

iii). For Equity Fund,

$$Y_3 = \frac{X(12.1+9.2+10.3+13.1) - X(15.5)}{X(12.1+9.2+10.3+13.1)}.$$

$$Y_3 = 65.324384\%$$

$$Y_4 = \frac{C/(44.7) - C/(15.5)}{C/(44.7)}$$

$$Y_4 = -188.38709\%$$

A6). i) Loan amount = ₹ 160,000.

Term (n) = 10 years.

$i = 8\%$ p.a.

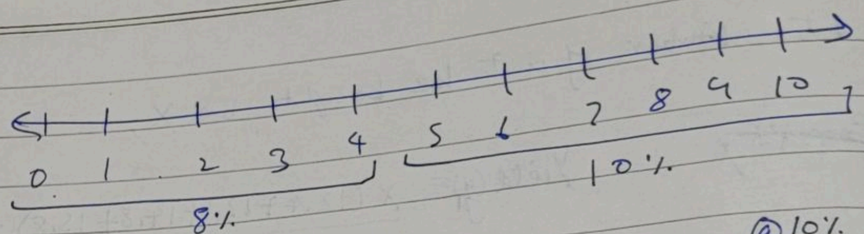
Let annual repayment amount be X.

$$160{,}000 = X \, a_{\overline{10|}} @8\%.$$

$$160{,}000 = X\left(\frac{1-(1+0.08)^{-10}}{0.08}\right)$$

$$X = ₹23{,}844.71819$$

ii)



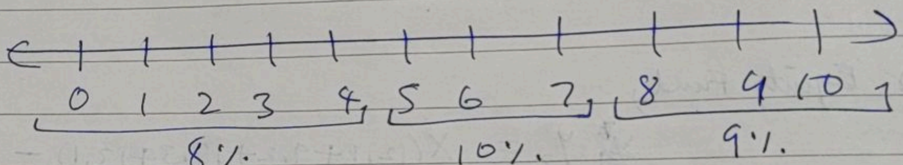
$$160{,}000 = X\left[a_{\overline{4}|}^{@8\%} + a_{\overline{10-4}|}^{@10\%}\, v^{4\,@8\%}\right].$$

~~X = ₹~~

$$\Rightarrow 160{,}000 = X(3.312126 + \cancel{2.974701}\ 3.201246)$$

$$\underline{X = ₹\ 24564.84867}.$$

iii)



$$160{,}000 = X\left[a_{\overline{4}|}^{@8\%} + a_{\overline{7-4}|}^{@10\%}\, v^{4\,@8\%} + a_{\overline{10-7}|}^{@9\%}\, v^{3\,@10\%}\, v^{4\,@8\%}\right]$$

$$160{,}000 = X\left(3.312126 + \cancel{1.698553}\ 1.827910 + \cancel{1.384704}\ 1.397829\right].$$

$$X = ₹\ 24472.63331$$

~~X = ₹ 25018.09479~~.

$$160{,}000 = X\, a_{\overline{10}|}^{@i}$$

$$\Rightarrow a_{\overline{10}|}^{@i} = 6.395383 = \frac{1-(1+i)^{-10}}{i}$$

$$\Rightarrow \underline{i = 9.07\%}.$$

A7) i) Some reasons why investing in property may not be preferred alternative to investing in government securities ~~as~~ are –

→ Government securities (or bonds) are more secure ~~than~~ investments, i.e, carry lower risk.

→ These securities come with tax benefits.

→ Fixed interest rate.

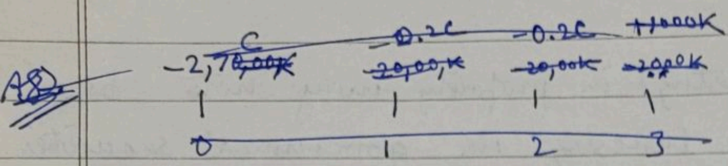
ii) a) The government issues a loan tender by inviting bids for large projects that must be submitted within a finite deadline.

C). Some securities which have uncertain income are -

→ Index-linked bond — Interest income is related to specific price index [CPI]

→ Cash on deposit — Interest rate is subject to regular change

→ Equities — Interest rate is variable and net ~~income~~ ~~can~~ accumulated value can be negative.



