

CHAPTER 2

1. As a rule of thumb, real rates of interest are calculated by subtracting the inflation rate from the nominal rate. What is the error from using this rule of thumb for calculating real rates of return in the following cases?

Nominal rate (%)	7	12	18	22
Inflation rate (%)	4	6	8	10

Solution:

Nominal rate(%) (NR)	7	12	18	22
Inflation rate(%) (IR)	4	6	8	10
Real rate by the rule of thumb(%)	3	6	10	12
Correct rate(%)= $(1+NR)/(1+IR)-1$	2.88	5.66	9.26	10.91
Error from using the rule of thumb(%)	0.12	0.34	0.74	1.09

2. As a rule of thumb, real rates of interest are calculated by subtracting the inflation rate from the nominal rate. What is the error from using this rule of thumb for calculating real rates of return in the following cases?

Nominal rate (%)	4	8	11	19
Inflation rate (%)	1	3	2	4

Solution:

Nominal rate(%) (NR)	4	8	11	19
Inflation rate(%) (IR)	1	3	2	4
Real rate by the rule of thumb(%)	3	5	9	15
Correct rate(%)= $(1+NR)/(1+IR)-1$	2.97	4.85	8.82	14.42
Error from using the rule of thumb(%)	0.03	0.15	0.18	0.58

CHAPTER 3

1. At the end of March, 20X6 the balances in the various accounts of Dhoni & Company are as follows:

<i>Accounts</i>	<i>Rs. in million</i> <i>Balance</i>
Equity capital	120
Preference capital	30
Fixed assets (net)	217
Reserves and surplus	200
Cash and bank	35
Debentures (secured)	100
Marketable securities	18
Term loans (secured)	90
Receivables	200
Short-term bank borrowing (unsecured)	70
Inventories	210
Trade creditors	60
Provisions	20
Pre-paid expenses	10

Required: Prepare the balance sheet of Dhoni & Company as per the format specified by the Companies Act.

Solution:

Balance Sheet of Dhoni & Company As on March 31, 20 X 6

Liabilities			Assets	
Share capital			Fixed assets	
	Equity	120	Net fixed assets	217
	Preference	30		
Reserve & surplus		200	Investments	
			Marketable securities	18
Secured loans			Current assets, loans & advances	
	Debentures	100		
	Term loans	90		
Unsecured loans			Pre-paid expenses	10
			Inventories	210
Short term bank borrowing		70	Receivables	200
Current liabilities & provisions			Cash & Bank	35
	Trade creditors	60		
	Provisions	20		
		690		690

2. At the end of March, 20X7 the balances in the various accounts of Sania Limited are as follows:

<i>Accounts</i>	<i>Rs. in million</i> <i>Balance</i>
Equity capital	250
Preference capital	80
Fixed assets (net)	380
Reserves and surplus	350
Cash and bank	100
Debentures (secured)	190
Marketable securities	30
Term loans (secured)	120
Receivables	420
Short-term bank borrowing (unsecured)	110
Inventories	310
Trade creditors	90
Provisions	70
Pre-paid expenses	20

Required: Prepare the balance sheet of Sania Limited as per the format specified by the Companies Act.

Solution:

Balance Sheet of Sania Limited as on March 31, 20 X 7

Liabilities			Assets	
Share capital			Fixed assets	
	Equity	250	Net fixed assets	380
	Preference	80		
Reserve & surplus		350	Investments	
			Marketable securities	30
Secured loans			Current assets, loans & advances	
	Debentures	190		
	Term loans	120		
Unsecured loans			Pre-paid expenses	20
			Inventories	310
Short term bank borrowing		110	Receivables	420
Current liabilities & provisions			Cash & Bank	100
	Trade creditors	90		
	Provisions	70		
		1260		1260

3. The comparative balance sheets of Evergreen Company are given below:

<i>Owners' Equity and Liabilities</i>	<i>(Rs. in million)</i>	
	<i>As on 31.3.20X6</i>	<i>As on 31.3.20X7</i>
Share capital	70	70
Reserves and surplus	40	80
Long-term debt	80	90
Short-term bank borrowings	80	85
Trade creditors	40	70
Provisions	10	20
Total	320	415
<i>Assets</i>		
Fixed assets (net)	120	210
Inventories	90	95
Debtors	60	65
Cash	25	30
Other assets	25	15
Total	320	415

