Date :

Financial Mathematics - Assignment 2 [43]

i)

Q1] Loan Amount = 20,000
Monthly installment = 427.90
Time taken = 5 years

∴ APR =

$$20{,}000 = 427.90 \times a^{(12)}_{\overline{60}|} \quad @ \; i^{(12)}/12$$

$$\frac{20{,}000}{427.90} = \frac{1 - v^{60}}{i}$$

← [Found using excel]

∴ $\frac{i^{(12)}}{12} = 0.85834\%$

∴ $\boxed{i = 10.8\%}$

$$\text{flat rate} = \frac{\text{Total Repaid} - \text{Original Amount}}{\text{Term of loan} \times \text{Original Amt}}$$

$$= \frac{(427.9 \times 60) - 20{,}000}{20{,}000 \times 5}$$

$$= 5.674\%$$

APR = $5.674\% \times 2$
$\approx 11.248\%$

ii) ∴ NPV after 1 year

$$= 427.9 \times a^{(12)}_{\overline{4}|} \quad @ \; i = 10.8\%$$

$= 16{,}776.83$ ₹ → [Using excel]

∴ Term of new loan

$$\frac{16776.83}{5} = 274.49 \times a_{\overline{n}|} \quad @ \; i^{(12)}/12 = 0.85834\%$$

$$\frac{16776.83}{274.49} = \frac{1-(1.0085843)^{-n}}{0.0085843}$$

$$\therefore n = \boxed{7.2511 \text{ years}}$$

ii) ∴ Interest with 2nd method =

$$(427.9 \times 12) + (274.49 \times 12 \times 7.25) - 20\,000$$

$$= 23880.63 + 16775.83 - 20{,}000$$

$$= 9015.43$$

Interest in 1st method

$$= 5674$$

More $= 9015.43 - 5674$

$$= \boxed{3341.43}$$

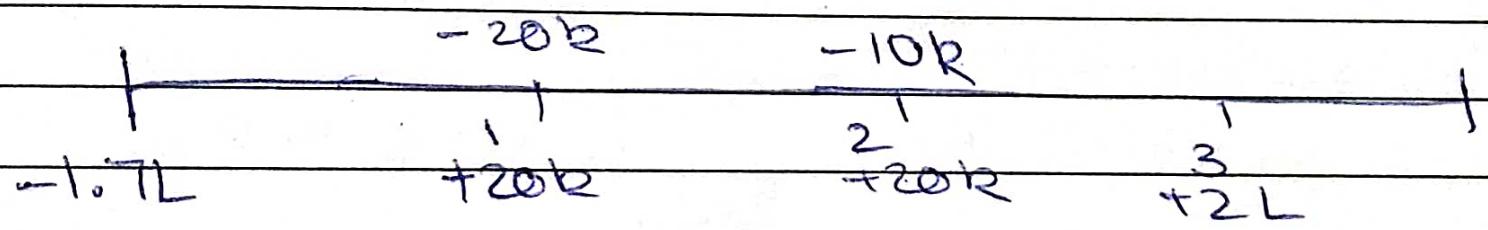
Q2] i) a) It is the time at which the NPV turns from positive to negative, the initial outlay has been recovered taking interest into account.

b) It is the time when cumulative receipts are greater than the initial expenditure without considering interest rate

iii) NPV shows us the difference between the present value of inflow and present value of outflow, hence showing us the feasibility of the project the amount of return expected to be generated using a pessimistic risk

discount rate whereas DPP and PP just show us how much time it will take to recover our investment

Project A



NPV = $-170k + 10k\,v^2 + 200\,v^3$

$= -170k + 10k\,v^2 + 200v^3$ @ 6%

$= -170 + 8.899 + 169.92385$

$= ₹6822.85$

IRR = PV = $0 = -170 + 10v^2 + 200v^3$

IRR @ = 7.423%

Project B

$$NPV = -200k + 14k\, a_{\overline{6}|} @ 6\% + 200k\, v^6$$

$$= -200 + 14(4.9173) + 200\,(1.06)^{-6}$$

$$= 9,834.65$$

IRR =

$$0 = -200 + 14\, a_{\overline{6}|} + 200 v^6$$

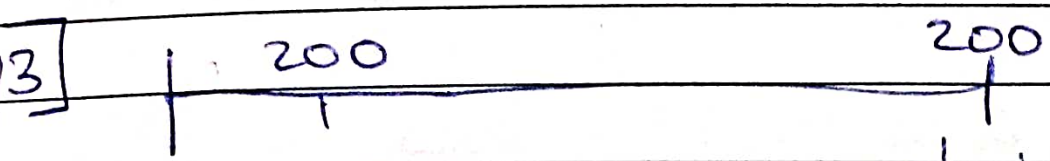
∴ **IRR i = 7%**

iii) Each of the project would only be profitable if the rate of interest is below IRR.

