CHAPTER 2: TERM STRUCUTRE OF INTEREST RATES

1. *Solution*

Here given: Interest rate (i) = 8%; Inflation risk premium (IRP) = 1.75%; Real interest rate (RR) = 3.5%; Liquidity risk premium (LRP) = 0.25%; Maturity risk premium (MRP) = 0.85%; Special feature premium (SCP) = 0; Default risk premium (DRP) = ?

We have,

i_C = RR + IRP + LRP + MRP + DRP + SCP

Or, 8% = 3.5% + 1.75% + 0.25% + 0.85% + DRP + 0

Or, 8% - 6.35% = DRP

Or, DRP = 1.65%

2. *Solution*

Here given: One year T-bills rate (i_{Tbills}) = 3.25%; Real interest rate (RR) = 2.25%; Default risk premium (DRP) = 1.15%; Liquidity risk premium (LRP) = 0.50%; Maturity risk premium (MRP) = 1.75%; Special feature premium (SCP) = 0

a. Inflation premium (IP) =?

$i_{T\text{-bills}}$ = RR + IP Or, 3.25% = 2.25% + IP Or, IP = 1%

a. Fair interest rate for corporation (i_c) = ?

We have,

i_C = RR + IP + LRP + MRP + DRP + SCP

= 2.25% + 1% + 0.50% + 1.75% + 1.15% + 0 % = 6.65%

3. *Solution*

Here given: Current one year T-bill rate (S_1) = 5.2%; Expected one year rate 12 months from now ($f_{1,2}$) = 5.8%; Current rate for 2 year Treasury security (S_2) = ?

We have,

$(1 + S_2)^2 = (1 + S_1)(1 + f_{1,2})$

Or, $(1 + S_2)^2 = (1 + 0.052)(1 + 0.058)$

Or, $(1 + S_2)^2 = 1.113016$

Or, $(1 + S_2) = (1.113016)^{1/2}$

Or, $S_2 = 1.0550 – 1 = 0.0550$ Or, 5.5%

Therefore the current rate for a two year Treasury security is 5.5%.

4. **Solution**

Here given:

Current one year rate (S1) = 6%; Expected one year T-bill rate in year 2 ($f_{1,2}$) = 7%; Expected one year T-bill rate in year 3 ($f_{2,3}$) = 7.5%; Expected one year T-bill rate in year 4 ($f_{3,4}$) = 7.85; Current long term rate for one year T-security (S_1) = ?

S_1 = 6% (given)

Current long term rate for two year T-security (S_2) = ?;

$(1 + S_2)^2 = (1 + S_1)(1 + f_{1,2})$

Or, $(1 + S_2)^2 = (1 + 0.06)(1 + 0.07)$

Or, $(1 + S_2)^2 = 1.1342$

Or, $(1 + S_2) = (1.1342)^{1/2}$

Or, $S_2 = 1.0650 – 1 = 0.0650$ Or, 6.50%

Therefore the current rate for a two year Treasury security is 6.50%.

Current long term rate for three year T-security (S_3) =?

$(1 + S_3)^3 = (1 + S_1)(1 + f_{1,2})(1 + f_{2,3})$

Or, $(1 + S_3)^3 = (1 + 0.06)(1 + 0.07)(1 + 0.075)$

Or, $(1 + S_3)^3 = 1.219265$

Or, $(1 + S_3) = (1.219265)^{1/3}$

Or, $S_3 = 1.06832 - 1 = 0.06832$ Or, 6.832%

Current long term rate for four year T-security (S_4) =?

$(1 + S_4)^4 = (1 + S_1)(1 + f_{1,2})(1 + f_{2,3})(1 + f_{3,4})$

Or, $(1 + S_4)^4 = (1 + 0.06)(1 + 0.07)(1 + 0.075)(1 + 0.0785)$

Or, $(1 + S_4)^4 = 1.3150$

Or, $(1 + S_4) = (1.3150)^{1/4}$

Or, $S_4 = 1.07085 - 1 = 0.07085$ Or, 7.085%

5. *Solution*

Here given: Current one year T-bill rate (S_1) = 3.45%; Expected one year rate from now $(f_{1,2})$ = 3.65%; Current rate for 2 year Treasury security (S_2) = ?

We have,

$(1 + S_2)^2 = (1 + S_1)(1 + f_{1,2})$

Or, $(1 + S_2)^2 = (1 + 0.0345)(1 + 0.0365)$

Or, $(1 + S_2)^2 = 1.07226$

Or, $(1 + S_2) = (1.07226)^{1/2}$

Or, $S_2 = 1.0355 - 1 = 0.0355$ Or, 3.55%

Therefore the current rate for a two year Treasury security is 3.55%.

6. *Solution*

Here given: Current one year T-bill rate (S_1) = 8%; Current rate for 2 year Treasury security (S_2) = 10%; Expected one year interest rate expected one year from now $(f_{1,2})$ = ?

We have,

$(1 + S_2)^2 = (1 + S_1)(1 + f_{1,2})$

Or, $(1 + 0.10)^2 = (1 + 0.08)(1 + f_{1,2})$

Or, $1.21 = (1.08)(1 + f_{1,2})$

Or, $1.12037 = (1 + f_{1,2})$

Or, $f_{1,2} = 1.12037 - 1 = 0.12037$ Or, 12.037%

Therefore the current rate for a two year Treasury security is 12.037%.

7. **Solution**

Here given:

Three year Treasury security rate (S_3) = 12%; Expected one year rate in year 2 $(f_{1,2})$ = 8%; Expected one year rate in year 3 $(f_{2,3})$ = 10%; One year Treasury security (S_1) = ?

We have,

$(1 + S_3)^3 = (1 + S_1)(1 + f_{1,2})(1 + f_{2,3})$

Or, $(1 + 0.12)^3 = (1 + S_1)(1 + 0.08)(1 + 0.10)$

Or, $1.4049 = (1 + S_1)\,1.188$

Or, $(1 + S_1) = 1.1826$

Or, $S_1 = 1.1826 - 1 = 0.1826$ Or, 18.26%

8. *Solution*

Here given:

Four year Treasury security rate (S_4) = 5.6%; Five year Treasury securities (S_5) = 6.15%; One year Treasury rate to be four years from today $(f_{4,5})$ = ?

We have,

$(1 + S_5)^5 = (1 + S_4)^4 (1 + f_{4,5})$

Or, $(1 + 0.0615)^5 = (1 + 0.056)^4 (1 + f_{4,5})$

Or, $1.3477 = 1.2435\,(1 + f_{4,5})$

Or, $(1 + f_{4,5}) = 1.0838$

Or, $f_{4,5} = 1.0838 – 1 = 0.0838$ Or, 8.38%

9. *Solution*

Here given:

Yield on three year Treasury note (S_3) = 2.25%; Yield on four year Treasury note (S_4) = 2.60%; Yield on five year T-note (S_5) = 2.98%; Yield on six year Treasury note (S_6) = 3.25%

Expected one year rate during 4 year ($f_{3,4}$) = ?

We have,

$(1 + S_4)^4 = (1 + S_3)^3 (1 + f_{3,4})$

Or, $(1 + 0.026)^4 = (1 + 0.0225)^3 (1 + f_{3,4})$

Or, $1.1081 = 1.0690 (1 + f_{3,4})$

Or, $(1 + f_{3,4})= 1.0366$

Or, $f_{3,4} = 1.0366 – 1 = 0.0366$ Or, 3.66%

Expected one year rate during 5 year ($f_{4,5}$) = ?

We have,

$(1 + S_5)^5 = (1 + S_4)^4 (1 + f_{4,5})$

Or, $(1 + 0.0298)^5 = (1 + 0.026)^4 (1 + f_{4,5})$

Or, $1.1581 = 1.1081 (1 + f_{4,5})$

Or, $(1 + f_{4,5}) = 1.0451$

Or, $f_{4,5} = 1.0451 – 1 = 0.0451$ Or, 4.51%

Expected one year rate during 6 year ($f_{5,6}$) = ?

We have,

$(1 + S_6)^6 = (1 + S_5)^5 (1 + f_{5,6})$

Or, $(1 + 0.0325)^6 = (1 + 0.0298)^5 (1 + f_{5,6})$

Or, $1.2115 = 1.1581 (1 + f_{5,6})$

Or, $(1 + f_{5,6}) = 1.0461$

Or, $f_{4,5} = 1.0461 – 1 = 0.0461$ Or, 4.61%

10. *Solution*

Here given:

Current one year rate (S_1) = 0.10 or 10%; Current two year rate (S_2) = 0.14 or 14%; Expected one year rate in year 2 ($f_{1,2}$) = 0.10 or 10%; Liquidity premium for year 2 (L_2) = ?

We have,

$(1 + S_2)^2 = (1 + S_1) (1 + f_{1,2} + L_2)$

Or, $(1 + 0.14)^2 = (1 + 0.10) (1 + 0.10 + L_2)$

Or, $1.2996 = (1.10) (1.10 + L_2)$

Or, $1.1815 = (1.10 + L_2)$

Or, $L_2 = 1.1815 – 1.10 = 0.08145$ Or, 8.145%

Therefore the liquidity premium for year 2 is 8.145%.

11. *Solution*

Here given: current one year rate (S_1) = 5.65%; One year rate in year 2 ($f_{1,2}$) = 6.75%; One year rate in year 3 ($f_{2,3}$) = 6.85%; One year rate in year 4 ($f_{3,4}$) = 7.15%; Liquidity premium in year 2 (L_2) = 0.05%; Liquidity premium in year 3 (L_3) = 0.10%; Liquidity premium in year 4 (L_4) = 0.12%

Current long term rate for one year T-security (S_1) =?

S_1 = 6% (given)

Current long term rate for two year T-security (S_2) =?

We have,

$(1 + S_2)^2 = (1 + S_1) (1 + f_{1,2} + L_2)$

Or, $(1 + S_2)^2 = (1 + 0.0565)\ (1 + 0.0675 + 0.0005)$

Or, $(1 + S_2) = (1.128342)^{1/2}$

Or, $S_2 = 1.0622 – 1 = 0.0622$ Or, 6.22%

Therefore the spot rate of 2 years Treasury security is 6.22%.

Current long term rate for three year T-security (S_3) =?

We have,

$(1 + S_3)^3 = (1 + S_1)\ (1 + f_{1,2} + L_2)\ (1 + f_{2,3} + L_3)$

Or, $(1 + S_3)^3 = (1 + 0.0565)\ (1 + 0.0675 + 0.0005)\ (1 + 0.0685 + 0.0010)$

Or, $(1 + S_3)^3 = (1.0565)\ (1.068)\ (1.0695)$

Or, $(1 + S_3) = (1.206762)^{1/3}$

Or, $S_3 = 1.0646 – 1 = 0.0646$ Or, 6.46%

Therefore the spot rate of 3 years Treasury security is 6.46%.

Current long term rate for four year T-security (S_4) =?

We have,

$(1 + S_4)^4 = (1 + S_1)\ (1 + f_{1,2} + L_2)\ (1 + f_{2,3} + L_3)\ (1 + f_{3,4} + L_4)$

Or, $(1 + S_4)^4 = (1 + 0.0565)\ (1 + 0.0675 + 0.0005)\ (1 + 0.0685 + 0.0010)\ (1 + 0.0715 + 0.0012)$

Or, $(1 + S_4)^4 = (1.0565)\ (1.068)\ (1.0695)\ (1.0727)$

Or, $(1 + S_4) = (1.2945)^{1/4}$

Or, $S_4 = 1.0666 – 1 = 0.0666$ Or, 6.66%

Therefore the spot rate of 4 years Treasury security is 6.66%.

Yield curve will be upward sloping because liquidity premium is increasing.

12. *Solution*

Here given: Rate on three year Treasury securities (S_3) = 5.25%; Rate on four year Treasury securities (S_4) = 5.50%; One year rate expected in three years ($f_{2,3}$) = 6.10%; Liquidity premium for four year bond (L_4) = ?

We have,

$(1 + S_4)^4 = (1 + S_3)^3\ (1 + f_{3,4} + L_4)$

Or, $(1 + 0.0550)^4 = (1 + 0.0525)^3\ (1 + 0.0610 + L_4)$

Or, $1.2388 = (1.1659)\ (1.0610 + L_4)$

Or, $1.0625 = (1.0610 + L_4)$

Or, $L_4 = 1.0625 – 1.0610 = 0.0015$ Or, 0.15%

Therefore the liquidity premium for four year Treasury security is 0.15%.

13. *Solution*

a. Here given: Current one year T-bill rate (S_1) = 5.50%; Current rate for 2 year Treasury security (S_2) = 6.50%; Current rate for 3 year Treasury security (S_3) = 9.00%; Expected one year forward rate for the period beginning one year from today ($f_{1,2}$) = ?

We have,

$(1 + S_2)^2 = (1 + S_1)\ (1 + f_{1,2})$

Or, $(1 + 0.065)^2 = (1 + 0.055)\ (1 + f_{1,2})$

Or, $1.1342 = (1.055)\ (1 + f_{1,2})$

Or, $1.07507 = (1 + f_{1,2})$

Or, $f_{1,2} = 1.07507 – 1 = 0.07507$ Or, 7.507%

Therefore the expected one year forward rate for the period beginning one year from today is 7.507%.

b. Expected one year forward rate for the period beginning two years from today ($f_{2,3}$) = ?

We have,

$(1 + S_3)^3 = (1 + S_1)\ (1 + f_{1,2})\ (1 + f_{2,3})$

Or, $(1 + 0.09)^3 = (1 + 0.055)\ (1 + 0.07507)(1 + f_{2,3})$

Or, $1.295029 = (1.1342)(1 + f_{2,3})$

Or, $1.1418 = (1 + f_{2,3})$

Or, $f_{2,3} = 1.1418 - 1 = 0.1418$ Or, 14.18%

Therefore the expected one year forward rate for the period beginning two year from today is 14.18%.