The profit and loss account of Evergreen Company for the year ending 31st March 2007 is given below:

<i>(Rs. in million)</i>	
<i>Profit & Loss Account for the Period 1.4.20X6 to 31.3.20X7</i>	
Net sales	750
Cost of goods sold	505
Stocks	290
Wages and salaries	105
Other manufacturing expenses	110
	245
Gross profit	
Operating expenses	135
Selling, administration and general	120
Depreciation	15
	110
Operating profit	110
Non-operating surplus or deficit	(20)
EBIT	90
Interest	25
Profit before tax	65
Tax	15
Profit after tax	50
Dividends	10
Retained earnings	40

- Required: (a) Prepare the classified cash flow statement for the period 1.4.20X6 to 31.3.20X7
 (b) Develop the cash flow identity for the period 1.4.20X6 to 31.3.20X7

Solution:

A.	Cash flow from operating activities	
	- Net profit before tax and extraordinary items	85
	- Adjustments for	
	Interest paid	25
	Depreciation	15
	- Operating profit before working capital changes	125
	- Adjustments for	
	Inventories	(5)
	Debtors	(5)
	Trade creditors	30
	Provisions	10
	Increase in other assets	10
	- Cash generated from operations	165
	Income tax paid	(15)
	- Cash flow before extraordinary items	150
	Extraordinary item	(20)
	- Net cash flow from operating activities	130
B.	Cash flow from investing activities	
	- Purchase of fixed assets	(105)
	- Net cash flow from investing activities	(105)
C.	Cash flow from financing activities	
	- Increase in loans	15
	- Dividends paid	(10)
	- Interest paid	(25)
	Net cash flow from financing activities	(20)
D.	Net increase in cash and cash equivalents	5
	- Cash and cash equivalents as on 31.03.20X6	25
	- Cash and cash equivalents as on 31.03.20x7	30

Note It has been assumed that “other assets” represent “other current assets”.

(b)

A. Cash flow from assets	
- Operating cash flow	90
- Net capital spending	(105)
- Decrease in net working capital	35
- Cash flow from assets	20
B. Cash flow to creditors	
- Interest paid	25
- Repayment of long term debt	(15)
- Cash flow to creditors	10
C. Cash flow to shareholders	
- Dividends paid	10
- Net new equity raised	0
- Cash flow to shareholders	10

We find that

$$(A) = (B) + (C)$$

i.e., Cash flow from assets = Cash flow to creditors + Cash flow to shareholders

4. The comparative balance sheets of Xavier Limited are given below:

<i>Owners' Equity and Liabilities</i>	<i>As on 31.3.20X6</i>	<i>(Rs. in million)</i> <i>As on 31.3.20X7</i>
Share capital	20	30
Reserves and surplus	10	18
Long-term debt	30	25
Short-term bank borrowings	15	15
Trade creditors	10	15
Provisions	5	8
Total	90	111
<i>Assets</i>		
Fixed assets (net)	16	20
Inventories	44	55
Debtors	20	21
Cash	5	8
Other assets	5	7
Total	90	111

The profit and loss account of Xavier Limited for the year 2007 is given below:

<i>(Rs. in million)</i>	
<i>Profit & Loss Account for the Period 1.4.20X6 to 31.3.20X7</i>	
Net sales	220
Cost of goods sold	140
Stocks	90
Wages and salaries	35
Other manufacturing expenses	15
	80
Gross profit	
Operating expenses	40
Selling, administration and general	20
Depreciation	5
	15
Operating profit	15
Non-operating surplus or deficit	1
EBIT	16
Interest	4
Profit before tax	12
Tax	2
Profit after tax	10
Dividends	2
Retained earnings	8

- Required: (a) Prepare the classified cash flow statement for the period 1.4.20X6 to 31.3.20X7
 (b) Develop the cash flow identity for the period 1.4.20X6 to 31.3.20X7

Solution :

A.	Cash flow from operating activities	
-	Net profit before tax and extraordinary items	11
-	Adjustments for	
	Interest paid	4
	Depreciation	5
-	Operating profit before working capital changes	20
-	Adjustments for	
	Inventories	(11)
	Debtors	(1)
	Trade creditors	5
	Provisions	3

