$i^{(p)} = p$

Assignment



$20000 = 12 \times 427.9\, a_{\overline{5}|}^{(12)}$

$a_{\overline{5}|}^{(12)} = 3.89499104$

Flat rate $= \dfrac{\text{total int.}}{\text{loan} \times \text{total yrs}} = \dfrac{(5 \times 12 \times 427.9) - 20000}{20000 \times 5} = 5.674\%$

$\therefore$ APR $\approx 2 \times$ Flat rate $\approx 11.348\%$

~~Interpolating~~

~~$\dfrac{i - 10\%}{3.89499 -}$~~

At $i = 11\%$ $a_{\overline{5}|}^{(12)} = 3.87872$

$i = 10\%$ $= 3.96154$

Interpolating

$$\frac{i - 10\%}{3.89499 - 3.96154} = \frac{11\% - 10\%}{3.87872 - 3.96154}$$

$i = 10.8\%$

ii APR $= 10.8\%$

After 1 yr, Capital o/s $= 12 \times 427.90\, a_{\overline{4}|@10.8\%}^{(12)}$

$= 12 \times 427.90 \times \dfrac{1 - \left(\frac{1}{1.108}\right)^4}{12 \times (1.108^{1/12} - 1)}$

$= 16775.98$

Let t denote term of new loa

$\therefore 16775.98 = 12 \times 274.49\, a_{\overline{t}|}^{(12)}$

$= 3293.88 \times \dfrac{1 - 1.108^{-t}}{12 \times (1.108^{1/12} - 1)}$

$1.108^{-t} = 0.4754$

$t = 7.25$ yrs

iii Total int. of orig. loa $= 4 \times 12 \times 427.9 - 16775.98 = 3763.22$

new loa $= 7.25 \times 12 \times 247.49 - 16775.98 = 7104.65$

$\therefore$ They will pay $: 7104.65 - 3763.22$

$= 3341.43$ more int.

2 i a DPP is the smallest t for which PV/AV of returns up to t exceeds PV/AV of costs up to t

b Same as DPP, except that PV/AV calculation is carried out using int-rate of 0. It's the earliest time for which monetary val. of returns exceeds monetary val. of costs.

ii Unlike NPV, neither DPP nor PP give indication of profitability of a project, as cashflows after AV=0 are ignored.

- There may be multiple times when investor's account balance changes from -ve to +ve. However NPV can always be calculated.
- PP gives misleading results as it doesn't take into account the time value of money.

iii

a IRR For A

$-170K - 20Kv - 10Kv^2 + 20Kv + 20Kv^2 + 200Kv^3$

in 000s

$10v^2 + 200v^3 = 170$

$i = 7\% \longrightarrow 10v^2 + 200v^3 = 171.99$

$8\% \longrightarrow \qquad = 167.34$

Interpolation

$i = 7 + \dfrac{170 - 171.99}{167.34 - 171.99}(8-7)$

$IRR_A = 7.4\%$

For B

Income is 7% of initial capital, returned at end of 6 yrs

$\therefore IRR_B = 7\%$

b NPV

Discounting payments at 6%

$NPV_A = 170\,000 + 10\,000v^2 + 200\,000v^3 = 6823.82$

$NPV_B = -200\,000 + 14\,000a_{\overline{6}|} + 200\,000v^6 = 9834.65$

To be profitable A requires rate less than 7.4%
B 7%

2. Value on 1/11/85

Annuity 1 $= 200 v^{1/4} \ddot{a}_{\overline{27}|} @8\% = 200 \times 0.980944 \times 11.01676$
$= 2161.363$

Annuity 2 $= 320 \times (1+i)^{1/12} \times a^{(4)}_{\overline{16.25}|} @8\% = 320 \times 1.006434 \times 9.184257$
$= 2957.872$

Annuity 3 $= 180 \times a^{(12)}_{\overline{18.7}|} = 180 \times 9.892583 = 1780.665$

Total val $= 6899.90$

Reversed annuity is A,

Val. $= A \times (1+i)^{1/4} \times a^{(2)}_{\overline{21.5}|}$

$$A = \frac{6899.90}{1.019427 \times 10.30886}$$
$= 656.56$

4. $(Ia)_{\overline{n}|} = 1v + 2v^2 + 3v^3 \ldots + nv^n$ (I)

Multiplying both sides by $(1+i)$

$(Ia)_{\overline{n}|}(1+i) = 1 + 2v + 3v \qquad + nv^{n-1}$ (II)

Subtracting (I) from (II)

$(Ia)_{\overline{n}|}(1+i) - (Ia)_{\overline{n}|} = 1 + v + v^2 + v^3 + \ldots + v^{n-1} - nv^n$

$i(Ia)_{\overline{n}|} = \ddot{a}_{\overline{n}|} - nv^n$

$$\therefore (Ia)_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{i}$$

5.