14. *Solution*

Here given: Current one year rate (S_1) = 4.75%; Current rate for 2 year rate (S_2) = 4.95%; Current rate for 3 year rate (S_3) = 5.25%; Current rate for 4 year rate (S_4) = 5.65%; One year forward rate on treasury bonds ($f_{1,2}$) = ?

We have,

$(1 + S_2)^2 = (1 + S_1)(1 + f_{1,2})$

Or, $(1 + 0.0495)^2 = (1 + 0.0475)(1 + f_{1,2})$

Or, $1.1015 = (1.0475)(1 + f_{1,2})$

Or, $1.05155 = (1 + f_{1,2})$

Or, $f_{1,2} = 1.05155 - 1 = 0.05155$ Or, 5.16%

Therefore the one year forward rate in year 2 is 5.16%.

One year forward rate in year 3 on treasury bonds ($f_{2,3}$) = ?

We have,

$(1 + S_3)^3 = (1 + S_2)^2 (1 + f_{2,3})$

Or, $(1 + 0.0525)^3 = (1 + 0.0495)^2 (1 + f_{2,3})$

Or, $1.1659 = (1.1015)(1 + f_{2,3})$

Or, $1.0585 = (1 + f_{2,3})$

Or, $f_{2,3} = 1.0585 - 1 = 0.0585$ Or, 5.85%

Therefore the one year forward rate in year 3 is 5.85%.

One year forward rate in year 4 on treasury bonds ($f_{3,4}$) = ?

We have,

$(1 + S_4)^4 = (1 + S_3)^3 (1 + f_{3,4})$

Or, $(1 + 0.0565)^4 = (1 + 0.0525)^3 (1 + f_{3,4})$

Or, $1.2459 = (1.1659)(1 + f_{3,4})$

Or, $1.0686 = (1 + f_{3,4})$

Or, $f_{2,3} = 1.0686 - 1 = 0.0686$ Or, 6.86%

Therefore the one year forward rate in year 4 is 6.86%.

15. *Solution*

Here given:

Interest rate for 3 years Treasury note (S_3) = 6%; Interest rate for 4 years bond (S_4) = 6.35%; Interest rate for 5 years bond (S_5) = 6.65%; Interest rate for 6 years bond (S_6) = 6.75%

One year forward rate in year 4 on treasury notes ($f_{3,4}$) = ?

We have,

$(1 + S_4)^4 = (1 + S_3)^3 (1 + f_{3,4})$

Or, $(1 + 0.0635)^4 = (1 + 0.06)^3 (1 + f_{3,4})$

Or, $1.2792 = (1.1910)(1 + f_{3,4})$

Or, $1.0741 = (1 + f_{3,4})$

Or, $f_{2,3} = 1.0741 - 1 = 0.0741$ Or, 741%

Therefore the one year forward rate in year 4 is 7.41%.

One year forward rate in year 5 on treasury notes ($f_{4,5}$) = ?

We have,

$(1 + S_5)^5 = (1 + S_4)^4 (1 + f_{4,5})$

Or, $(1 + 0.0665)^5 = (1 + 0.0635)^4 (1 + f_{4,5})$

Or, $1.3798 = (1.2792) (1 + f_{4,5})$

Or, $1.0786 = (1 + f_{4,5})$

Or, $f_{4,5} = 1.0786 - 1 = 0.0786$ Or, 7.86%

Therefore the one year forward rate in year 5 is 7.86%.

One year forward rate in year 6 on treasury notes ($f_{5,6}$) = ?

We have,

$(1 + S_6)^6 = (1 + S_5)^5 (1 + f_{5,6})$

Or, $(1 + 0.0675)^6 = (1 + 0.0665)^5 (1 + f_{5,6})$

Or, $1.4798 = (1.3798) (1 + f_{5,6})$

Or, $1.0725 = (1 + f_{5,6})$

Or, $f_{5,6} = 1.0725 - 1 = 0.0725$ Or, 7.25%

Therefore the one year forward rate in year 6 is 7.25%.

16. *Solution*

Here given: Current interest rate on a one year Treasury bond (S_1) = 4.50%; Current rate on two year Treasury bond (S_2) = 5.25%; Current rate on three year Treasury bond (S_3) = 6.50%; One year interest rate expected on treasury bills during 3 years ($f_{2,3}$) = ?

We have,

$(1 + S_3)^3 = (1 + S_1) (1 + f_{1,2}) (1 + f_{2,3})$

Or, $(1 + 0.065)^3 = (1 + 0.045) (1 + 0.0601)(1 + f_{2,3})$

Or, $1.2079 = (1.1078) (1 + f_{2,3})$

Or, $1.0904 = (1 + f_{2,3})$

Or, $f_{2,3} = 1.0904 - 1 = 0.0904$ Or, 9.04%

Therefore the one year forward rate in year 3 is 9.04%.

Working notes:

Calculation of one year forward rate in year 2 ($f_{1,2}$)

We have,

$(1 + S_2)^2 = (1 + S_1) (1 + f_{1,2})$

Or, $(1 + 0.0525)^2 = (1 + 0.045) (1 + f_{1,2})$

Or, $1.1078 = (1.045) (1 + f_{1,2})$

Or, $1.0601 = (1 + f_{1,2})$

Or, $f_{1,2} = 1.0601 - 1 = 0.0601$ Or, 6.01%

Therefore the one year forward rate in year 2 is 6.01%.

17. *Solution*

The general solution to forward rate problems is:

$(1 + \text{long spot rate})^n = (1 + \text{short spot rate})^n (1 + \text{short forward rate})^n$

Knowing any two of the three rates lets you calculate the third by multiplying or dividing and taking the appropriate root.

a. The square of the two year spot rate is equal to the product of the one year spot rate and one year forward rate:

$(1 + s_2)^2 = (1 + s_1) (1 + f_{1,2})$

Or, $(1.115)^2 = (1 + 0.11) (1 + f_{1,2})$

Or, $(1 + f_{1,2}) = 1.243/1.115 = 1.12$ Or $f_{1,2} = 12\%$

b. The product of the cube of the three year spot rate and the square of the two –year forward rate is equal to the five year spot rate to the fifth power.

$(1 + s_5)^5 = (1 + s_3)^3 (1 + f_{3,5})^2$

Or, $(1 + f_{3,5})^2 = (1.128)^5/(1.123)^3$
Or, $(1 + f_{3,5}) = (1.2895)^{1/2}$
Or, $f_{2,5} = 1.1355 - 1 = 0.1355$ Or 13.55%

c. The four year spot rate to the fourth power is equal to the product of the one year spot rate and the cube of the three year forward rate.

$(1 + s_4)^4 = (1 + s_1)^1 (1 + f_{1,4})^3$
Or, $(1 + f_{1,4})^3 = (1.125)^4/(1.11)$
Or, $(1 + f_{1,4}) = (1.4431)^{1/3}$
Or, $f_{1,4} = 1.1300 - 1 = 0.1300$ Or 13.00%

d. The product of the four year spot rate to the fourth power and the one year forward rate is equal to the five year spot rate to the fifth power.

$(1 + s_5)^5 = (1 + s_4)^4 (1 + f_{4,5})$
Or, $(1 + f_{4,5}) = (1.128)^5/(1.125)^4$
Or, $(1 + f_{4,5}) = 1.1401$
Or, $f_{1,4} = 1.1401 - 1 = 0.1401$ Or 14.01%

e. Your forecast would be the two year forward rate from year three to year five, computed as 13.55%.

CHAPTER 3: THE CENTRAL BANK AND MONETARY POLICY

1. *Solution*

Here given:
Reserve injected by the central bank (ΔR) = Rs 10 million
Required reserve ratio (REQ) = 10 percent
Money multiplier (M) =?

We have, Money multiplier (M) = $\frac{1}{REQ} = \frac{1}{0.10} = 10$ times

Total demand deposit created (ΔTDD) =?

We have, $\Delta TDD = \frac{\Delta R}{REQ} = \frac{Rs\ 10}{0.10}$ = Rs 100 million

2. Solution

Here given:
Required reserve ratio (REQ) = 12%; Total deposit of Bank A (D) = Rs 100 million; Total deposits of Bank B (D) = Rs 50 million

a. Required reserve =?
We have,
Required reserve (Q) = D × REQ
For Bank A: Q = Rs 100 × 0.12 = Rs 12 million
For Bank B: Q = Rs 50 × 0.12 = Rs 6 million

b. Excess reserve of Bank A =?
We have,
Excess reserve = Total reserve – Required reserve = Rs 20 – Rs 12 = Rs 8 million

c. Short of reserve of Bank B =?
Excess reserve = Total reserve – Required reserve
= Rs 5 – Rs 6 = -Rs 1 million
Therefore short of reserve of Bank B is Rs 1 million.

d. Funds available =?
We have,
Funds available = D (1 – REQ)
For Bank A: Funds available = Rs 100 (1 – 0.12) = Rs 88 million
For Bank B: Funds available = Rs 50 (1 – 0.12) = Rs 44 million

3. *Solution*

For the purchase of $ 1 billion in securities, the balance sheet of the Federal Reserve System and commercial banks is shown below.

Change in Federal Reserve's Balance Sheet

Assets		Liabilities	

Treasury securities	+ $ 1	Reserve account of securities dealers' banks	+ $ 1

Change in Commercial Bank Balance Sheets

Assets		Liabilities	
Reserve accounts of Federal Reserve	+$ 1	Securities dealers' demand deposit accounts	+ $ 1

4. *Solution*

For the sale of $ 850 million in securities, the balance sheet of the Federal Reserve System and commercial banks is shown below.

Change in Federal Reserve's Balance Sheet

Assets		Liabilities	
Treasury securities	- $850	Reserve account of securities dealers' banks	-$850

Change in Commercial Bank Balance Sheets

Assets		Liabilities	
Reserve accounts of Federal Reserve	- $850	Securities dealers' demand deposit accounts	- $850

5. *Solution*

a. Panel A: Initial Balance Sheets

Federal Reserve Bank

Assets		Liabilities	
Securities	+ $ 60	Reserve accounts	+ $ 60

Bank Three

Assets		Liabilities	
Loans	+$ 540	Transaction deposits	+ $ 600
Reserve deposits at Fed	60		
Total	$ 600	Total	$ 600

Panel B: Balance sheet after all changes resulting from decrease in reserve requirement

New initial required reserves = 0.08 × $ 600 = $ 48 million

Change in bank deposits = (1/0.08) × ($ 60 - $ 48) = $ 150 million

Federal Reserve Bank

Assets		Liabilities	
Securities	+ $ 60	Reserve accounts	+ $ 60

Bank Three

Assets		Liabilities	
Loans ($ 750- $ 60)	+$ 690	Transaction deposits ($ 60/0.08)	+ $ 750
Reserve deposits at Fed	60		
Total	$ 750	Total	$ 750

b. Panel A: Initial Balance Sheets

Federal Reserve Bank

Assets		Liabilities	
Securities	+ $ 60	Reserve accounts	+ $ 60

Bank Three

Assets		Liabilities	
Loans	+$ 540	Transaction deposits	+ $ 600
Reserve deposits at Fed	60		
Total	$ 600	Total	$ 600

Panel B: Balance sheet after all changes resulting from decrease in reserve requirement

New initial required reserves = 0.12 × $ 600 = $ 72 million

Change in bank deposits = (1/0.12) × ($ 60 - $ 72) = - $ 100 million

Federal Reserve Bank

Assets		Liabilities	
Securities	+ $ 60	Reserve accounts	+ $ 60

Bank Three

Assets		Liabilities	
Loans ($ 500- $ 60)	+$ 440	Transaction deposits ($ 60/0.12)	+ $ 500
Reserve deposits at Fed	60		
Total	$ 500	Total	$ 500

6. Solution

a. Increase in bank deposits and money supply = $\frac{1}{0.05}$ × $ 500 = $ 10,000 million

b. Increase in bank deposits and money supply = $\frac{1}{[0.05 + (1 - 0.95)]}$ × $ 500 = $ 5,000 million

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CHAPTER - 4 MONEY MARKETS

1. Solution

Here given:

Discount yield (d) = ?; Bond equivalent yield (BEY) = ?; Effective annual rate (EAR) = ?; Face value (FV) = Rs 1,000,000; Purchase price (P) = 97..375% of Rs 1,000,000 = Rs 973,750; Days to maturity (t) = 65 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.1,000,000 - Rs\ 973,750}{Rs.1,000,000} \times \frac{360}{65} = 0.1454 \text{ or } 14.54\%$$

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.1,000,000 - Rs\ 973,750}{Rs.973,750} \times \frac{365}{65} = 0.1514 \text{ or } 15.14\%$$

Effective annual rate (EAR) =?

We have,

$$EAR = \left(1 + \frac{BEY}{m}\right)^m - 1 = \left(1 + \frac{0.1514}{5.6154}\right)^{5.6154} - 1 = 1.1611 - 1 = 0.1611 \text{ Or, } 16.11\%$$

Working notes:

Number of compounding in a year (m) = $\frac{365}{t} = \frac{365}{65}$ = 5.6154 times

2. Solution

Here given:

Bond equivalent yield (BEY) = ?; Effective annual rate (EAR) = ?; Days to maturity (t) = 115 days; Nominal yield (i) = 6.56%

Bond equivalent yield (BEY) = $\frac{i}{360} \times 365 = \frac{0.0656}{360} \times 365$ = 0.0665 Or, 6.65

Effective annual rate (EAR) =?