	Increase in other assets	(2)
	- Cash generated from operations	14
	Income tax paid	(2)
	- Cash flow before extraordinary items	12
	Extraordinary item	1
	- Net cash flow from operating activities	13
B.	Cash flow from investing activities	
	- Purchase of fixed assets	(9)
	- Net cash flow from investing activities	(9)
	Cash flow from financing activities	
C.	- Increase in equity	10
	- Repayment of term loans	(5)
	-Dividend paid	(2)
	- Interest paid	(4)
	Net cash flow from financing activities	(1)
D.	Net increase in cash and cash equivalents	3
	- Cash and cash equivalents as on 31.03.20X6	5
	- Cash and cash equivalents as on 31.03.20x7	8

Note It has been assumed that “other assets” represent “other current assets”.

(b)

A	Cash flow from assets	
	- Operating cash flow	19
	- Net capital spending	(9)
	- Decrease in net working capital	(9)
	- Cash flow from assets	1
B.	Cash flow to creditors	
	- Interest paid	4
	- Repayment of long term debt	5
	- Cash flow to creditors	9
C.	Cash flow to shareholders	
	- Dividends paid	2
	- Net new equity raised	(10)
	- Cash flow to shareholders	(8)

We find that

$$(A) = (B) + (C)$$

i.e., Cash flow from assets = Cash flow to creditors + Cash flow to shareholders

CHAPTER 4

1. Premier Company's net profit margin is 8 percent, total assets turnover ratio is 2.5 times, debt to total assets ratio is 0.6. What is the return on equity for Premier?

Solution:

$$\begin{aligned}\text{Return on equity} &= \frac{\text{Net profit}}{\text{Equity}} \\ &= \frac{\text{Net profit}}{\text{Net sales}} \times \frac{\text{Net sales}}{\text{Total assets}} \times \frac{\text{Total assets}}{\text{Equity}} \\ &= 0.08 \times 2.5 \times \frac{1}{0.4} = 0.5 \text{ or } 50 \text{ per cent}\end{aligned}$$

Note : $\frac{\text{Debt}}{\text{Total assets}} = 0.6$ So $\frac{\text{Equity}}{\text{Total assets}} = 1 - 0.6 = 0.4$

Hence Total assets/Equity = 1/0.4

2. The following information is given for Alpha Corporation

Sales	3500
Current ratio	1.5
Acid test ratio	1.2
Current liabilities	1000

What is the inventory turnover ratio?

Solution:

$$\begin{aligned}\text{Current assets} &= \text{Current liabilities} \times 1.5 \\ &= 1000 \times 1.5 = 1500 \\ \text{Quick assets} &= \text{Current liabilities} \times 1.2 \\ &= 1000 \times 1.2 = 1200 \\ \text{Inventories} &= 300\end{aligned}$$

$$\text{Inventory turnover ratio} = \frac{3500}{300} = 11.7$$

3. The following information is given for Beta Corporation.

Sales	5000
Current ratio	1.4
Inventory turnover ratio	5
Acid test ratio	1.0

What is the level of current liabilities?

Solution:

$$\text{Inventory} = 5000/5 = 1000$$

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}} = 1.4$$

$$\text{Acid test ratio} = \frac{\text{Current assets} - \text{Inventories}}{\text{Current Liabilities}} = 1.0$$

$$\frac{\text{C.A} - 1000}{\text{CL}} = 1.0$$

$$\frac{\text{CA}}{\text{CL}} - \frac{1000}{\text{CL}} = 1.0$$

$$1.4 - \frac{1000}{\text{CL}} = 1.0$$

$$0.4 = \frac{1000}{\text{CL}} \implies \text{CL} = 2500$$

4. Safari Inc. has profit before tax of Rs.90 million. If the company's times interest covered ratio is 4, what is the total interest charge?

Solution:

PBT = Rs.90 million

$$\text{Times interest covered} = \frac{\text{PBIT}}{\text{Interest}} = 4$$

So $\text{PBIT} = 4 \times \text{Interest}$

$$\text{PBT} = \text{PBIT} - \text{interest}$$
$$= 4x \text{ interest} - \text{interest} = 3 \times \text{interest} = 90 \text{ million}$$

Therefore interest = $90/3 = \text{Rs.30 million}$

5. A has profit before tax of Rs.40 million. If its times interest covered ratio is 6, what is the total interest charge?

