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FINANCIAL MATHEMATICS

ASSIGNMENT 2

Q.1. (i) Amt – 20,000.
Period – 12 years.

$20,000 = 12 \times 427.90 \; a_{\overline{5}|}^{(12)}$.

$\therefore a_{\overline{5}|}^{(12)} = 3.89499$.

$$\text{Flat rate} = \frac{(5 \times 12 \times 427.90) - 20,000}{20,000 \times 5}$$

$$= 5.67\ \%$$

Approx APR = 11 %.

At $i = 11\ \%$. $a_{\overline{5}|}^{(12)} = 3.87812$

At $i = 10\ \%$. $a_{\overline{5}|}^{(12)} = 3.96154$.

By interpolation,

$$\frac{i - 10\ \%}{3.89499 - 3.96154} = \frac{11\ \% - 10\ \%}{3.87814 - 3.96154}$$

$i = 10.8\ \%$.

APR = 10.8 %

(ii) APR = 10.8 %.

After 1 year capital left to pay

$= 17 \times 427.90 \; a_{\overline{4}|}^{(12)}$ @10.8 %.

= INR 16,775.8.

Let x denote the term of new loan.

$\therefore 16,775.98 = 12 \times 274.49 \; a_{\overline{x}|}^{(12)}$

$$16,775.98 = 3293.88 \left(\frac{1 - (1.08)^{(-x)}}{12 \times (1.08)^{1/12} - 1} \right).$$

$1.108^{-x} = 0.4754$

$x = 7.25$

∴ Term of new loan = 7.25 years

(iii) Interest for original loan = 4 × 12 × 427.90 − 16778.98

= 3763.22.

Interest for new loan = 7.25 × 12 × 274.49 − 16778.98

= 7104.65

Now 7104.65 − 3763.22 = 3341.43.

∴ Mr. & Mrs Jones will pay INR 3341.43 more interest under the new loan.

Q.2 (i) a) Discounted payback Period –

It is a capital budgeting procedure used to determine the profitability of a project.

b) Payback Period –

This refers to the time required to recoup the funds expanded in an investment.

(ii)

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Q. 3. Value at 1/11/1983

Annuity 1 = $2000 \times v^{1/4} \times \ddot{a}_{\overline{22}|} @ 8\%$

$= 2000 \times 0.980944 \times 11.01676$

$= INR\ 2161.363$

Annuity 2 = $320 \times (1+i)^{1/4} \times a^{(4)}_{\overline{16.23}|}$

$= 320 \times 1.00644 \times 9.1842$

$= INR\ 2957.872$

Annuity 3 = $180 \times a^{(12)}_{\overline{18.75}|}$

$= 180 \times 9.842583$

$= 1780.665$

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Total = 2161.363 + 2957.872 + 1780.665

= INR 6899.96

Revised Annuity = $x \times (1+i)^8 a + a^{(2)}_{\overline{2|10}}$

$x = \frac{6899.90}{1.019427 \times 10.30886}$

$x = 656.56$

Revised annuity = 656.56

Q.4. $(I\ddot{a})_{\overline{n}|} = 1 + 2v + 3v^2 + 4v^3 + 5v^4 + \cdots nv^{n-1}$

Multiplying v on both sides,

$v(I\ddot{a})_{\overline{n}|} = v + 2v^2 + 3v^3 + 4v^4 + \cdots nv^{n-1}$

Subtraction,

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

$(1-v)(I\ddot{a})_{\overline{n}|} = \frac{(1-v^n)}{(1-v) - nv^n}$

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

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

Hence Proved.

Q.5. i) TWRR for property fund

$= \frac{16.4}{12.4} - 1 = 0.3226$

$= 32.26\%$

TWRR for equity fund

$= \frac{18.5}{12.1} - 1 = 0.28102$

$= 28.10\%$

(ii) a) Assumption = 100 units.

$= 1240(1+i) + 1310(1+i)^{3/4} + 1480(1+i)^{1/2} + 1586(1+i)^{1/4}$

$= 4.1640$

By interpolation,

$i = 0.02932$

$i = 29.32\%$

b) Assumed purchased at INR 100 made each quarter.