We have,

$$EAR = \left(1 + \frac{i}{m}\right)^m - 1 = \left(1 + \frac{0.0656}{3.1739}\right)^{3.1739} - 1 = 1.0671 - 1 = 0.0671 \text{ Or, } 6.71\%$$

Working notes:

Number of compounding in a year (m) = $\frac{365}{t} = \frac{365}{115}$ = 3.1739 times

3. Solution

Here given:

Face value (FV) = Rs 10,000; Days to maturity (t) = 68 days; Purchase price (P) = Rs 9,875; Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 9,875}{Rs.10,000} \times \frac{360}{68} = 0.0662 \text{ or } 6.62\%$$

4. Solution

Here given:

Days to maturity (t) = 125 days; Purchase price (P) = Rs 9,765; Face value (FV) = Rs 10,000

a. Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 9,765}{Rs.10,000} \times \frac{360}{125} = 0.06768 \text{ or } 6.768\%$$

b. Bond equivalent yield (BEY) = ?

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.10,000 - Rs\ 9,765}{Rs\ 9,765} \times \frac{365}{125} = 0.07027 \text{ or } 7.0271\%$$

5. Solution

Here given:

Days to maturity (t) = 95 days; Purchase price (P) = Rs 9,965; Face value (FV) = Rs 10,000

a. Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 9,965}{Rs.10,000} \times \frac{360}{95} = 0.013263 \text{ or } 1.3263\%$$

b. Bond equivalent yield (BEY) = ?

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.10,000 - Rs\ 9,965}{Rs.9,965} \times \frac{365}{95} = 0.013495 \text{ or } 1.3495\%$$

c.Effective annual rate (EAR) =?

We have,

$$EAR = \left(1 + \frac{i}{m}\right)^{m} - 1 = \left(1 + \frac{0.013495}{3.8421}\right)^{3.8421} - 1 = 1.013563 - 1 = 0.013563 \text{ Or, } 1.3563\%$$

Working notes:

$$\text{Number of compounding in a year (m)} = \frac{365}{t} = \frac{365}{95} = 3.8421 \text{ times}$$

6. *Solution*

a. Ask price = P = ?

Days to maturity (t) = 57 days; Ask price (P) = ?; Face value (FV) = Rs 10,000 (assume)

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0191 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{57} \text{ Or, } P = Rs\ 9,969.7583$$

b. Bid price = P = ?

Days to maturity (t) = 127 days; Bid price (P) = ?; Face value (FV) = Rs 10,000 (assume)

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0212 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{127} \text{ Or, } P = Rs\ 9,925.21$$

7. Solution

Bid price = P = ?; Face value (FV) = Rs 10,000; Bid discount rate (d) = 2.23%

If days to maturity (t) = 10 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0223 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{10} \text{ Or, } P = Rs\ 9,993.81$$

If days to maturity (t) = 25 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0223 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{25} \text{ Or, } P = Rs\ 9,984.51$$

If days to maturity (t) = 50 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0223 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{50} \text{ Or, } P = Rs\ 9,969.03$$

If days to maturity (t) = 100 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0223 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{100} \text{ Or, } P = Rs\ 9,938.06$$

If days to maturity (t) = 250 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} \text{ Or, } 0.0223 = \frac{Rs.10,000 - P}{Rs.10,000} \times \frac{360}{250} \text{ Or, } P = Rs\ 9,845.14$$

8. *Solution*

Here given:

Days to maturity (t) = 225 days; Purchase price (P) = Rs 95,850; Face value (FV) = Rs 100,000

a. Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.100,000 - Rs\ 95,850}{Rs.100,000} \times \frac{360}{225} = 0.0664 \text{ or } 6.64\%$$

Bond equivalent yield (BEY) = ?

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.100,000 - Rs\ 95,850}{Rs.95,850} \times \frac{365}{225} = 0.07024 \text{ or } 7.024\%$$

b. Days to maturity (t) = 300 days

Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.100,000 - Rs\ 95,850}{Rs.100,000} \times \frac{360}{300} = 0.0498 \text{ or } 4.98\%$$

Bond equivalent yield (BEY) = ?

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.100,000 - Rs\ 95,850}{Rs.95,850} \times \frac{365}{300} = 0.0527 \text{ or } 5.27\%$$

9. Solution

Here given:

Discount yield (d) = ?; Face value (FV) = Rs 10,000; Purchase price (P) = Rs 8,885

Days to maturity (t) = 10 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 8,885}{Rs.10,000} \times \frac{360}{10} = 4.014\%,$$

Days to maturity (t) = 25 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 8,885}{Rs.10,000} \times \frac{360}{25} = 1.606\%$$

Days to maturity (t) = 50 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 8,885}{Rs.10,000} \times \frac{360}{50} = 0.803\%$$

Days to maturity (t) = 100 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 8,885}{Rs.10,000} \times \frac{360}{100} = 0.401\%$$

Days to maturity (t) = 250 days

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.10,000 - Rs\ 8,885}{Rs.10,000} \times \frac{360}{250} = 0.161\%$$

10. Solution

Here given:

Interest rate = 2.25%; Bond equivalent rate or bond equivalent yield (BEY) = ?; Quoted rate = 3.75%

We have,

$$\text{Bond equivalent yield} = \text{Quoted interest rate} \times \frac{365}{360} = 2.25\% \times \frac{365}{360} = 2.28\%$$

$$\text{Bond equivalent yield} = \text{Quoted interest rate} \times \frac{365}{360} = 3.75\% \times \frac{365}{360} = 3.80\%$$

11. *Solution*

Here given:

Selling price = Rs 10,008,548; Purchase price = Rs 10,000,000; Days to maturity = 5 days; discount yield on repo = ?; bond equivalent yield on repo = ?

a. Calculation of discount yield on repo

We have,

Interest = Loan × repo rate /360 × days to maturity

Or, Rs 50,000 = Rs 25,000,000 × Repo rate /360 × 7

Or, 50,000 = Rs 486,111.1111 Repo rate

∴ Repo rate = Rs 50,000/Rs 486,111.1111 = 0.1029 Or, 10.29%

b. Calculation of discount yield on repo

We have,

Interest = Loan × repo rate /360 × days to maturity

Or, Rs 50,000 = Rs 25,000,000 × Repo rate /360 × 21

Or, 50,000 = Rs 1,458,333.333 Repo rate

∴ Repo rate = Rs 50,000/Rs 1,458,333.333 = 0.0343 Or, 3.43%

12. Solution

Here given:

Days to maturity (t) = 45 days; Purchase price (P) = Rs 495,000; Face value (FV) = Rs 500,000

Discount yield (d) = ?

$$d = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{Rs.500,000 - Rs\ 495,000}{Rs.500,000} \times \frac{360}{45} = 0.08 \text{ or } 8\%$$

Bond equivalent yield (BEY) = ?

$$BEY = \frac{FV - P}{P} \times \frac{365}{t} = \frac{Rs.500,000 - Rs\ 495,000}{Rs\ 495,0000} \times \frac{365}{45} = 8.19\%$$

13. Solution

Days to maturity (t) = 4 months; Principal = Rs 500,000; Interest rate = 5.5%

a. Market interest rate = 6%; Current market value (P) = ?

We have,

$$P = \frac{P + \left[P \times \frac{i}{12} \times m\right]}{\left[1 + \frac{k}{12} \times m\right]} = \frac{Rs\ 500,000 + \left[Rs\ 500,000 \times \frac{0.055}{12} \times 4\right]}{\left[1 + \frac{0.06}{12} \times 4\right]}$$

$$= \frac{Rs\ 500,000 + Rs\ 9,166.67}{1.02} = Rs\ 499,183.0098$$

b. Market interest rate = 5.25%; Current market value (P) = ?

We have,

$$P = \frac{P + \left[P \times \frac{i}{12} \times m\right]}{\left[1 + \frac{k}{12} \times m\right]} = \frac{Rs\ 500,000 + \left[Rs\ 500,000 \times \frac{0.055}{12} \times 4\right]}{\left[1 + \frac{0.0525}{12} \times 4\right]} = \frac{Rs\ 500,000 + Rs\ 9,166.67}{1.0175}$$

= Rs 500,409.5

14. Solution:

Here given

Bid price = 97.270; Days to maturity (t) = 91 days

a. Discount interest rate (d) = ?

We have,

$$d = \frac{360}{t} \times \frac{DISC}{FV} = \frac{360}{91} \times \frac{Rs.2.73}{Rs.100} = 0.108 \text{ Or, } 10.8\%$$

Working notes:

Discount amount (DISC) = FV – P = Rs 100 – Rs 97.27 = Rs 2.73

b. Equivalent yield = ?

We have,

$$\text{Equivalent yield} = \frac{365 \times d}{360 - d \times t} = \frac{365 \times 0.108}{360 - 0.108 \times 91} = 0.1126 \text{ Or, } 11.26\%$$

c. Price of T-bill after 30 days =? Remaining days (t_1) = 91 – 30 = 61 days; Discount rate after 30 days (d_1) = 12%

We have,

$d_1 = \frac{DISC}{FV} \times \frac{360}{t_1}$ Or, $0.12 = \frac{\text{Rs } 100 - PP}{\text{Rs.}100} \times \frac{360}{61}$ Or, $0.12 \times 61 \times$ Rs 100 = 360 (100 – PP) Or, 732 = 36,000 – 360 PP Or, PP = 35,268/360 = Rs 97.97

d. Holding period return for 30 days

We have,

$$HPR = \frac{(\text{Ending price} - \text{Beginning price})}{\text{Beginning price}} = \frac{(\text{Rs.}97.97 - \text{Rs.}97.27)}{\text{Rs.}97.27} = 0.007196 \text{ or } 0.7196\%$$

Annual rate or EAR = $(1 + \text{periodic rate})^m - 1 = (1 + 0.007196)^{365/30} - 1 = 9.1156\%$

15. *Solution*

Here given:

Asked discount yield = 6.58%; Days to maturity = 124 days

a. Asked price = ?; Face value = Rs 100,000

Ask price = Face value – Rupee discount
= Face value – [Face value × discount yield × (t/360)]
= Rs 100,000 – [Rs 100,000 × 0.0658 × (124/360)]
= Rs 100,000 – Rs 2,266.44
= Rs 97,733.56

b. The asked price corresponds to the price asked by the securities dealer – or, the amount paid by the investor.

c. Bond equivalent yield = ?

$$\text{Bond equivalent yield} = \frac{\text{Par value} - \text{Purchase price}}{\text{Purchase price}} \times \frac{365}{\text{Days to maturity}}$$

$$= \frac{\text{Rs } 100{,}000 - \text{Rs } 97{,}733.56}{\text{Rs } 97{,}733.56} \times \frac{365}{124} = 0.0683 \text{ Or, } 6.83\%$$

16. Solution

a. Here given:

Borrowed amount = Rs 25 million; RP rate = 6.25%; Time to maturity = 24-hour or 1 day; RP Interest income =?

We have,

$$\text{RP interest income} = \text{Amount of loan} \times \text{RP rate} \times \frac{\text{Number of days loaned}}{360 \text{ days}}$$

$$= \text{Rs } 25{,}000{,}000 \times 0.0625 \times \frac{1}{360} = \text{Rs } 4{,}340.28$$

Therefore the dealer income from the 24-hour loan is Rs 4,340.28

b. Here given:

Borrowed amount = Rs 40 million; time to maturity (t) = 1 day; interest payment (I) = Rs 3,500; RP loan rate =?

We have,

$$\text{RP interest income} = \text{Amount of loan} \times \text{RP rate} \times \frac{\text{Number of days loaned}}{360 \text{ days}}$$

$$\text{Or, Rs } 3{,}500 = \text{Rs } 40{,}000{,}000 \times \text{Current RP rate} \times \frac{1}{360}$$

Or, Current RP rate = Rs 3,500/Rs 111,111.111 = 0.0315 Or, 3.15%

c. Here given:

Interest income (I) = Rs 55,600; RP loan rate (r) = 5.7%; Amount of loan =?

We have,

$$\text{RP interest income} = \text{Amount of loan} \times \text{current RP rate} \times \frac{\text{Number of days loaned}}{360 \text{ days}}$$

$$\text{Or, Rs } 55{,}600 = \text{Amount of loan} \times 0.057 \times \frac{1}{360}$$

Or, Rs 55,600 = Amount of loan × 0.000158

Or, Amount of loan = Rs 55,600/0.000158 = Rs 351,898,734.2

17. *Solution*

a. $$\text{Yield} = \frac{\text{Face value} - \text{Purchase price}}{\text{purchase price}} \times \frac{365}{t} = \frac{10000 - 8800}{8800} \times \frac{365}{91} = 0.547 \text{ Or, } 54.7\%$$

b. Price = ? We have, $\text{Price} = \frac{\text{Rs } 10000}{(1 + 0.03)} = \text{Rs } 9{,}708.74$

c. T-bill yield = ?

We have,

$$\text{Yield} = \frac{\text{Face value – Purchase price}}{\text{purchase price}} \times \frac{365}{t} = \frac{\text{Rs } 100{,}000 - \text{Rs } 98{,}000}{\text{Rs } 98{,}000} \times \frac{365}{120} = 0.0621 \text{ Or, } 6.21\%$$

$$\text{Discount yield} = \frac{FV - P}{FV} \times \frac{360}{t} = \frac{\text{Rs } 100{,}000 - \text{Rs } 98{,}000}{\text{Rs } 100{,}000} \times \frac{360}{120} = 0.0600 \text{ Or, } 6.00\%$$

d. Yield = ?