Solution:

$$\begin{aligned} PBT &= \text{Rs. 40 million} \\ \text{Times interest covered} &= \frac{PBIT}{\text{Interest}} = 6 \\ \text{So } PBIT &= 6 \times \text{Interest} \\ PBIT - \text{Interest} &= PBT = \text{Rs.40 million} \\ 6 \times \text{Interest} - \text{Interest} &= \text{Rs. 40 million} \\ 5 \times \text{Interest} &= \text{Rs.40 million} \\ \text{Hence Interest} &= \text{Rs.8 million} \end{aligned}$$

6. McGill Inc. has profit before tax of Rs.63 million. If the company's times interest covered ratio is 8, what is the total interest charge?

Solution:

$$\begin{aligned} PBT &= \text{Rs.63 million} \\ \text{Times interest covered} &= \frac{PBIT}{\text{Interest}} = 8 \\ \text{So } PBIT &= 8 \times \text{Interest} \\ PBIT - \text{Interest} &= PBT = \text{Rs.63 million} \\ 8 \times \text{Interest} - \text{Interest} &= 7 \times \text{Interest} = \text{Rs.63 million} \\ \text{Hence Interest} &= \text{Rs.9 million} \end{aligned}$$

7. The following data applies to a firm :
- | | |
|-------------------|--------------|
| Interest charges | Rs.200,000 |
| Sales | Rs.6,000,000 |
| Tax rate | 40 percent |
| Net profit margin | 5 percent |
- What is the firm's times interest covered ratio?

Solution:

$$\begin{aligned} \text{Sales} &= \text{Rs.6,000,000} \\ \text{Net profit margin} &= 5 \text{ per cent} \\ \text{Net profit} &= \text{Rs.6,000,000} \times 0.05 = 300,000 \\ \text{Tax rate} &= 40 \text{ per cent} \end{aligned}$$

$$\text{So, Profit before tax} = \frac{300,000}{(1-.4)} = \text{Rs.500,000}$$

$$\text{Interest charge} = \text{Rs.200,000}$$

$$\text{So Profit before interest and taxes} = \text{Rs.700,000}$$

$$\text{Hence Times interest covered ratio} = \frac{700,000}{200,000} = 3.5$$

8. The following data applies to a firm:

Interest charges	Rs.50,000
Sales	Rs.300,000
Tax rate	25 percent
Net profit margin	3 percent

What is the firm's times interest covered ratio?

Solution:

$$\text{Sales} = \text{Rs.300,000}$$

$$\text{Net profit margin} = 3 \text{ per cent}$$

$$\text{Net profit} = \text{Rs.300,000} \times 0.03 = 9,000$$

$$\text{Tax rate} = 25 \text{ per cent}$$

$$\text{So, Profit before tax} = \frac{9,000}{(1-.25)} = \text{Rs.12,000}$$

$$\text{Interest charge} = \text{Rs.50,000}$$

$$\text{So Profit before interest and taxes} = \text{Rs.62,000}$$

$$\text{Hence Times interest covered ratio} = \frac{62,000}{50,000} = 1.24$$

9. The following data applies to a firm :

Interest charges	Rs.10,000,000
Sales	Rs.80,000,000
Tax rate	50 percent
Net profit margin	10 percent

What is the firm's times interest covered ratio?

Solution:

Sales = Rs.80,000,000
Net profit margin = 10 per cent
Net profit = Rs.80,000,000 x 0.1 = 8,000,000
Tax rate = 50 per cent
So, Profit before tax = $\frac{8,000,000}{(1-.5)}$ = Rs.16,000,000
Interest charge = Rs.10,000,000
So Profit before interest and taxes = Rs.26,000,000
Hence
Times interest covered ratio = $\frac{26,000,000}{10,000,000}$ = 2.6

10. A firm's current assets and current liabilities are 25,000 and 18,000 respectively. How much additional funds can it borrow from banks for short term, without reducing the current ratio below 1.35?

Solution:

CA = 25,000 CL = 18,000
Let BB stand for bank borrowing
$\frac{CA+BB}{CL+BB} = 1.35$
$\frac{25,000+BB}{18,000+BB} = 1.35$
$1.35 \times 18,000 + 1.35 BB = 25,000 + BB$
$0.35BB = 25,000 - 24,300 = 700$
$BB = 700/0.35 = 2,000$

11. LNG's current assets and current liabilities are 200,000 and 140,000 respectively. How much additional funds can it borrow from banks for short term, without reducing the current ratio below 1.33?