∴ For A less than 7.4%

For B less than 7%

Q3]

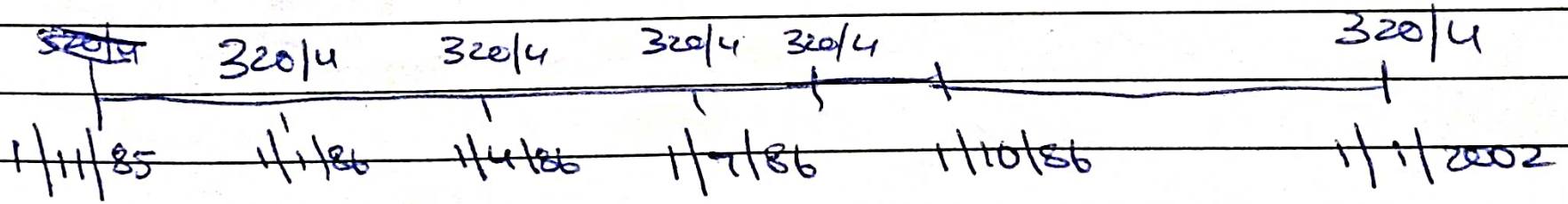


∴ Annuity 1

$$= 200 \times v^{0.25} \times a^{\infty}_{22|}$$

$$= 200 \times 0.980944 \times 11.01676$$

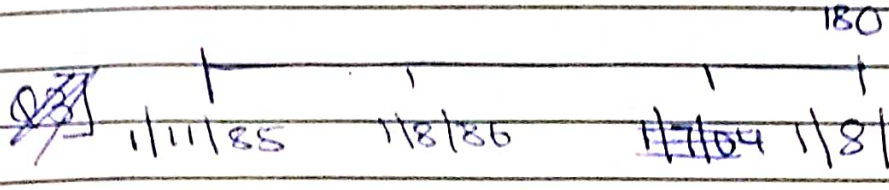
$$= 2161.36$$



Annuity 2

$$= 320 \times (1+i)^{1/12} \times a^{(4)}_{16.25|}$$

$$= 320 \times 1.05 = 2957.872$$



∴ Annuity 3

$$= 180 \times \overset{\circ}{a}_{\overline{18.5}|}^{(12)} \quad @\ 8\%$$

$$= 1780.665$$

∴ Sum of 3

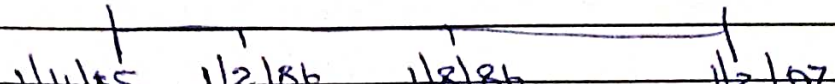
$$= 1780.67 + 2957.87 + 2161.36$$

$$= 6899.9$$

∴ Revised Annuity

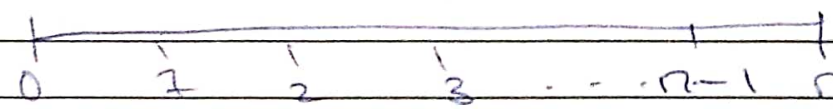
$$6899.9 = A \times (1+\overset{\circ}{i})^{1/4} \times \overset{\circ}{a}_{\overline{21.5}|}^{(2)}$$

$$\boxed{A = 656.56}$$



Q4)

$\ddot{I}a_{\overline{n}|}$



$$\ddot{P}\cdot V = 1 + 2v + 3v^2 + 4v^3 + \cdots + nv^{n-1}$$

$$= (1+i)\,\ddot{I}a_{\overline{n}|} = (1+i)(\ddot{I}a_{\overline{n}|})$$

$$= (1+i) \times \left(\frac{\ddot{a}_{\overline{n}|} - nv^n}{i}\right)$$

$$= \frac{\ddot{a}_{\overline{n}|} - nv^n}{i/1+i}$$

$$\ddot{I}a_{\overline{n}|} = \frac{\ddot{a}_{\overline{n}|} - nv^n}{id}$$

Q5

i) TWRR of property fund

$(1+i) = \frac{16.4}{12.4}$

$i = 1.3225806 - 1$

$= 32.258\%$

TWRR of equity fund

$(1+i) = \frac{15.5}{12.1} = 28.099\%$

ii) a) Assuming bought 10 units each quarter

$124(1+i) + 131(1+i)^{0.75} + 148(1+i)^{0.5} + 158(1+i)^{0.25}$

$= 4 \times 164$

(Using excel) (goal seek)