$400 \times \ddot{s}_{\overline{1}|}^{(4)} = 100 \times 16.4 \left(\frac{1}{12.4} + \frac{1}{13.1} + \frac{1}{14.8} + \frac{1}{13.} \right.$

$\ddot{s}_{\overline{1}|}^{(4)} = 1.180)$

$i = 0.2979.$

$i = 29.82\%.$

(iii) a) $1210(1+i) + 920(1+i)^{3/4} + 1630(1+i)^{1/2} + 1310(1+i)^{1/4} = 4 \times 1556$

$i = 0.673)$

$i = 67.31\%.$

b) $400 \times \ddot{s}_{\overline{1}|}^{(4)} = 100 \times 15.5 \left(\frac{1}{12.2} + \frac{1}{9.2} + \frac{1}{10.3} + \frac{1}{13.4} \right.$

$\ddot{s}_{\overline{1}|}^{(4)} = 0.4735$

$\therefore i = 0.7088$

$= 70.88\%.$

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Q.6. (i) $1,60,000 = X \; a_{\overline{10}|}$ @ 8%.

$$X = \frac{16,000}{a_{\overline{10}|}}$$

$$= \frac{16,000}{6.7101} = 23,844.65$$

(ii) $23,844065 \times a_{\overline{6}|}$ @ 8%.

$= 23,844.65 \times 4.6229$

$= 110,231.422$

Y = new installment

$Y \cdot a_{\overline{6}|} = 110,231.442$ at 6%.

$$Y = \frac{110,231.442}{a_{\overline{6}|}}$$

$$= \frac{110,231.442}{4.3553}$$

$= 25,309.92.$

(iii) $25,309.77 \; a_{\overline{3}|}$ @ 10%.

$= 25309.77 \times 2.4869$

$= 62,942.74.$

Σ = new installment.

$\Sigma a_{\overline{3}|} = 62,942.74$ @ 9%.

$$= \frac{62,942.74}{2.5313}$$

$= 24,865.77$

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Q.7. (i) 1) There are large buying and selling experience

2) The return on property may be lower, expect in short term.

3) The maintainance cost at the property is high.

(ii) a) Government raise money, by floating a load on stock exchange. The terms of issue are set out by tender - The investors are invited to nominate the price that they are prepared to pay the loan is issued to highest bidder.

b) Advantages to Goverment is that they know the price that investor pay therefore it will know the cost of borrowing

Disadvantage to Government is that they may not meet its finance requirement.

c) Name of 3 securities are

1) Equity - Divided varies according to companies performance

2) Property - Rent payments are subject to prevat

3) Index - Linked Bond - final redemption price can increase.

Q.8. i) $2.7 + 0.2\, a_{\overline{3}|}$ @ i → Present Value

$0.1\, v^3 + a_{\overline{10}|}\,(0.25\, v + 0.2\, v^2 + 0.11)$ @ i
→ Expected value.

Equating both equation sides,

$2.7 + 0.2\, a_{\overline{3}|} = 0.1\, v^3 + a_{\overline{10}|}\,(0.25 + 0.2\, v + 0.11)$ @ i

$\therefore i = 9.31\%$.

ii) $0.1\, v^3 + 0.85\, a_{\overline{10}|}\, v^3$

$= 0.1\, v^3 + 0.85\, a_{\overline{10}|}\, v^3 - 2.7\, a_{\overline{2}|}$ @ $i = 10\%$

$= 0.1 \times 0.75\,13 \times 0.85 \times 6.4463 - 2.70 \times 0.2 \times 2.4868$.

$= 4193.19$

$= 1.0089$

As NPV is positive it is worth investing.

Q.9 i) TWRR

$(1+i)^3 = \frac{33}{30.56} \times \frac{4105.45}{33+6} \times \frac{45.6}{41.65} \times \frac{47}{45.62.50}$

$(1+i)^3 = 1.081967 \times 0.93717 \times 1.11084 \times 1.9$

$(1+i)^3 = 1.228313$

$1+i = \sqrt[3]{1.22831}$

$1+i = 1.7095$,

$i = 1.709\,81 - 1$

$i = 7.0951\%$.

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MWRR

$= 30.5 \times (1+i)^3 + 6 \times (1+i)^{2.23} + 4.5 \times (1+i)^{1.15} - 2.5 \times (1+i)^{0.5}$

$= 47$

$i = 7\%$

$\therefore$ MWRR = 7.20%

(iii) TWRR eliminates the effect of the cashflow amount of timing and therefore gives a fair prices basis for assisting investment performance