We have,

$$\text{Yield} = \frac{\text{Selling price – Purchase price}}{\text{purchase price}} \times \frac{365}{t} = \frac{\text{Rs } 9{,}100 - \text{Rs } 9{,}000}{\text{Rs } 9{,}000} \times \frac{365}{90} = 0.0451 \text{ Or, } 4.51\%$$

18. *Solution*

a. HPR = (1,000,000 – 980,000) + 45,000 /980,000 = 0.0663 Or, 6.63%

b. Calculation of discount yield on repo

We have,

$100{,}000 = 4{,}900{,}000 \times \text{repo rate} / 360 \times 40$

$\therefore$ Repo rate = Rs 100,000/544,444.44 = 0.1837 Or, 18.37%

c. Investor's yield =?

We have,

$$\text{Yield} = \frac{\text{Face value – Purchase price}}{\text{purchase price}} \times \frac{365}{t} = \frac{\text{Rs } 1{,}000{,}000 - \text{Rs } 940{,}000}{\text{Rs } 940{,}000} \times \frac{365}{180} = 0.1294 \text{ Or, } 12.94\%$$

d. Required rate of return

We have,

$FV = PV (1 + \text{required rate})^n$

Or, $10{,}000 = \text{Rs } 8{,}816.60. (1 + \text{required rate})^2$ Required rate = 6.5%

♦-♦

CHAPTER -5 CAPITAL MARKETS

1. *Solution*

a. The Ask price is \$10,000 x 107 9/32% **=** \$10,728.125

b. The Bid price is \$10,000 x 104 31/32% = \$10,496.875

2. Solution

a. July 19, 2010 to March 31, 2011 is 256 days, or 0.70136986 years. Thus,

$V_b = (0.875\%/2) \{[1-(1/(1 + .002374/2)^{2(0.70136986)})]/.002374/2\} + 100\%/(1 + .002374/2)^{2(0.70136986)}$ = 100.4465566% or to the nearest 1/32% = 100-14%

On a financial calculator: N = 0.70136986(2) = 1.40273972, I = .002374/2 = 0.1187, PMT = 0.4375, FV = 100, => PV = 100.4465566%

b. July 19, 2010 to November 30, 2013 is 3 years 136 days, or 3.37260274 years. Also, 103:02 = 103.0625%. Thus, 103.0625% = $(2.00\%/2) \{[1-(1/(1 + \text{ask yield}/2)^{2(3.37260274)})]/\text{ask yield}/2\} + 100\%/(1 + \text{ask yield}/2)^{2(3.37260274)}$

Solving for Asked yield, we get 1.0734%

On a financial calculator: N = 3.37260274(2) = 6.74520248, PV = -103.0625%, PMT = 1.000, FV = 100,

=> I = 0.5367 x 2 = 1.0734

3. *Solution*

a. July 19, 2010 to August 15, 2015 is 5.07671233 years. Also, the Asked price is 91.173%. Thus,

$91.173\% = 100\%/ (1 + \text{Asked yield}/2)^{2x5.07671233}$

Solving for "Asked yield," we get 1.83%

b. July 19, 2010 to November 15, 2016 is 6.32876712 years. Thus,

$V_b = 100\%/ (1 + 2.24515\%/2)^{2x6.32876712} = 86.823\%$

4.*Solution*

a. Accrued interest over the 145 days is calculated as:

(4.375%/2) x 145/184 = 1.723845%

of the face value of the bond, or \$172.38 per \$10,000 face value bond.

b. Clean price + Accrued interest = Dirty price
105.25% + 1.723845% = 106.973845% of the face value of the bond, or $10,697.3845 per $10,000 face value bond.

5. Solution

a. The inflation-adjusted principal at the end of the first six months June 30, 2014, is found by multiplying the original par value ($100,000) by the semiannual inflation rate. Thus, is adjusted upward by 0.3 percent (e.g., $100,000 x 1.003), or to $100,300. Therefore, the first coupon payment, paid on June 30, 2014, is $4,012 ($100,300 x 4.0%).

b. The inflation adjusted principal at the beginning of the second six months is $100,300.

c. The principal amount used to determine the second coupon payment is adjusted upward by 1 percent (e.g., $100,300 x 1.01), or to $101,303. The coupon payment to the investor for the second six month period is the inflation-adjusted principal on this coupon payment date ($101,304) times the semiannual coupon rate (4 percent). Or on December 31, 2014, the investor receives a coupon payment of $4,052.12 ($101,303 x 4.0%).

6. Solution

If your marginal tax rate is 21 percent, the after-tax or equivalent tax exempt rate of return on the taxable bond is
9.5% (1 - .21) = 7.50%
The municipal that pays 7.75 percent is the better deal.

7. a. If your marginal tax rate is 28 percent, the after-tax or equivalent tax exempt rate of return on the taxable bond is 6.75%/(1 - .28) = 9.375%

b. If your marginal tax rate is 21 percent, the after-tax or equivalent tax exempt rate of return on the taxable bond is 6.75%/(1 - .21) = 8.554%

8. a. The Hawaii Department of Budget & Finance bonds had a coupon rate of 5.500%, their price was 95.757%, and the yield was 5.80%.

b. On July 15, 2010, the Massachusetts Department of Transportation bonds were selling at 105.232% - .078% = 105.154%

c. $97.736\% = (5.000\%/2) \{[1-(1/(1 + 0.0515/2)^{2(years)})]/0.0515ytm/2\} + 100\%/(1 + 0.0515/2)^{2(years)}$

Solving for the years, we get 29.53816 years.

On a financial calculator: PV = -97.736%, PMT = 2.500, FV = 100, I = 5.15/2 = 2.575
=> N = 59.07632744 and years = 59.07632744/2 = 29.53816 years

9. Solution

a. The closing price of Bank of America bonds on July 16, 2010 was 105.266% of the face value of the bond.

b. The S&P bond rating on Morgan Stanley 5.500 percent coupon bonds maturing in 2020 on July 16, 2010 was A.

c. The closing price of Cox Communications 7.750 percent bonds on July 15, 2010 was 101.800% + 0.158% = 101.958% of the face value of the bond.

10. Solution

Before the rating change:

$V_b = (\$1,000(6.5\%)/2) \{[1-(1/(1 + 0.072/2)^{2(15)})]/0.072/2\} + 1,000/(1 + 0.072/2)^{2(15)}$

Solving for V_b, we get $936.4268335.

On a financial calculator: PMT = 32.50, FV = 1,000, I = 7.20/2 = 3.60, N = 15(2) = 30=> PV = -936.4268335

After the rating change:

$V_b = (\$1,000(6.5\%)/2) \{[1-(1/(1 + 0.085/2)^{2(15)})]/0.085/2\} + 1,000/(1 + 0.085/2)^{2(15)}$

Solving for V_b, we get $832.2098283.

On a financial calculator: PMT = 32.50, FV = 1,000, I = 8.5/2 = 4.25, N = 15(2) = 30=> PV = -832.2098283

$ change in V_b = $832.2098283 - $936.4268335 = -$104.2170052

% change in V_b = ($832.2098283 - $936.4268335)/$936.4268335 = -$104.2170052/$936.4268335 = -11.129%

11. Solution:

Since the client's marginal tax rate is 33 percent, the tax equivalent rate of return on the municipal bond is 4.5%/(1 - .33) = 6.716%. This is greater than the yield on the corporate bond, 6.45%, so the client would make more profit with the municipal bond.

12. Solution

Before the rating change:

$V_b = (1,000(6.75\%)/2) \{[1-(1/(1 + 0.082/2)^{2(10)})]/0.082/2\} + 1,000/(1 + 0.082/2)^{2(10)}$

Solving for V_b, we get $902.336888.

On a financial calculator: PMT = 33.75, FV = 1,000, I = 8.20/2 = 4.10, N = 10(2) = 20=> PV = -902.336888

After the rating change:

$V_b = (1,000(6.75\%)/2)\ \{[1-(1/(1 + 0.071/2)^{2(10)})]/0.071/2\} + 1,000/(1 + 0.071/2)^{2(10)}$

Solving for V_b, we get \$975.2404439.

On a financial calculator: PMT = 33.75, FV = 1,000, I = 7.1/2 = 3.55, N = 10(2) = 20=> PV = -975.2404439

\$ change in V_b = \$975.2404439 - \$902.336888 = \$72.9035558

% change in V_b = (\$975.2404439 - \$902.336888)/\$ 902.336888 = \$72.9035558/\$902.336888 = 8.079%

13. Solution: Bond value = 102-17%; Bond value = 103-03%; Bond value = 103-19%; Bond value = 104-14%

14. Solution

a. If a bond holder were to convert Hilton Hotels bonds into stock, each bond (worth \$975.00) could be exchanged for 61.2983 shares of stock worth \$15.90. The conversion value of the bonds is: \$15.90 x 61.2983 = \$974.50

b. The bonds are currently worth \$975.00 per bond, while their conversion value is \$974.5. Thus, there is virtually no difference in dollar value of the investment to the investor if he or she holds Hilton's debt or its common stock equivalent.

15. *Solution*

a.Here given:

Holding period (n_H) = 5 years; Purchase price (PP) = Rs 935; Selling price (SP) = Rs 980; Interest payment (I) = Rs 75 per year; Realized yield =?

We have,

$$\text{Approximate yield} = \frac{I + \frac{SP - PP}{n_H}}{\frac{SP + 2PP}{3}} = \frac{Rs.75 + \frac{Rs.980 - Rs.935}{5}}{\frac{Rs.980 + 2 \times Rs.935}{3}} = (75 + 9)/950 = 8.84\%$$

Referring approximate yield, it is seems that the actual yield lies between 8% and 9%, so try at these rates.

NPV = TPV – Purchase price

NPV = [I × $PVIFAr,n_H$ + SP × $PVIFr,n_H$] – Purchase price

At 8%

NPV = [Rs 75 × $PVIFA_{8,5}$ + SP × $PVIF_{8,5}$] – Purchase price
= [Rs 75 × 3.9927 + Rs 980 × 0.6806] – Rs 935
= Rs 966.4405 – 935
= Rs 31.4405

At 9%

NPV = [Rs 75 × $PVIFA_{9,5}$ + SP × $PVIF_{9,5}$] – Purchase price
= [Rs 75 × 3.8897 + Rs 980 × 0.6499] – Rs 935
= Rs 928.6295 – 935
= - Rs 6.3705

Interpolation between these two values

$$\text{Actual yield} = LR + \frac{NPV_{LR}}{NPV_{LR} - NPV_{HR}} \times (HR - LR)$$

$$= 8\% + \frac{31.4405}{Rs\ 31.4405 - (-Rs\ 6.3705)} \times (9\% - 8\%)$$

$$= 8\% + 0.8315\% = 8.8315\%$$

b. Here given:

Holding period (n_H) = 5 years; Purchase price (PP) = Rs 935; Selling price (SP) = Rs 980; Interest payment (I) = Rs 75 per year; Realized yield =?

$$\text{Approximate yield} = \frac{I + \frac{SP - PP}{n_H}}{\frac{SP + 2PP}{3}} = \frac{Rs.75 + \frac{Rs.990 - Rs.980}{3}}{\frac{Rs.990 + 2 \times Rs.980}{3}}$$

$$= (75 + 3.3333)/983.3333 = 7.966\%$$

16. Solution

a. $V_b = 1,000(.12)\ \{[1-(1/(1 + .10)^{12})]\} + 1,000/(1 + .10)^{12} = \$1,136.27$
b. $V_b = 1,000(.12)\ \{[1-(1/(1 + .11)^{12})]\} + 1,000/(1 + .11)^{12} = \$1,064.92$
c. $\Delta V_b = (\$1,064.92 - \$1,136.27)/\$1,136.27 = -0.0628$ or –6.28 percent.
d. $V_b = 1,000(.12)\ \{[1-(1/(1 + .10)^{16})]\} + 1,000/(1 + .10)^{16} = \$1,156.47$

V_b = 1,000(.12) {[1-(1/(1 + .11)^{16})]} + 1,000/(1 + .11)^{16} = $1,073.79

ΔV_b = ($1,073.79 - $1,156.47)/$1,156.47 = -0.0715 or –7.15 percent.

e. For the same change in interest rates, longer-term fixed-rate assets experience a greater change in price.

17. Solution

a. V_b = 1,000(.15) {[1-(1/(1 + .12)^5)]} + 1,000/(1 + .12)^{12} = $1,108.14

b. V_b = 1,000(.15) {[1-(1/(1 + .13)^5)]} + 1,000/(1 + .13)^{12} = $1,070.34

c. ΔV_b = ($1,070.34 - $1,108.14)/$1,108.14 = -0.0341 or –3.41 percent.

d. V_b = 1,000(.15) {[1-(1/(1 + .11)^5)]} + 1,000/(1 + .11)^{12} = $1,147.84

ΔV_b = ($1,147.84 - $1,108.14)/$1,108.14 = 0.0358 or 3.58 percent

e. For a given percentage change in interest rates, the absolute value of the increase in price caused by a decrease in rates is greater than the absolute value of the decrease in price caused by an increase in rates.