$i = 29.32\%$

b) Assuming investor bough Rs 100 worth units

$400 \overline{s}_{17}^{(i)} = 100 \times \left[\frac{16.4}{12.4} + \frac{16.4}{13.1} + \frac{16.4}{14.8} + \frac{16.4}{15.8} \right]$

$i = 29.79\%$

iii) Assuming investor bought 10 units of equity fund

$$121(1+i)^{0.75} + 92(1+i)^{0.5} + 103(1+i)^{0.25} + 131 = 4 \times 155$$

$$\therefore i = \boxed{67.31\%}$$

Assuming investor put Rs 100 per quarter

$$400\, s^{(4)}_{\overline{1}|}{}^{\infty} = 100 \times 15.5 \left(\frac{1}{12.1} + \frac{1}{9.2} + \frac{1}{10.3} + \frac{1}{13.1} \right)$$

$$\therefore i = \boxed{70.88\%}$$

Q6

i) $160,000 = X \; a_{\overline{10}|} \; @ \; 8\% \text{ p.a}$

$$\therefore X = \frac{160,000}{6.7101}$$

$$\boxed{= 23,844.65}$$

ii) Loan o/s after 4th payment = PV

$$= 23,844.65 \times a_{\overline{6}|} \; @ \; 8\%$$

$$\boxed{= 21,10,231.4325}$$

So annual repayment,

$$110\,231.4325 = Y \times a_{\overline{7}|}\ @\ 10\%$$

$$\therefore Y = \boxed{₹25,309.722}$$

iii) Loan o/s after 7th payment

$$2350 = 25309.722 \times a_{\overline{3}|}\ @\ 10\%$$

$$= \boxed{62,942.747\ ₹}$$

$$\therefore 62,942.747 = X \times a_{\overline{3}|}\ @\ 9\%$$

$$\therefore X = \boxed{24865.779}$$

∴ Total Repayment

$$= (4 \times 23844.65) + (3 \times 25309.722) + (3 \times 24865.779)$$

$$= 2,45,905.907$$

$$\therefore 160,000\ (1+i)^{10} = 245905.907$$

$$\therefore \boxed{i = 4.3914\%}$$

Q7] i) Government securities provide fixed yield regardless market conditions whereas in property, income depends on market conditions and there could be periods with no income.
Govt securities are also safest and most secure unlike property which was proven in 2008 crash.

ii) a) A loan by tender could involve the government asking investors to submit prices at which they will buy the fixed security from government

b) Advantages to government is that it can choose the highest price to offer and sell all securities
Disadvantage could be that if the securities might not be held by a wide variety of investors and be concentrated

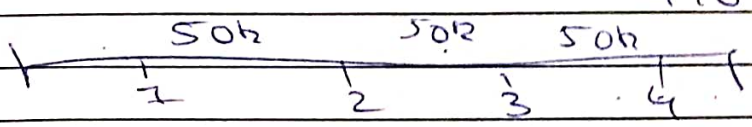
Advantage to investor is they can bid on their ideal price
Disadvantage could be that if their price is lower they won't get any.

iii) Shares have uncertain income, as dividend is at discretion of directors

Index linked bonds as the absolute income to be received isn't know and there could be deflation

Savings interest as interest rate change very frequently.

Q8



i) ∴ NPV

~~$= -2.7\,cr - 20L\, a_{\overline{3}|}\ @\ i\%$~~

~~$+10.1\,cr\, v^3\ @\ i\%$~~

Present value of outlay = PV of inflow

$= -2.7\,cr - 20L\, a_{\overline{3}|}\ @\ i + 0.1v^3 + a_{\overline{10}|}\,(0.25v + 0.2v^2 + 0.3v^3)$

$\therefore\ i = 9.3\%$

ii)

$0.1v^3 + 0.85\, a_{\overline{10}|}\, v^3 - 2.7 - 0.2\, a_{\overline{3}|}\ @\ i = 10\%$