~~A8)~~ (i). Working in units of crores,

$$P.V. \text{ of outlay} = 2.7 + 0.2\, a_{\overline{3|}} @ i. \longrightarrow \mathrm{I}.$$

$$E.P.V. \text{ of income} = 0.1v^3 + \bar{a}_{\overline{10|}} (0.25v + 0.2v^2 + 0.1v^3) @ i \rightarrow \mathrm{II}$$

Equating I & II,

$$2.7 + 0.2\, a_{\overline{3|}} @ i = 0.1v^3 + \bar{a}_{\overline{10|}} (0.25v + 0.2v^2 + 0.1v^3) @ i$$

$$2.7 + 0.2\left(\frac{1-v^3}{i}\right) = 0.1v^3 + \left(\frac{1-v^3}{\ln(1+i)}\right)(0.25v + 0.2v^2 + 0.1v^3)$$

$$2.7 - 0.1v^3 = (1-v^3)\left(\frac{0.25v + 0.2v^2 + 0.1v^3}{\ln(1+i)}\right) - \left(\frac{1}{i}\right).$$

$$i = 9.3\%$$

(ii)

$$N.P.V. \text{ of income} = 0.1v^3 + 0.85\, \bar{a}_{\overline{10|}}^{@10\%} v^3 - 2.7 - 0.2\, a_{\overline{3|}}^{@10\%}$$

$$= 4.19 - 3.19$$

$$N.P.V. = 1.0089.$$

Yes, it is profitable to invest in the project.

A9) $(1+i)^3 = TWRR = \cancel{\frac{30.50}{33}} \frac{33}{30.50} \times \frac{(41.5-4.5)}{(33+6)} \times \frac{45.6}{41.05} \times \frac{47}{(45.6-2.5)}$

$1+i = 1.070951$

$i = 7.0951\%$

MWRR

$30.5(1+i)^3 + 6(1+i)^{2.25} + 4.5(1+i)^{1.5} - 2.5(1+i)^{0.5} = 47.$

$i = 7.206\%$

4g) ii).

r(2011), $\Rightarrow 30.5(1+i)+6(1+i)^{0.25}=38.5$

$i=6.266\%$.

r for 2012,

$38.5(1+i)+4.5(1+i)^{0.5}=45$

$i=4.92\%$.

r for 2013,

$45(1+i)+2.5(1+i)^{0.5}=47$.

$i=10.276\%$.

$$LIRR = (1+i)^3 = \cancel{1+6.02}(1.06266)(1.0492)(1.10276)$$

$$1+i=1.071296$$

$$\underline{i=7.129\%}. \text{ Ans.}$$

iii). MWRR is sensitive to amounts and timings of net cash flows. TWRR ~~the~~ eliminates the effect of cash flow amounts and timing, and thus gives a fairer basis for assessing.

A10) iii) Let loan amount be X.

Term = 15 years.

$i = 12\%$. , $\delta = 11.33286\%$

First repayment = ₹2,00,000.

$$X = 1,80,000 \, a_{\overline{15|}} @12\% + 20,000 \, (Ia)_{\overline{15|}} @12\%$$

$$X = ₹20,40,588$$

Let total cost of house be Y.

$$0.80 \times Y = X$$

$$Y = \frac{20,40,588}{0.80}$$

$$Y = ₹25,50,735$$

ii). Loan outstanding at begin of 9th year $= 340,000\, a_{\overline{7}|}^{@12\%} + 20,000\, (Ia)_{\overline{7}|}^{@12\%}$

$= ₹18,75,850.33$

~~Loa~~ Required Loan Schedule is as follows -

Time (Year)	Loan outstanding	Installment	Interest	Capital Repayment
9	18,75,850.33	36,0000	2,25,102.04	1,34,897.96
10	17,40,952.37	3,80,000	2,08,914.28	1,71,085.72
11	15,69,866.65			

iii). Loan amount $= 15,69,866.65\ (L)$

$\cancel{150}\ 15,69,866.65 = X\, a_{\overline{5}|}$

$X = 4,14,126.87.$

Extra payment made to bank 1,

$P_1 = (4,00,000 + 420,000 + 4,40,000 + 4,60,000 + 4,80,000) - 1569866.65$
$= 6,30,133.35.$

Extra payment made to bank 2,

$P_2 = 5(X) + 0.1(L) - L.$

$P_2 = 5,16,466.35$

Since $P_2 < P_1$,

Yes, it is advisable for Mr. Sam to transfer its loan to new bank.