18. *Solution*

a. V_b = 1,000(.08) {[1-(1/(1+.09)^{10})]/.09} + 1,000(1 + .09)^{10} = $935.82

b. Bond Value = $1,268.27; Bond Value = $1,169.36; Bond Value = $1,000.00; Bond Value = $862.01

c. V_b = $\frac{1,000(.07)}{4}$ {[1-(1/(1 + .14/4)$^{4(4)}$)]/.14/4} + 1,000/(1 + .14/4)$^{4(4)}$ = $788.35

19. Solution

a. $1,100 = $\frac{1,000(.12)}{2}$ {[1-(1/(1 + ytm/2)$^{2(10)}$)]/ytm/2} + 1,000/(1 + ytm/2)$^{2(10)}$ => ytm = 10.37%

b. V_b = 945.80 = $\frac{1,000(.09)}{2}$ {[1-(1/(1 + ytm/2)$^{2(7)}$)]/ytm/2} + 1,000/(1 + ytm/2)$^{2(7)}$ => ytm = 10.099%

20. Solution

$863.73 = 1,000(.08) {[1-(1/(1 + .10)^n)]/.10} + 1,000/(1 + .10)^n => n = 12 years

Or, on a financial calculator: I = 10, PV = -963.73, PMT = 80, FV = 1,000, => n = 12 years

21. Solution

a. V_b = $\frac{1,000(.1)}{2}$ {[1-(1/(1 + .06/2)$^{2(10)}$)]/.06/2} + 1,000/(1 + .06/2)$^{2(10)}$ = $1,297.55

b. V_b = $\frac{1,000(.1)}{2}$ {[1-(1/(1 + .08/2)$^{2(10)}$)]/.08/2} + 1,000/(1 + .08/2)$^{2(10)}$ = $1,135.90

c. From parts a. and b. of this problem, there is a negative relation between required rates and fair values of bonds.

22. Solution

a. 985 = $\frac{1,000(.09)}{2}$ {[1-(1/(1 + ytm/2)$^{2(15)}$)]/ytm/2} + 1,000/(1 + ytm/2)$^{2(15)}$ => ytm = 9.186%

b. 915 = $\frac{1,000(.08)}{4}$ {[1-(1/(1 + ytm/4)$^{4(10)}$)]/ytm/4} + 1,000/(1 + ytm/4)$^{4(10)}$ => ytm = 9.316%

c. 1,065 = 1,000(.11) {[1-(1/(1 + ytm)^6)]/ytm} + 1,000/(1 + ytm)^6 => ytm = 9.528%

23. Solution

a. V_b = $\frac{1,000(.06)}{2}$ {[1-(1/(1 + .10/2)$^{2(12)}$)]/.10/2} + 1,000/(1 + .10/2)$^{2(12)}$ = $724.03

b. V_b = $\frac{1,000(.08)}{2}$ {[1-(1/(1 + .10/2)$^{2(12)}$)]/.10/2} + 1,000/(1 + .10/2)$^{2(12)}$ = $862.01

c. V_b = $\frac{1,000(.10)}{2}$ {[1-(1/(1 + .10/2)$^{2(12)}$)]/.10/2} + 1,000/(1 + .10/2)$^{2(12)}$ = $1,000.00

d. From parts a. through c. in this problem, there is a positive relation between coupon rates and present values of bonds.

e. a. V_b = $\frac{1,000(.06)}{2}$ {[1-(1/(1 + .08/2)$^{2(12)}$)]/.08/2} + 1,000/(1 + .08/2)$^{2(12)}$= $847.53

b. V_b = $\frac{1,000(.08)}{2}$ {[1-(1/(1 + .08/2)$^{2(12)}$)]/.08/2} + 1,000/(1 + .08/2)$^{2(12)}$ = $1,000.00

% change in bond value versus part (a) = ($1,000 - $847.53)/$847.53 = 17.99%

c. V_b = $\frac{1,000(.10)}{2}$ {[1-(1/(1 + .08/2)$^{2(12)}$)]/.08/2} + 1,000/(1 + .08/2)$^{2(12)}$ = $1,152.47

% change in bond value versus part (b) = ($1,152.47 - $1,000)/$1,000 = 15.25%

d. From these results we see that as coupon rates increase, price volatility decreases.

24. *Ans: a. Rs 1,135.90; b. Rs 1,172.92; c. Rs. 1,197.93; d. Positive; e. Rs 940.25; % change = -17.22%; Rs 927.33; % change = - 13.*

Solution

a. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .08/2)^{2(10)})]/.08/2\} + 1,000/(1 + .08/2)^{2(10)} = \$1,135.90$

b. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .08/2)^{2(15)})]/.08/2\} + 1,000/(1 + .08/2)^{2(15)} = \$1,172.92$

c. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .08/2)^{2(20)})]/.08/2\} + 1,000/(1 + .08/2)^{2(20)} = \$1,197.93$

d. From these results we see that there is a positive relation between time to maturity and the difference between present values and face values on bonds.

e. a. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .11/2)^{2(10)})]/.11/2\} + 1,000/(1 + .11/2)^{2(10)} = \$940.25$

% change in bond value = ($940.25 - $1,135.90)/$1,135.90 = -17.22%

b. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .11/2)^{2(15)})]/.11/2\} + 1,000/(1 + .11/2)^{2(15)} = \$927.33$,% change 3.72%

% change in bond value = ($927.33 - $1,172.92)/$1,172.92 = -20.94%

c. $V_b = \frac{1,000(.10)}{2} \{[1-(1/(1 + .11/2)^{2(20)})]/.11/2\} + 1,000/(1 + .11/2)^{2(20)} = \$919.77$ % change 2.28%

% change in bond value = ($919.77 - $1,197.93)/$1,197.93 = -23.22%

d. As interest rates increase the variability in bond prices increases as time to maturity increases.

25. *Solution*

Price before the change in interest rates:

$V_b = \frac{1,000(.06)}{2} \{[1-(1/(1 + .05/2)^{2(5)})]/.05/2\} + 1,000/(1 + .05/2)^{2(5)} = \$1,043.76$

Price after the change in interest rates:

$V_b = \frac{1,000(.06)}{2} \{[1-(1/(1 + .055/2)^{2(5)})]/.055/2\} + 1,000/(1 + .055/2)^{2(5)} = \$1,021.60$

Or, the bond decreased in price by $22.16.

26. Solution

a.P_0 = 2.10/.054 = $38.89; b. P_0 = 3.50/.068 = $51.47

27. *Solution*

a.P_0 = 5/.10 = $50

b. $P_o = \frac{1.20(1 + .10)}{.12 - .10} = \$66.00$

c. $P_o = \frac{0.60(1 + .125)}{.145 - .125} = \$33.75$

28. *Solution*

a. $P_o = \frac{2.50(1 + .015)}{.12 - .015} = \$24.167$

b. $P_4 = \frac{2.50(1 + .015)^5}{.15 - .015} = \$19.95$

29. *Solution*

a. $E(r_s) = \frac{4.50}{64} + .03 = 10.03\%$

b. $E(r_s) = \frac{4.50}{64} + .05 = 12.03\%$

c. From parts a. and b. of this problem, there is a positive relation between the dividend growth rate and the expected rate of return on stocks.

30. Solution

Step 1: Find the present value of dividends during the period of supernormal growth.

Year	Dividends ($D_0(1+g_s)^t$)	$1/(1+.10)^t$	Present Value
1	$5.5(1+.08)^1 = 5.940$	.9091	5.400
2	$5.5(1+.08)^2 = 6.415$	.8264	5.302
3	$5.5(1+.08)^3 = 6.928$	.7513	5.205
4	$5.5(1+.08)^4 = 7.483$	.6830	5.111
5	$5.5(1+.08)^5 = 8.081$	.6209	5.018
6	$5.5(1+.08)^6 = 8.728$	.5645	4.927

Present value of dividends during supernormal growth period $30.963

Step 2: Find present value of dividends after period of supernormal growth

a. Find stock value at beginning of constant growth period

$$P_6 = \frac{D_7}{r_s - g} = \frac{D_0(1+g_s)^6(1+g)^1}{r_s - g} = \frac{5.5(1+.08)^6(1+.03)^1}{.10-.03} = \$128.423$$

b. Find present value of constant growth dividends

$$P_0 = P_6/(1+.10)^6 = 128.423(.5645) = \$72.492$$

Step 3: Find present value of stock = value during supernormal growth period + value during normal growth period $30.963 + $72.492 = $103.455

31. *Solution*

a. $k_s = \frac{0.46}{44.12} + 0.145 = 15.54\%$

b. $ks = \frac{0.84}{40.11} + 0.15 = 17.09\%$

c. $P_0 = (\$1.32\times(1+0.095))/(0.13 - 0.95) = \$41.30$

d. $k_s = [\$0.35\times(1+0.105)/ \text{Rs } 24.25] + 0.105 = 12.09\%$

♦-♦

CHAPTER 6: COMMERCIAL BANKS

1. **Solution:**
   The treasury security offers 7% before tax and 4.9% after tax. This is less than the 5% offered by the municipal. Alternatively, the municipal offers a 7.14% tax equivalent yield. Of course, the treasury security should have less risk than the municipal.
2. **Solution:** The tax equivalent yield is 0.06/(1-0.35) = 0.0923 or 9.23%.
3. **Solution:**
   a. Earning assets = investment securities + net loans
      = Rs 4,050 + Rs 2,025 + Rs 15,525 – Rs 1,125 = Rs 20,475
   b. ROA = (Rs 2,600 – Rs 1,650 – Rs 180 + Rs 140 – Rs 420 – Rs 90)/Rs 23,960 = 1.67%
   c. Asset utilization = (Rs 2,600 + Rs 140)/Rs 23,960 = 11.44%
   d. Spread = (Rs 2,600/Rs 20,475) – (Rs 1,650/(Rs 10,800 +Rs 3,200 + Rs 2,250)) = 2.54%
4. **Solution:**
   a. Earning assets = investment securities + net loans = Rs 3,100 + Rs 1,664 + Rs 9,120 = Rs 13,884
   b. Interest bearing liabilities = Rs 4,020 + Rs 4,680 + Rs 312 = Rs 9,012
   c. Total operating income = Rs 1,150 + Rs 260 = Rs 1,410
   d. Asset utilization ratio = Rs 1,410/Rs 15,600 = 9.038%
   e. Net interest margin = (Rs 1,150 – Rs 475)/Rs 13,884 = 4.862%
5. **Solution**
   a. Earning assets = investment securities + net loans = Rs 6,080 + Rs 2,990 + Rs 20,040 = Rs 29,110
   b. Interest bearing liabilities = Rs 10,350 + Rs 7,670 + Rs 470 = Rs 18,490
   c. Spread = (Rs 4,048/Rs 29,110) – (Rs 2,024/Rs 18,490) = 2.959%
   d. Interest expense ratio = Rs 2,024/(Rs 4,048 + Rs 700) = 42.628%
6. **Solution**
   a. Earning assets = investment securities + net loans = Rs 1,800 + Rs 900 + Rs 6,900 – Rs 500 = Rs 9,100
   b. ROA = (Rs 2,450 – Rs 1,630 – Rs 80 + Rs 240 – Rs 410 – Rs 40)/Rs 10,650 = 4.977%
   c. Total operating income = Rs 2,450 + Rs 240 = Rs 2,690
   d. Spread = (Rs 2,450/Rs 9,100) – (Rs 1,630/(Rs 4,800 + Rs 1,425 + Rs 1,000)) = 4.363%
7. **Solution**
   Revenues (in thousands) = 6,000 x 0.04 + 22,000 x 0.08 + 12,000 x 0.06 + 80,000 x 0.10 + 4,000 x 0.09 = Rs 11,080

Expenses (in thousands) = 69,000 x 0.05 + 18,000 x 0.07 + 14,000 x 0.08 = 5,830
Net income = 11,080,000 - 5,830,000 + 120,000 - 80,000 - 2,500,000 = Rs 2,790,000 or Rs 2,790 (in thousands)

8. **Solution** (in millions of dollars)

a. return on equity = 5,000/28,000 = 17.86%
b. return on assets = 5,000/183,000 = 2.73%
c. asset utilization = (20,000 + 2,000)/183,000 = 12.02%
d. equity multiplier = 183,000/(12,000 + 4,000 + 12,000) = 6.54X
e. profit margin = 5,000/(20,000 + 2,000) = 22.73%
f. interest expense ratio = 11,000/(20,000 + 2,000) = 50.00%
g. provision for loan loss ratio = 2,000/(20,000 + 2,000) = 9.09%
h. noninterest expense ratio = 1,000/(20,000 + 2,000) = 4.55%
i. tax ratio = 3,000/(20,000 + 2,000) = 13.64%

9. **Solution**

ROA = PM x AU = 0.21 x 0.11 = 0.0231 = 2.31%
ROE = ROA x EM = 0.0231 x 12 = 0.2772 = 27.72%

10. **Solution**

ROA = PM x AU = 0.05 x 0.20 = 0.0100 = 1.00%
ROE = ROA x EM = 0.0100 x 7.75 = 0.0775 = 7.75%

11. Solution

a.Tier one Capital = Common stock + Perpetual preferred stock + Equity reserve + Undivided profit + Surplus = 10 + 6 + 25 + 15 + 4 = 60
b.Tier two capital = 10-year subordinated debt + Loan loss reserves + Limited life preferred stock = 35 + 20 + 15 = 70
c.Bank's total risk weighted asset = 400 × 0.00 + 600 × 0.20 + 800 × 0.50 + 1000 × 1.00 = Rs 1,520

d.Tier one capital ratio $= \frac{\text{Tier one capital}}{\text{Total risk weighted asset}} = \frac{60}{1520} = 0.0395$ Or, 3.95%

Since the Tier one capital ratio is less than 6, so tier one capital is not sufficient to meet the regulatory requirement.

e.Total capital ratio $= \frac{\text{Tier one capital + Tier two capital}}{\text{Total risk weighted asset}}$

$= \frac{60 + 70}{1520} = 0.0855$ Or, 8.55%

Since the total capital ratio is less than 10 percent, so total capital is not sufficient to meet the regulatory requirement.

12. **Solution**

a. The leverage ratio is (Rs 40 + Rs 30)/Rs 1,090 = 0.06422 or 6.422 percent.
b. Risk-adjusted assets = Rs 20x0.0 + Rs 40x0.0 + Rs 600x0.5 + Rs 430x1.0 = Rs 730. Tier I capital ratio = (Rs 40 + Rs 30)/Rs 730 = 0.09589 or 9.589 percent.
c. The total risk-based capital ratio = (Rs 40 + Rs 40 + Rs 30)/Rs 730 = 0.15068 or 15.068 percent.
d. The bank would be place in the well-capitalized category.