$= 4.19 - 3.19$

$= 1.0089$

As NPV is positive. Project can be considered for investment

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41.05 - 4.5
= 37.05 - 0.5
33.65

Q9]

i) TWRR of fund

$$(1+i)^3 = \frac{33}{30.5} \times \frac{38.65}{39} \times \frac{45.6}{41.05} \times \frac{47}{(45.6+2.5)}$$

$$(45.6-2.5)$$

$$\therefore i = 7.0951\%$$

MWRR

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

$$\therefore i = 7.206\%$$

ii) Linked ~~use~~ rate of return

=

iii) TWRR takes the time of income and outflow and fund into consideration and isn't affected by quantity of money that comes in goes out or grows unlike in MWRR which is affected by such quantities.

Q10]

$$\text{loan} = 180k\,[a_{\overline{15}|} @ 12\%] + 20k\,[Ia_{\overline{15}|}]$$

$$= 180\,[6.8109] + 20\,[40.731]$$

$$= 1225.962 + 814.62$$

$$= ₹\ 20,40,582$$

Total cost = loan + self

= 80% of TC + 20% of TC

$$\frac{80}{100} \times TC = 20,40,582$$

∴ Total cost = ₹ 25,50,727.5

loan o/s is after t = 8

$$340000 \times a_{\overline{7}|} @ 12\% + 20000\,(Ia)_{\overline{7}|}$$

$$= 15,51,692 + 324160$$

$$= ₹\ 18,75,852$$

Year	loan at start	Repaid	Int	Cap Rep	loan o/s
9	1875852	360000	225102.24	134897.76	
10	1740954	380000	208914.5	171085.49	

1740954

1569869

Time Taken : _____

Date : _____

(ii) TWRR

$$(1+i)^2 = \frac{500}{460} \times \frac{590}{540} \times \frac{X}{540}$$

$$(1.2)^2 = 1.44$$

$$X = (1.44 \times 550) / (1.086975 \times 1.1111)$$

$$X = 655.78$$

(iii) MWRR

$$460(1+i)^2 + 40(1+i)^{1.25} - 50(1+i) = 655.78$$

$$i = 19.85\%$$

(iii) Effective interest rate of 2015

$$460(1+i) + 40(1+i)^{0.75} = 600$$

$$i = 20.44\%$$

Effective interest rate of 2016

$$(1+i) = \frac{655.78}{550} = 1.1923$$

LWRR

$$(1+i)^2 = 1.1923 \times 1.2044$$

$$i = 19.83\%$$

Q12] i) DPP is when NPV turns positive first time taking interest into account

ii) a)

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

$\therefore$ $t = 17.767$ using Trial and error

b) Accumulated profit after 22 years

$\therefore 100\,\overline{s}_{\overline{4.233}|}$ @ 6% = 480

$\therefore$ Rs 480,000

iii) $100\,\overline{s}_{\overline{17}|} = 102.971$ at end of year

$$-800(1+i)^t - 50(1+i)^{t-1} + 102.971\,s_{\overline{t-2}|} \text{ @ 7\%} \geq 0$$

By Trial and error

$t = 18$ years

$$-800(1+i)^{18} - 50(1+i)^{17} + 102.971\,s_{\overline{16}|}$$

$= 9.7714$

Hence AV_{22}

$= 462.79$

$\therefore$ ₹ 462,790

Q13]

i) $X\, a^{(12)}_{\overline{25}|} = 9880$ @ 7%

$X = 821.76$

$X|12 = \boxed{68.48}$

ii) loan o/s after 10/03/29

$821.76 \times a^{(12)}_{\overline{11\frac{1}{3}}|} = 648,600$

$= 648,600$

iii) Loan o/s on 10th Sept 2016

$821.76 \times a^{(12)}_{\overline{13\frac{5}{6}}|}$

loan o/s on 10th Oct 2016

$821.76 \times a^{(12)}_{\overline{13.75}|}$

$\therefore 821.76 \left[a^{(12)}_{\overline{13\frac{5}{6}}|} - a^{(12)}_{\overline{13.75}|} \right]$

$= \boxed{26.86}$

iv) Interest = $821.76 - 516.20 = 305.56$

Q14) i) Capital Repayment on 12th month

$821.76 \left[a^{(12)}_{\overline{7\frac{1}{3}}|} - a^{(12)}_{\overline{6\frac{1}{3}}|} \right] = \boxed{516.20}$