A11) (i) $TWRR = 0.20$

$$(1.2)^2 = \frac{(500+\cancel{100})}{460} \times \frac{(550-50)}{(500+40)} \times \frac{X}{\cancel{600}\,550}$$

$\underline{X = ₹786.9312}$

ii) $MWRR \Rightarrow 460(1+i)^2 + 40(1+i)^{7/4} - 50(1+i) = 655.78$

$\underline{i = 19.85\%}$ ~~pa~~.

iii). r for 2015,

$$460(1+i)+40(1+i)^{3/4}=600$$

$$r_1\ i = 20.44\%$$

r for 2016,

$$550(1+i) = 655.78$$

$$r_2\ i = 19.23\%$$

→ LIRR,

$$(1+i)^2 = (1+r_1)(1+r_2)$$
$$1+i = \sqrt{1.2044 \times 1.1923}$$
$$1+i = 1.1983$$
$$i = 19.83\%$$

Ans

iv). When sub intervals for LIRR coincide with intervals between net ~~cha~~ cash flows, then LIRR will be identical to TWRR.

v). TWRR is a better measure of fund performance than MWRR as it eliminates the effect of cashflow amounts and timings ~~of the~~ while MWRR is sensitive to the same.

A12) i) Discounted payback period is the unique time at which ~~balance in~~ the net cash flow changes to positive.

ii) a) Working in units of ~~1000~~ thousands,

$i = 7\%$. ~~-800k~~

$$-800(1+i)^t - 50(1+i)^{t+1} + 100 \cancel{(1+i)^{t-2}} s_{\overline{t-2}|} = 0$$

$\Rightarrow$ ~~$-800(1+i)$~~

$$\Rightarrow -800(1.07)^t - 50(1.07)^{t+1} + 100\left(\frac{(1.07)^{t-2} - 1}{0.07}\right) = 0.$$

$$D.P.P. = t = 17.767$$

b) ~~iii)~~ ~~Time~~ = Here ~~t~~ = T = 22 − 17.767 = 4.233 years.

$$A.V. \text{ after 22 years} = 100\, s_{\overline{4.233}|} @6\%.$$

$$AV_{22} = 480$$

$$AV_{22} = ₹4,80,000$$

iii) Rental income at the end of the year $= 100\, \bar{s}_{\overline{1}|} @ 6\%$

$= 102.971.$

$$-800(1+i)^t - 50(1+i)^{t+1} + 102.9715\, s_{\overline{t-2}|}^{@7\%} = 0.$$

$$\Rightarrow -800(1.07)^t - 50(1.07)^{t+1} + 102.9715\left(\frac{(1.07)^{t-2} - 1}{0.07}\right) = 0$$

$$t = 18 \text{ years}$$

~~Accu~~ AV_{18} after 18 years $= -800(1.07)^{18} - 50(1.07)^{17} + 102.9715\, s_{\overline{16}|}^{@7\%}$

$= 9.7714.$

A.V. after 22 years $= 9.7714(1+0.06)^4 + 100\, \bar{s}_{\overline{4}|} @6\%.$

$= 462.78$

$= ₹4,62,780.$

Term = 25 years

iv

A13) Loan Amount $= ₹988{,}000$

$i = 7\%$

$i^{(12)} = 6.78497\%$

Let, Repayment amount be X

annual

$$988{,}000 = X\, a^{(12)}_{\overline{25|}}$$

$$= X\, a_{\overline{25|}} \frac{i}{i^{(P)}}$$

$$X = ₹82176.\cancel{38}.$$

Monthly repayment $= \frac{X}{12} = ₹6848.03$

ii) $\cancel{X\, a^{(12)}_{\overline{34/3|}} @7\% = 6486.}$

Loan O/s after repayment on 10 March 2029 $= 82176.38\, a^{(12)\,7\%}_{\overline{34/3|}}$

$= ₹6485.76$

iii) Loan O/s after repayment on 10 Sept 2026 $= \cancel{\frac{X}{12}\, a_{\overline{166|}} @ i^{(12)}}$

$$= X\, a^{(12)}_{\overline{83/6|}} @7\%$$

Loan O/s after repayment on 10 Oct 2026 $= X\, a^{12}_{\overline{55/4|}} @7\%.$

Capital repaid on 10 Oct 2026 $= X \left(\cancel{a_{83}}\, a^{(12)}_{\overline{55/4|}} - a^{(12)}_{\overline{83/6|}} \right)$ @7%

$= 26.85.$

$= ₹2685$

iv) ~~Capital repayment~~ Loan outstanding after repayment on 10 March 2034

$$= X\, a^{(12)}_{\overline{22/3}|} \text{ @ } 7\%.$$

Loan O/s after repayment on 10 April 2033,

$$= X\, a^{(12)}_{\overline{19/3}|} \text{ @ } 7\%.$$

$$\text{Capital repayment} = X\left(a^{(12)}_{\overline{22/3}|} - a^{(12)}_{\overline{19/3}|}\right) \text{@ } 7\%.$$

$$= ₹516.20. \text{ Ans}$$

$$= \cancel{116}$$

$$\text{Interest amount} = X - \text{Capital repayment}$$

$$= 30556.$$