13. **Solution**

a. Calculation of on-balance sheet items and credit equivalent off balance sheet items:

Assets items	Risk weight
Cash	Rs 120 × 0 = 0
Government securities	Rs 450 × 0 = 0
Domestic inter-bank deposits	Rs 240 × 0.20 = 40 million
Standby credit letters	Rs 75 × 0.20 = 15 million
Real estate loans (residential)	Rs 370 × 1.00 = 370 million
Commercial loans	Rs 520 × 1.00 = 520 million
Long term loan commitments	Rs 180 × 1.00 = 90 million
Total risk weighted assets	Rs 1,125 million

b. Tier 1 capital = Common stock (par) + Surplus + Undivided profit
= 18 + 22 + 84 = 124 million

Tier 2 capital = Allowance for loan loss + Subordinated debt capital + Intermediate term preferred stock
= 75 + 40 + 12 = 127 million

c. Tier one ratio $= \frac{\text{Tier one capital}}{\text{Total risk weighted assets}} = \frac{\text{Rs 124 million}}{\text{Rs 1,125 miliion}} = 0.1102$ or 11.02%

Capital adequacy ratio $= \frac{\text{Total capital}}{\text{Total risk weighted assets}} = \frac{\text{Rs 124 + Rs 127}}{\text{Rs 1,125}} = 0.2231$ or 22.31%

The bank appears to have enough Tier 1 and total capital ratio to meet current regulatory requirements, therefore the bank is adequately capitalized.

d. Due to the minimum requirement of capital set by Basel agreement, the bank must hold required capital so selection of assets must be on the basis of minimum requirement.

14. Solution

a. Core capital = Paid up capital + General reserves + Capital adjustment reserve + Undistributed profit
= 492 + 652 + 100 + 30 = 1274

Supplementary capital = Exchange fluctuation reserve + Loan loss provision = 38 + 135 = 173

Total capital = Core capital + Supplementary capital = 1274 + 173 = 1447

b. Risk weighted assets

Risk weighted assets (on balance sheet)

Assets	Weight	Amount	Product
Cash and balance at NRB	0	1080	0
Investment in government securities	0	3589	0
Balance at local banks	0.20	107	21.4
Money at call	0.20	670	134
Loans against G'tee of A+ rated int'l banks	0.20	2920	584
Shares & Bond investment	1.00	25	25
Loans & Advances	1.00	7077	7077
Fixed assets	1.00	252	252
Other assets	1.00	709	709
Total			8,802.4

Risk weighted assets (off balance sheet)

Assets	Weight	Amount	Product
Advance payment guarantees	1.00	Rs 2,193	2,193
Performance bonds	0.50	1582	791
			2,984

Total risk weighted assets = On balance sheet + off balance sheet = 8,802.4 + 2,984= 11,786.4

c. Calculation of Tier I and total capital ratio

Tier one ratio $= \frac{\text{Core capital}}{\text{Total risk weighted assets}} = \frac{1274}{11786.4} = 10.81\%$

Tier one ratio $= \frac{\text{Core capital + Supplementary capital}}{\text{Total risk weighted assets}} = \frac{1274 + 173}{11786.4} = 12.28\%$

The bank have sufficient capital to meet the NRB capital requirements, the tier one capital is higher than 5.5 percent and total capital ratio is also higher than 11 percent.

15. Solution

a. Tier I capital decreases to Rs 400,000 and total capital decreases to Rs 400,000+Rs 400,000 = Rs 800,000. Cash has a 0 risk weight so risk-weighted assets do not change. Thus, the Tier I ratio decreases to 4 percent and the total capital ratio decreases to 8 percent.

b. The risk weight for mortgages is 50 percent. Thus, risk-weighted assets increase to Rs 10 million + Rs 2 million (0.5) = Rs 11 million. The Tier I ratio decreases to Rs 500,000/Rs 11 million = 4.54 percent and the total capital ratio decreases to 8.18 percent.

c. T-bills have a 0 risk weight so risk-weighted assets remain unchanged. Thus, both ratios remain unchanged.

d. Tier I equity increases to Rs 1.3 million and total capital increases to Rs 1.7 million. Since the developer has an A- credit rating, the loan's risk weight is 50 percent. Thus, risk-weighted assets increase to Rs 10 million + Rs 800,000 (0.5) = Rs 10.4 million. The Tier I ratio increases to Rs 1.3m/Rs 10.4m = 12.50 percent and the total capital ratio increases to 16.35 percent.

e. Tier I capital is unchanged. Total capital increases to Rs 1.9 million. General obligation municipal bonds fall into the 20 percent risk category. So, risk-weighted assets increase to Rs 10 million + Rs 1 million (0.2) = Rs 10.2 million. Thus, the Tier I ratio decreases to Rs 500,000/Rs 10.2 million = 4.90 percent and the total capital ratio decreases to 18.63 percent.

f. The mortgage loans were Category 3 (50%) risk weighted. The ATMs are Category 4 (100%) risk weighted. Thus, risk-weighted assets increase to Rs 10 million – Rs 4 million (0.5) + Rs 2 million (1.0) = Rs 12 million. The Tier I capital ratio decreases to Rs 500,000/Rs 12 million = 4.17 percent and the total capital ratio decreases to 7.50 percent.

CHAPTER -7: INSURNACE COMPANY

1. *Solution*

a.PVA = PMT × PVIFAi,n = Rs 14,000 × PVIFA6%,38 = Rs 14,000 × 14.846 = Rs 207,844.27

b. PVA = PMT × PVIFAi,n = Rs 14,000 × PVIFA6%,27 = Rs 14,000 × 13.2105 = Rs 184,947

and PV = Rs 184,947/(1 + 0.06)^{11} = Rs 97,428

2. Solution

a. The annual cash flows are given by X:
$1,000,000= X{[1-(1/(1+.10)^{20})]/.10} => X = $1,000,000/(8.51356372) = $117,459.62
Solving for X, annual cash flows X = $117,459.62.
or using a financial calculator, N = 20, I = 10, FV = 1,000,000, then compute PMT = $117,459.62
b. In this case, the first annuity is to be received five years from today. The initial sum today will have to be compounded by five periods to estimate the annuities: $1,000,000(1+0.10)^5 = X{[1-(1/(1+.10)^{20})]/.10}
Solving for X, annual cash flows, X = $189,169.90 or using a financial calculator, N = 20, I = 10, PV = 1,000,000(1+0.10)^5, then compute PMT = $117,459.62
c. The required payment is the present value of $200,000 per year for 20 years at 10 percent.
200,000{[1-(1/(1+.10)^{20})]/.10} = $1,702,712.74
or using a financial calculator, N = 20, I = 10, PMT = 200,000, then compute PV = $1,702,712.74

3. Solution

You deposit Rs 10,000 annually into a life insurance fund for th2. The value of $10,000 deposited nnually in a fund will amount to the following in ten years:
FV = 10,000{[(1+.08)^{10}-1]/.08} = $144,865.62 or using a financial calculator, N = 10, I = 8, PMT = 10,000, then compute FV = $144,865.62
The annuities per year over the next twenty years at 8% will be:
$144,865.62 = X{[1-(1/(1+.08)^{20})]/.08}
Solving for X, annual cash flows, X = $14,754.88 or using a financial calculator, N = 20, I = 8, PV = 144,865.62, then compute PMT = $144,865.62

4. *Solution*

a. FV = $10,000{[(1+.08)^{10}-1]/.08}(1 + .08) = $10,000 (14.48656247)(1 + .06) = $156,454.87
or using a financial calculator, N = 10, I = 8, PMT = 10,000, BEG mode, then compute FV = $156,454.87
b. In this case, the first annuity is to be received ten years from today. The amount of retirement funds at the end of year ten (the answer to part (a) of $156,454.87) will be paid out over twenty years with the first payment to be

$156,454.87 = X{[1-(1/(1+.08)^{20})]/.08}(1.08) => *X* = $14,754,88 or using a financial calculator, N = 20, I = 8, PV = $156,454.87, BEG mode, then compute PMT = $14,754,88

c.

Deposit Period	Value at 10 Years	Distribution Period	Annual Payment
7 percent	$147,835.99	7 percent	$13,041.75
		9 percent	$14,857.72
9 percent	$165,602.93	7 percent	$14,609.11
		9 percent	$16,643.32

5. Solution

a. 20,000{[1-(1/(1+.06)^{15})]/.06} = $194,244.98
or using a financial calculator, N = 15, I = 6, PMT = 20,000, then compute PV = $194,244.98
b. 20,000{[1-(1/(1+.06)^{20})]/.06} = $229,398.42
or using a financial calculator, N = 20, I = 6, PMT = 20,000, then compute PV = $229,398.42
c. For 15 years, the lump sum is $194,244.98 x (1.06) = $205,899.68. For 20 years, the lump sum is $229,398.42 x (1.06) = $243,162.33.

6. Solution

a. No, because the combined ratio is 73% + 12.5% + 18% = 103.5%.
b. Yes, because the combined ratio adjusted for investment yield is 103.5% - 8% = 95.5%.

7. Solution

Combined ratio = 77.5% + 12.9% + 16.0% = 106.40%.
In order to be profitable, the yields on investments have to be greater than 6.40%.

8. Solution

Pure loss = \$3.6 million - \$1.96 million = \$1.64 million
Expenses = 0.066 x \$3,600,000 = \$237,600
Dividends = 0.012 x \$3,600,000 = \$43,200
Investment returns = \$170,000
Net profits = 1,640,000 - 237,600 - 43,200 + 170,000 = \$1,529,200

9. Solution

a. The combined ratio (after dividends) = 75.5% + 29.2% + 1.5% = 106.2%
b. The operating ratio = Combined ratio after dividends – investment yield
= 106.2 – 9.5 = 96.7%
c. The operating ratio being less than 100 suggests that Coverall is profitable. Note that, with insufficient investment income, they would be unprofitable on the basis of their premiums and losses – this is reflected in their combined ratio after dividends exceeding 100.

10. Solution

Loss ratio = \$4,343,750/\$6,250,000 = 69.5%
Expense ratio = \$1,593,750/\$6,250,000 = 25.5%
Dividend ratio = \$156,250/\$6,250,000 = 2.5%
Combined ratio = 69.5% + 25.5% + 2.5% = 97.5%
Investment ratio = \$218,750/\$6,250,000 = 3.5%
Operating ratio = 97.5% - 3.5% = 94.0%
Overall profitability = 100.0% - 94.0% = 6.0%

CHAPTER -8: SECURITIES FIRMS, INVESTMENT BANKS AND MUTUAL FUNDS

1. Solution

Here given:
Price paid to company = Rs 23.50; Number of shares (N) = 3,000,000; Selling price to the public = Rs 25; Money received by KDO = ?
We have,
Money received by KDO = Number of shares × Price paid by investment banker
= 3,000,000 × Rs 23.50 = Rs 70,500,000
Money received by investment banker = Number of shares × Selling price to the public
= 3,000,000 × Rs 25 = Rs 75,000,000
Investment banker's profit = Money received – Money paid
= Rs 75,000,000 – Rs 70,500,000
= Rs 4,500,000
Therefore the investment banker's profit is Rs 4,500,000. From the perspective of KDO, the Rs 4,500,000 represents the commission that it must pay to issue the stock.

2. Solution

Here given:
Price paid by investment banker = Rs 33.50; Number of shares = 4 million; Selling price to the public = Rs 32 per share; Money received by GM = ?
We have,
Money received by GM = Number of shares × Price paid by investment banker
= 4,000,000 × Rs 33.50
= Rs 134,000,000
Profit to the investment bank = Number of shares × (Selling price to the public – Price paid by investment banker)
= 4,000,000 × (Rs 32 – Rs 33.50) = - Rs 6,000,000
The stock price of GM is Rs 32.00 since that is what the public must pay. From the perspective of the investment bank, the Rs 6,000,000 represents the loss that it must incur on the firm commitment offering.

3. Solution

Here given:
Number of shares issued (N) = 5,000,000; Investment bank sells = 4,200,000 shares; Selling price = Rs 54; Commission = Rs 1.25 per share; Money received by MEP =?; Investment bank's profit = ?; Stock price of MEP = ?

We have,

Money received by MEP = Number of shares sold × (Selling price – commission per share)
= 4,200,000 × (Rs 54 – Rs 1.25)
= Rs 221,550,000

Investment bank's profit = Number of shares sold × Commission per share
= 4,200,000 × Rs 1.25
= Rs 5,250,000

Therefore investment bank's profit is Rs 5,250,000, and the stock price is Rs 54 per share since that is what the public pays.

4. Solution

Here given:

Number of shares = 10 million; Method of selling = Best efforts basis; Number of shares sold (N) = 8.4 million; Selling price = Rs 27 per share; Commission = Rs 0.675 per share; Money received by XYZ company =?; Profit to the investment bank = ?; Stock price of XYZ = ?

We have,

Gross money received by XYZ = Number of shares sold × Selling price
= 8,400,000 × Rs 27
= Rs 226,800,000

Net amount received by XYZ = Number of shares sold × (Selling price – commission per share)
= 8,400,000 × (Rs 27 – Rs 0.675)
= Rs 221,130,000

Investment bank's profit = Number of shares sold × Commission per share
= 8,400,000 × Rs 0.675
= Rs 5,670,000

Therefore investment bank's profit is Rs 5,670,000, and the stock price is Rs 27 per share since that is what the public pays.

5. *Solution*

Here given:

Underwrite amount = Rs 500 million, 10 year, 8% semiannual bond of KDO corporation

Required rate of return (k_d) = 8%

Method of selling = Commitment basis

Investment bank pays KDO on Thursday and plan to sale to public on Friday

Interest rate rise = by 0.05% or 5 basis point

Impact on the profits of the investment bank =?