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

6. $i = 8\%$

$X_i a_{\overline{10|}} = 160000$

$X = \dfrac{160000}{6.7101}$

$= 25931.5084$

ii $4X_i = 103726.0336$

Remaing $= 155589.0504$

$X_{ii} a_{\overline{6|}} = 155589.0504$ $\qquad i = 10\%$

$X_{ii} = \dfrac{15589.0504}{4.3553}$

$= 35724.07192$

iii $4X_i + 3X_{ii} = 210898.2494$

Remaing $= 48416.8346$

$X_{iii}\, a_{\overline{3|}} = 48416.8346$

$X_{iii} = \dfrac{48416.8346}{2.5313}$ $\qquad i = 9\%$

$= 19127.26054$

$(1+i)^{10} = (1+i)^4 (1+i)^3 (1+i)^3$

$= (1.08)^4 (1.1)^3 (1.09)^3$

$i = 8.8968349\%$

1,00,00,000

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8. $PV_{out} = 2.7 + 0.2\ddot{a}_{\overline{3}|}$

$PV_{in} = 0.1v^3 + 0.25\bar{a}_{\overline{9}|} + 0.2\bar{a}_{\overline{8}|} + 0.1\bar{a}_{\overline{7}|}$

$PV_{OUT} = PV_{in}$

$2.7 + 0.2\left(\frac{1-(1+i)^{-3}}{(1/1+i)}\right) + 0.1(1+i)^{-3} + 0.25\left(\frac{1-(1+i)^{-9}}{\ln(1+i)}\right)$

$+ 0.2\left(\frac{1-(1+i)^{-8}}{\ln(1+i)}\right) + 0.1\left(\frac{1-(1+i)^{-7}}{\ln(1+i)}\right)$

9.

| t | T - t | FV(before) | Cashflow | FV(after) |
|---|---|---|---|---|
| 0 | 4 | | | 30.5 |
| 0.75 | 3.25 | | | 33 |
| 1 | 3 | 32.5 | +6 | 38.5 |
| 1.5 | 2.5 | 36.55 | +4.5 | 41.05 |
| 2 | 2 | | | 45 |
| 2.5 | 1.5 | | | 45.6 |
| 4 | 0 | 44.5 | -2.5 | 47 |

$(1+i)^4 = \cancel{\frac{33}{30.5}} \times \frac{32.5}{30.5} \times \frac{36.55}{38.5} \times \frac{44.5}{45.6} \times \frac{47}{45.6}$

7.

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10.8. i $L = 180000 \times a_{\overline{15}|} + 20000 \times (Ia)_{\overline{15}|}$ @12%

$= 180000 \times 6.8109 + 20000 \times (\ddot{a}_{\overline{15}|} - 15v^{15})/i$

$= 1225962 + 20000(7.6282 - 2.74044)/0.12$

$= 2040588$

Total cost of house $= \frac{2040588}{0.8} = 2550735$

ii Loan o/s at beginning of $9^{th}$ yr

$L = (180000v + 180000v^2 + \dots 180000v^7) + (9 \times 20000v + 10 \times 20000v^2 \dots + 15 \times 20000v^7)$

$L(9) = 340000 \times a_{\overline{7}|} + 20000 \times (Ia)_{\overline{7}|}$

$= 340000 \times 4.5638 + 20000 \times (5.1114 - 7 \times 0.45235)/0.12$

$= 1875850.33$

Loan Schedule

| Yr | Loan o/s | Loan installment | Interest | Capital repay |
|---|---|---|---|---|
| 9 | 1875850.33 | 360000 | 225102.04 | 134897.96 |
| 10 | 1740952.37 | 380000 | 208914.28 | 171085.72 |
| 11 | 1569866.65 | | | |

iii Let new installment be P

$1569866.65 = P\, a_{\overline{5}|}$

$= P \times 3.790786$

$P = 414126.87$

Extra payment made if contd. w 1st bank

$(400000 + 420000 + 440000 + 460000 + 480000) - 1569866.65$

$630133.35$

if transferred to 2nd bank

$5 \times 414126.90 + 0.01 \times 1569866.65 - 1569866.65$

$516466.35$

Advisable to transfer to 2nd bank

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Q.1 $X a_{\overline{27}|}^{(12)} = 9880$ @ 7%
$X = 821.76$
$X/12 = 68.48$ ← Monthly repayment

ii Loan o/s immediately after repayment on 10/3/29
$X a_{\overline{34/3}|}^{(12)} = 48600$ @ 7%
iii just after repayment on 10/9/26 made
$X a_{\overline{83/6}|}^{(12)}$ @ 7%
10/10/26
$X a_{\overline{13.75}|}^{(12)}$ @ 7%

Capital repaid on 10/10/26 is
$X\left[a_{\overline{83/6}|}^{(12)} - a_{\overline{13.75}|}^{(12)}\right]$ @ 7%
$X\left[\dfrac{v^{13.75} - v^{83/6}}{i^{(2)}}\right]$ @ 7%

26.86

iv(i) Capital repayment contd in these 12 installments is
$X\left[a_{\overline{22/3}|}^{(12)} - a_{\overline{11/3}|}^{(12)}\right]$ @ 7% $= 516.26$

(ii) Total int in these 12 installments is
$X - 516.20 = 305.56$