If the market rates increase by 5 basis points i.e. k_d = 8% + 0.05% = 8.05%

$$V_0 = I/2 \times \left[\frac{1 - \frac{1}{(1 + k_d/2)^{2n}}}{k_d/2}\right] + \frac{M}{(1 + k_d/2)^{2n}}$$

$$= \text{Rs } 40{,}000{,}000/2 \times \left[\frac{1 - \frac{1}{(1 + 0.0805/2)^{2\times10}}}{0.0805/2}\right] + \frac{\text{Rs } 500{,}000{,}000}{(1 + 0.0805/2)^{2\times10}}$$

$$= \text{Rs } 20{,}000{,}000 \times \left[\frac{1 - \frac{1}{(1 + 0.04025)^{20}}}{0.04025}\right] + \frac{\text{Rs } 500{,}000{,}000}{(1 + 0.04025)^{20}}$$

= Rs 20,000,000 × 13.5603 + Rs 227,099,153.3
= Rs 271,206,000 + Rs 227,099,153.3
= Rs 498,305,153.3

Loss = Rs 498,305,153.3 – Rs 500,000,000 = Rs 1,694,846.7

An increase in interest rates will cause the value of the bonds to fall. If rates increase 5 basis points over night, the bonds will lose Rs 1,695,036.30 in value. The investment bank will absorb the decrease in market value, since the issuing firm has already received its payment for the bonds.

If the market rates decrease by 5 basis points i.e. kd = 8 – 0.05% = 7.95%

$$V_0 = I/2 \times \left[\frac{1 - \frac{1}{(1 + k_d/2)^{2n}}}{k_d/2}\right] + \frac{M}{(1 + k_d/2)^{2n}}$$

$$= \text{Rs } 40,000,000/2 \times \left[\frac{1 - \frac{1}{(1 + 0.0795/2)^{2 \times 10}}}{0.0795/2}\right] + \frac{\text{Rs } 500,000,000}{(1 + 0.0795/2)^{2\times10}}$$

$$= \text{Rs } 20,000,000 \times \left[\frac{1 - \frac{1}{(1 + 0.03975)^{20}}}{0.03975}\right] + \frac{\text{Rs } 500,000,000}{(1 + 0.03975)^{20}}$$

= Rs 20,000,000 × 13.6205 + Rs 229,293,331.10

= Rs 272,410,000 + Rs 229,293,331.10

= Rs 501,703,331.1

Gain = Rs 501,703,331.1 – Rs 500,000,000 = Rs 1,703,331.1

6. Solution

Here given: Net asset value of fund at beginning (NAV_0) = Rs 50; Dividend (D_1) = Rs 1.50; Capital gain (CG_1) = Rs 2; Fee = Rs 2 at sold; Ending NAV (NAV_1) = Rs 52.50; Ending NAV after fee (NAV_1) = Rs 52.50 – Rs 2 = Rs 50.50

Rate of return =?

Rate of return =

We have,

$$\text{Rate of return} = \frac{(NAV_1 - NAV_0) + CG_1 + D_1}{NAV_0} = \frac{(\text{Rs.}50.50 - \text{Rs.}50) + \text{Rs.}1.50 + \text{Rs } 2}{\text{Rs.}50} = 0.08 \text{ or } 8\%$$

Therefore, the rate of return to an investor in the fund during the year is 8%.

7. *Solution*

a. $NAV_{\text{open-end, A}}$ = (165 x \$25 + 50 x \$45)/1,000 = \$6.375

$NAV_{\text{closed-end, B}}$ = (75 x \$25 + 100 x \$45)/1,000 = \$6.375

b. $NAV_{\text{open-end, A}}$ = ((165 + 165) x \$25 + 50 x \$45)/(1,000 + 647) = \$6.375

Percentage change in NAV = \$6.375 - \$6.375)/\$6.375 = 0.00%

c. $NAV_{\text{open-end, A}}$ = (165 x \$26.25 + 50 x \$43.375)/1,000 = \$6.50

Percentage change in NAV = (\$6.50 - \$6.375)/\$6.375 = 1.96%

$NAV_{\text{closed-end, B}}$ = (75 x \$26.25 + 100 x \$43.375)/100 = \$6.30625

Percentage change in NAV = (\$6.30625 - \$6.375)/\$6.375 = -1.08%

Thus, the changes in prices lead to different effects. Fund A saw its NAV increase while Fund B saw it decline. The reason is Fund B had more shares that had a price decline than a price increase.

8. *Solution*

a. NAV = (400 x Rs 16 + 400 x Rs 28)/1,000 = Rs 17,600/1,000 = Rs 17.60
b. Expected NAV = (400 x Rs 20 + 400 x Rs 20)/100 = Rs 16,000/100 = Rs 16.00, or a decline of 9.09 percent
c. (400 x Rs 20)/1,000 + (400 x PM)/1,000 = Rs 17.60. Solving for P, we get Rs 24. The maximum decline is Rs 2.

9. *Solution*

Here given: Net asset value of fund at beginning (NAV_0) = Rs 100; Dividend (D_1) = Rs 3; Capital gain (CG_1) = Rs 4; Fee = Rs 2 at sold; Ending NAV (NAV_1) = Rs 105; Ending NAV after fee (NAV_1) = Rs 105 – Rs 2 = Rs 103, Rate of return =?

Rate of return =

We have,

$$\text{Rate of return} = \frac{(NAV_1 - NAV_0) + CG_1 + D_1}{NAV_0} = \frac{(\text{Rs.}103 - \text{Rs.}100) + \text{Rs.}3 + \text{Rs } 4}{\text{Rs.}100} = 0.10 \text{ or } 10\%$$

Therefore, the rate of return to an investor in the fund during the year is 10%.

10. *Solution*

Here given:

Total assets = 100 × Rs. 14 + 200 × Rs. 140 = Rs. 29,400

Number of shares = 100 shares

a. NAV of the fund = ?

We have, Net asset value (NAV) = $\frac{\text{Assets–Liabilities}}{\text{Number of shares}} = \frac{\text{Rs.29,400–Rs.0}}{100}$ = **Rs. 294 per share**

b. NAV of the fund at the end of year = ?
We have,

Net asset value (NAV) = $\frac{\text{Assets – Liabilities}}{\text{Number of shares}} = \frac{\text{Rs.23,800 – Rs.0}}{100}$ = **Rs. 238 per share**

Working notes

Total assets = 100 × Rs. 18 + 200 × Rs. 110 = Rs. 23,800

c. Price of Microsoft = ?
We have,

Net asset value (NAV) = $\frac{\text{Assets–Liabilities}}{\text{Number of shares}}$

Or, Rs. 294 = $\frac{[(100 \times \text{Rs.}18) + (200 \times x)] - 0}{100}$

Or, Rs. 29,400 = Rs. 1,800 + 200x

Or,x = $\frac{\text{Rs. 27,600}}{200}$

$\therefore x$ = **Rs. 138**

Therefore, the price of Microsoft Company decline to Rs. 138 i.e. decrease by Rs. 2.

11. *Solution*

Here given:

Open end Fund A		Closed end Fund B	
Number of shares purchase of ATT	100	Number of shares purchase of ATT	75
Price of ATT	Rs. 100	Price of ATT	Rs. 100
Number of shares purchase of Toro	50	Number of shares purchase of Toro	100
Price of Toro	Rs. 50	Price of Toro	Rs. 50
Number of shares outstanding	100	Number of shares outstanding	100

a. NAV for each fund = ?
We have,

Net asset value (NAV) = $\frac{\text{Assets–Liabilities}}{\text{Number of shares}}$

For fund A: NAV = $\frac{\text{Rs.125,00–Rs.0}}{100}$ = Rs. 125 per share

Total assets = 100 × Rs. 100 + 50 × Rs. 50 = Rs. 125,00
Number of shares = 100 shares
Liabilities = 0

For fund B: NAV = $\frac{\text{Rs.125,00–Rs.0}}{100}$ = Rs. 125 per share

Total assets = 75 × Rs. 100 + 100 × Rs. 50 = Rs. 125,00
Number of shares = 100 shares
Liabilities = 0

b. NAV for each fund =? if price of ATT stock has increased to Rs. 105 and price of Toro stock has decreased to Rs. 45
We have,

Net asset value (NAV) = $\frac{\text{Assets–Liabilities}}{\text{Number of shares}}$

For fund A: NAV = $\frac{\text{Rs.12,750–Rs.0}}{100}$ = Rs. 127.5 per share

Total assets = 100 × Rs. 105 + 50 × Rs. 45 = Rs. 12,750
Number of shares = 100 shares
Liabilities = 0

For fund B: NAV = $\frac{\text{Rs.12,375–Rs.0}}{100}$ = Rs. 123.75 per share

Total assets = 75 × Rs. 105 + 100 × Rs. 45 = Rs. 12,375
Number of shares = 100 shares
Liabilities = 0
Rate of return = ?

We have, Rate of return = $\frac{NAV_{t+1} - NAV_t}{NAV_t}$

For fund A: Rate of return = $\frac{\text{Rs. 127.5– Rs. 125}}{\text{Rs. 125}}$ = 0.02 Or, 2%

For fund B: Rate of return = $\frac{\text{Rs. 123.75– Rs. 125}}{\text{Rs. 125}}$ = – 0.01 Or, – 1%

c. Net asset value for fund A

We have,

Net asset value (NAV) = $\frac{\text{Assets–Liabilities}}{\text{Number of shares}} = \frac{\text{Rs.225,00–Rs.0}}{100}$ = Rs. 225 per share

Total assets = 200 × Rs. 100 + 50 × Rs. 50 = Rs. 225,00
Number of shares = 100 shares
Liabilities = 0

12. *Solution*

a. Net asset value

We have,

NAV = $\frac{\text{Total assets – Liabilities}}{\text{Number of shares outstanding}} = \frac{\text{Rs.1,654,994,445 – Rs.17,628,104.13}}{50,000,000}$ = Rs. 32.7473 per share

Working notes:

Total assets = Investment in listed securities + Public issue/right share/bonus share + Bank balance + Other assets
= 1,362,379,421.94 + 48,462,374.63 + 217,462,443.51 + 26,690,205.05
= 1,654,994,445

Total liabilities = Current liabilities + Fund manager and depository fee + Fund supervisor fee
= 1,283,728.21 + 15,010,141.16 + 1,334,234.76
= Rs 17,628,104.13

b. Buy the shares because shares are under priced.

c. NAV is the total asset value (net of expenses) per unit of the fund and is calculated by the Asset Management Company (AMC) at the end of every business day. Net asset value on a particular date reflects the realisable value that the investor will get for each unit that he is holding if the scheme is liquidated on that date.

d. This is closed end fund because this fund is trading at NEPSE.

e. Closed-end funds have a fixed number of shares outstanding. The share price is a function of supply and demand. Since closed-end funds issue a fixed number of shares at one time, which thereafter trade freely on the market among investors, depending on investor demand, a fund's share price may fall below or rise above its NAV.

13. *Solution*

Here given:

Investment = Rs 20,000; investment period (n) = 2 years; Load fee = 2.5%; Operating expense = 0.55%; fund rate of return (r) = 7%; Annual rate of return on the fund over 2 year period = ?

We have,

Investment after load fee adjustment = Rs 20,000 (1 – 0.025) = Rs 19,500

Investment value after one year = Rs 19,500 (1 + 0.07) = Rs 20,865

Average net asset value = $\frac{\text{Rs. 20,865 + Rs 19,500}}{2}$ = Rs 20,182.50

Operating expense (12b-1 fees) = 0.55% of Rs 20,182.50 = 0.0055 × Rs 20,182.50 = Rs 111.00375 ≈ Rs 111.00

Value of investment after 1 year = Rs 20,865 – Rs 111 = Rs 20,754

Again,

Value of investment at the end of two years = Rs 20,754 (1 + 0.07) = Rs 22,206.78

Again,

Average net asset value = $\frac{\text{Rs. 22,206.78 + Rs 20,754}}{2}$ = Rs 21,480.39

Operating expense = 0.0055 × Rs 21,480.39 = Rs 118.14

Value of investment at the end of 2 years = Rs 22,206.78 – Rs 118.14 = Rs 22,088.64

Now, calculate annual rate of return for 2 year investment period

We have,

FV = PV $(1 + i)^n$

Or, Rs 22,088.64 = Rs 20,000 $(1 + i)^n$

Or, Rs 1.1044 = $(1 + i)^2$

Or, 1.0509 = 1 + i

Or, i. = 1.0509 – 1 = 0.0509 Or, 5.09%

14. *Solution*

Here given:

Investment = Rs 10,000; investment period (n) = 2 years; load fee = 4%; Operating expense = 0.85%; fund rate of return (r) = 5%; Annual rate of return on the fund over 2 year period =?

We have,

Investment after load fee adjustment = Rs 10,000 (1 – 0.04) = Rs 9,600

Investment value after one year = Rs 9,600 (1 + 0.05) = Rs 10,080

Average net asset value = $\frac{\text{Rs. 10,080 + Rs 9,600}}{2}$ = Rs 9,840

Operating expense (12b-1 fees) = 0.85% of Rs 9,840 = 0.0085 × Rs 9,840 = Rs 83.64

Value of investment after 1 year = Rs 10,080 – Rs 83.64 = Rs 9,996.36

The investor's return on the mutual fund investment after one year is

Rate of return = $\frac{\text{(Rs. 9,996.30 - Rs 10,000)}}{\text{Rs 10,000}}$ = - 0.0004 or, - 0.004%

Again,

Value of investment at the end of two years = Rs 9,996.36 (1 + 0.05) = Rs 10,496.178

Again,

Average net asset value = $\frac{\text{Rs. 10,496.178 + Rs 9,996.36}}{2}$ = Rs 10,246.269

Operating expense = 0.0085 × Rs 10,246.269 = Rs 87.0933

Value of investment at the end of 2 years = Rs 10,496.178 – Rs 87.0933= Rs 10,409.0847

Now, calculate annual rate of return for 2 year investment period

We have,

FV = PV $(1 + i)^n$

Or, Rs 10,409.0847 = Rs 10,000 $(1 + i)^n$

Or, Rs 1.0409 = $(1 + i)^2$

Or, 1.0202 = 1 + i

Or, i. = 1.0202 – 1 = 0.0202 Or, 2.02%

Therefore, the investor's annual return on the mutual fund is 2.02 percent.

CHAPTER 9: PENSION FUNDS

NUMERICAL PROBLEMS

1. **Solution**

Annual benefit = Rs. 2,500 per year; Annual benefit payment = ?
(i) Annual benefit payment = Annual benefit $\times$ Years of service= Rs. 2,500 $\times$ 25 = Rs. 62,500
(ii) Annual benefit payment = Annual benefit $\times$ Years of service= Rs. 2,500 $\times$ 28 = Rs. 70,000
(ii) Annual benefit payment = Annual benefit $\times$ Years of service= Rs. 2,500 $\times$ 30 = Rs. 75,000

2. Solution

We have,
Annual pension = Career average salary $\times$ years worked $\times$ annual retirement payout
For 30 years worked: Annual pension = 60,000 $\times$ 30 $\times$ 0.05 = Rs 90,000
For 33 years worked:Annual pension = 62,500 $\times$ 33 $\times$ 0.05 = Rs 103,125
For 35 years worked:Annual pension = 65,000 $\times$ 35 $\times$ 0.05 = Rs 113,750

3. Solution

We have,
Annual pension = Career average salary $\times$ years worked $\times$ annual retirement payout
For 20 years worked:Annual pension = 50,000 $\times$ 20 $\times$ 0.05 = Rs 50,000
In 2 years Annual pension = 51,005 $\times$ 22 $\times$ 0.05 = Rs 56,105.5
In 5 years Annual pension = 52,551 $\times$ 25 $\times$ 0.05 = Rs 65,688.75
In 8 years Annual pension = 54,143 $\times$ 28 $\times$ 0.05 = Rs 75,800.2
In 10 years Annual pension = 55,231 $\times$ 30 $\times$ 0.05 = Rs 82,846.5

4. **Solution**

Final pay formula
Pension = Average salary $\times$ years worked $\times$ annual payout
Now: Pension = $ 50,000 $\times$ 20 $\times$ 0.04 = Rs 40,000
In 2 years : Pension = $ 51,005 $\times$ 22 $\times$ 0.04 = Rs 44.884
In 5 years : Pension = 52,551$\times$ 25 $\times$ 0.04 = Rs 60,640
In 10 years; Pension = 55,231 $\times$ 30 $\times$ 0.04 = Rs 66,277

5. Solution

Annual pension = Career average salary $\times$ years worked $\times$ annual retirement payout
= (4,000 $\times$ 12) $\times$ 30 $\times$ 0.04 = Rs 57,600
b. (i) Annual pension = [Career average salary + flat benefit] $\times$ years worked $\times$ annual retirement payout
= [(4,000 $\times$ 12) + 2,000] $\times$ 35 $\times$ 0.04 = Rs 70,000
(ii) Annual pension = = [(4,000 $\times$ 12) + 2,000] $\times$ 40 $\times$ 0.04 = Rs 80,000

6. Solution

a. Final pay formula
Pension = Average salary $\times$ years worked $\times$ annual payout
For 17 years : Pension = $ 40,000 $\times$ 17 $\times$ 0.03 = $ 20,400
For 20 years : Pension = $ 47,000 $\times$ 20 $\times$ 0.03 = $ 28,200
For 22 years : Pension = $ 50,000 $\times$ 22 $\times$ 0.03 = $ 33,000
b. Flat benefit = $ 3,000
For 17 years : Pension = ($ 40,000 + $ 3,000) $\times$ 17 $\times$ 0.03 = $ 22,950
For 20 years : Pension = ($ 47,000 + $ 3,000) $\times$ 20 $\times$ 0.03 = $ 30,000
For 22 years : Pension = ($ 50,000 + $ 3,000) $\times$ 22 $\times$ 0.03 = $ 34,980

7. **Solution**

a. Annual pension benefit using flat benefit formula

We have,

Retirement benefit = Annual benefit $\times$ Years of service

= Rs 1,000 $\times$ 33 = Rs 33,000

b. **Annual pension benefit using carrier average formula**

We have

Retirement benefit = Annual benefit payout $\times$ Career average salary $\times$ Years worked

= 0.038 $\times$ Rs 25,600 $\times$ 33 = Rs 32,102.4

c. **Annual pension benefit using final pay formula**

Retirement benefit = Annual benefit payout

$\times$ Last four years average salary $\times$ Years worked

= 0.023 $\times$ Rs 43,500 $\times$ 33 = Rs 33,016.50

Working notes:

Last four years average salary = $\frac{\text{Rs } 41{,}200 + \text{Rs } 43{,}800 + \text{Rs } 45{,}500}{3}$ = Rs 43,500

8. **Solution**

a. Your annual investment is

Employee's contribution = Rs 60,000 $\times$ 12 =	Rs 7,200	
Tax Savings = Rs 7,200 $\times$ 31 =		Rs 2,232
Employee's cost	Rs 4,968	
Employer's match = Rs 60,000 $\times$ 0.50 $\times$ 0.05 =	Rs 1,500	
Total 401(k) investment at year start	Rs 8,700	
Your one-year return is		
1-year earnings = Rs 8,700 $\times$ 0.10 =	Rs 870	
Total 401(k) investment at year-end	Rs 9,570	

Employee=s 1-year return = (Rs 9,570 - Rs 4,968)/Rs 4,968 = 92.63%

b. Assuming the employee=s salary, tax rate, and 401(k) yield remains constant over a 25-year career, when the employee retires the 401(k) will be worth

Value of fund = Rs 8,700 $\times$ FVIFA $_{10\%,25}$ = Rs 8,700 $\times$ 98.3471 = Rs 855,619.77

9. *Solution*

Option 1:

FV = 12,000 $\times$ 0.60 $\times$ FVIFA$_{10,30}$ + 12,000 $\times$ 0.40 $\times$ FVIFA $_{6,30}$

= 7,200 $\times$ 164.4940 + 4,800 $\times$ 79.0582

= Rs 1,563,836.16

Option 2:

FV = 12,000 $\times$ 0.50 $\times$ FVIFA$_{10,30}$ + 12,000 $\times$ 0.30 $\times$ FVIFA $_{6,30}$ + 12,000 $\times$ 0.20 $\times$ FVIFA $_{4,30}$

= 6,000 $\times$ 164.4940 + 3,600 $\times$ 79.0582 + 2,400 $\times$ 56.0849

= Rs 1,406,177.28

Option 3:

FV = 12,000 $\times$ 0.40 $\times$ FVIFA$_{10,30}$ + 12,000 $\times$ 0.50 $\times$ FVIFA $_{6,30}$ + 12,000 $\times$ 0.10 $\times$ FVIFA $_{4,30}$

= 4,800 $\times$ 164.4940 + 6,000 $\times$ 79.0582 + 1,200 $\times$ 56.0849

= Rs 1,331,222.28

Option 1 produces large terminal value because it includes the largest investment in equities.

10. *Solution*

a. Gross contribution = Rs 75,000 $\times$ 0.10 = Rs 7,500

b. Tax savings = Rs 7,500 $\times$ 0.31 = Rs 2,325

c. Net of tax contribution = Rs 7,500 – Rs 2,325 = Rs 5,175

d. Employer's contribution = Rs 75,000 $\times$ 0.40 $\times$ 0.06 = Rs 1,800

e. Total investment at start = 7,500 + 1,800 = 9,300

f. Total investment at end = 7,500 + 1,800 + 744 (i.e. 9,300 $\times$ 0.08) = Rs 10,044

g. One year earnings = Rs 9,300 $\times$ 0.08 = Rs 744

h. One year return = (10,044 – 5,175)/5,175 = 0.9409 Or, 94.09%

i. Value of contribution = 9,300 $\times$ FVIFA$_{8,20}$ = Rs 425,586

Employee's net of tax contribution = Rs 5,175 $\times$ 20 = Rs 103,500

11. *Solution*

a. Monthly pension benefit for civil servant Pension = $\frac{20 \times \text{Rs } 30{,}000}{50}$ = Rs 12,000

b. Monthly pension benefit for a professor Pension = $\frac{20 \times \text{Rs } 30{,}000}{50}$ = Rs 12,000

c. Monthly pension benefit for Lt. Colonel Pension = $\frac{20 \times \text{Rs } 30{,}000}{50}$ = Rs 12,000

d. Monthly pension benefit for SP: Pension = $\frac{20 \times \text{Rs } 30{,}000}{50}$ = Rs 12,000

12. Solution

Here given:
Annual payment (PMT) = Rs. 15,000; Number of years (n) = 10 years
a. Deposit made at the beginning of the year, interest rate (k) = 10%; Value of retirement fund at the end of 10 years (FVA_{DUE}) = ?
We have,
$FVA_{DUE} = PMT \times FVIFA_{k,n} \times (1 + k)$ = Rs. 15,000 $\times FVIFA_{10\%,10} \times (1 + k)$= Rs. 15,000 $\times$ 15.9374 $\times$ (1 + 0.10)
= Rs. 262,967.10
b. Here given:
PVA = Rs. 262,967.10; Number of years (n) = 20 years; Interest rate (k) = 10%
We have,
PVA = PMT $\times$ PVIFAk,n $\times$ (1 + k)
Or, Rs. 262,967.10 = PMT $\times PVIFA_{10\%, 20} \times$ (1 + 0.10)
Or, Rs. 262,967.10 = PMT $\times$ 8.5136 $\times$ 1.10
Or, Rs. 262,967.10 = PMT $\times$ 9.3650
$\therefore$ PMT = Rs. 262,967.10/9.3650 = Rs. 28,079.7758
c. If the interest rate is higher then the pension benefit also higher and vice versa.

13. Solution

Given,
Contribution by company = Rs 5,000 per year; contribution by herself = Rs 1,000 per year; Total contribution = Rs 6,000 per year; Contribution year (n) = 10 years; Annual rate of return (r) = 7%;
Future value of this year's contribution in 10 years
FV_{10} = Rs 6,000 $(1 + 0.07)^{10}$ = Rs 6,000 $\times$ 1.9672 = Rs 11,803.2
Calculation of total funds available at retirement
We have,
Total funds available at retirement
= PMT × $FVIFA_{r,n} \times$ (1 + r) = Rs 6,000 × $FVIFA_{7\%,10}$ × (1 + 0.07) = Rs 6,000 × 13.8164 × 1.07 = Rs 88,701.288
Calculation of expected annual retirement income
We have,
Expected annual retirement income
= Annual annuity rate $\times$ Total funds available to employee at retirement $\times$ Vesting ratio
= 0.06 $\times$ Rs 88,701.288 $\times$ 1.0 = Rs 5,322.08

14. Solution

Accumulated savings at retirement = Rs 205,800; Vesting ratio = 80% or 0.80; Annual annuity rate = 3.5%; Annual expected retirement income = ?
We have,
Expected annual retirement income
= Annual annuity rate $\times$ Total funds available to employee at retirement $\times$ Vesting ratio
= 0.035 $\times$ Rs 205,800 $\times$ 0.80 = Rs 5,762.40

15. Solution

Current fund assets = [$12 million × PVIFA (5.75%, 15 yrs)] + [$22 million × PVIFA (5.75%, 10 yrs) × PVIF (5.75%, 15 yrs)] = $189,311,572

16. Solution

Future value = 6,400 × $FVIFA_{8.50, 20}$ = 6,400 × 48.3770 = Rs 309,612.80
Working notes: Total amount received = (4,500 + 1,900) = 6,400 per year
Employee's contribution = Rs 75,000 × 0.06 = Rs 4,500

17. *Solution*

FV = 11,000 $\times$ 0.65 $\times FVIFA_{10,30}$ + 11,000 $\times$ 0.30 $\times FVIFA_{5, 30}$ + 11,000 $\times$ 0.05 $\times FVIFA_{3, 30}$

= 117,613.21 + 21924.80 + 2616.65
= Rs 142,154.66

18. Solution

Rs 1,200,000 = PMT × FVIFA9,25
Or PMT = 14,167.50
and PMT = 14,167.50 × (1 – 0.04) = Rs 13,600.80

19. *Solution*

Gross contribution = Rs 90,000 × 0.09 = Rs 8,100
Tax savings = Rs 8,100 × 0.28 = Rs 2,268
Net of tax contribution = Rs 8,100– Rs 2,268 = Rs 5,832
Employer's contribution = Rs 90,000 × 0.40 × 0.06 = Rs 2,160
Total investment at start = 8,100 + 2,160 = 10,260
Total investment at end = 8,100 + 2,160 + 1,026 (i.e. 10,260 × 0.10) = Rs 11,286
One year return = (11,286 – 5,832)/5,832 = 0.9352 Or, 93.52%

20. *Solution*

PVA = Rs 15,000,000 × PVIFA5.5, 15 = Rs 25,000,000 × 10.0376 = Rs 250,940,000

21. *Solution*

We have,
Flat benefit formula = Career average formula
Or, 4000 × 40 = Pension benefit × 0.0350 × 40
Or, Pension benefit = Rs 114,285.7143

♦-♦