Solution:

CA = 200,000 CL = 140,000
Let BB stand for bank borrowing

$$\frac{CA+BB}{CL+BB} = 1.33$$

$$\frac{200,000+BB}{140,000+BB} = 1.33$$

$$1.33 \times 140,000 + 1.33BB = 200,000 + BB$$

$$0.33 BB = 200,000 - 186,200 = 13,800$$

$$BB = 13,800 / 0.33 = 41,818$$

12. Navneet's current assets and current liabilities are 10,000,000 and 7,000,000 respectively. How much additional funds can it borrow from banks for short term, without reducing the current ratio below 1.4?

Solution:

$$CA = 10,000,000 \quad CL = 7,000,000$$

Let BB stand for bank borrowing

$$\frac{CA+BB}{CL+BB} = 1.4$$

$$\frac{10,000,000+BB}{7,000,000+BB} = 1.4$$

$$1.4 \times 7,000,000 + 1.4BB = 10,000,000 + BB$$

$$0.4 BB = 10,000,000 - 9,800,000 = 200,000$$

$$BB = 200,000 / 0.40 = 500,000$$

13. A firm has total annual sales (all credit) of 25,000,000 and accounts receivable of 8,000,000. How rapidly (in how many days) must accounts receivable be collected if management wants to reduce the accounts receivable to 6,000,000?

Solution:

$$\text{Average daily credit sales} = \frac{25,000,000}{365} = 68,493$$

If the accounts receivable has to be reduced to 6,000,000 the ACP must be:

$$\frac{6,000,000}{68,493} = 87.6 \text{ days}$$

14. A firm has total annual sales (all credit) of 1,200,000 and accounts receivable of 500,000. How rapidly (in how many days) must accounts receivable be collected if management wants to reduce the accounts receivable to 300,000?

Solution:

$$\text{Average daily credit sales} = \frac{1,200,000}{365} = 3287.67$$

If the accounts receivable has to be reduced to 300,000 the ACP must be:

$$\frac{300,000}{3287.67} = 91.3 \text{ days}$$

15. A firm has total annual sales (all credit) of 100,000,000 and accounts receivable of 20,000,000. How rapidly (in how many days) must accounts receivable be collected if management wants to reduce the accounts receivable to 15,000,000?

Solution:

$$\text{Average daily credit sales} = \frac{100,000,000}{365} = 273,972.6$$

If the accounts receivable has to be reduced to 15,000,000 the ACP must be:

$$\frac{15,000,000}{273,972.6} = 54.8 \text{ days}$$

16. The financial ratios of a firm are as follows.

$$\begin{aligned} \text{Current ratio} &= 1.25 \\ \text{Acid-test ratio} &= 1.10 \\ \text{Current liabilities} &= 2000 \\ \text{Inventory turnover ratio} &= 10 \end{aligned}$$

What is the sales of the firm?

Solution:

$$\begin{aligned} \text{Current assets} &= \text{Current liabilities} \times \text{Current ratio} \\ &= 2000 \times 1.25 = 2500 \\ \text{Current assets} - \text{Inventories} &= \text{Current liabilities} \times \text{Acid test ratio} \\ &= 2000 \times 1.10 = 2200 \\ \text{Inventories} &= 300 \\ \text{Sales} &= \text{Inventories} \times \text{Inventory turnover ratio} \\ &= 300 \times 10 = 3000 \end{aligned}$$

17. The financial ratios of a firm are as follows.

Current ratio	=	1.33
Acid-test ratio	=	0.80
Current liabilities	=	40,000
Inventory turnover ratio	=	6

What is the sales of the firm?

Solution:

Current assets	=	Current liabilities	x	Current ratio
	=	40,000	x	1.33 = 53,200
Current assets - Inventories	=	Current liabilities	x	Acid test ratio
	=	40,000	x	0.80 = 32,000
Inventories	=	21,200		
Sales	=	Inventories	x	Inventory turnover ratio
	=	21,200	x	6 = 127,200

18. The financial ratios of a firm are as follows.

Current ratio	=	1.6
Acid-test ratio	=	1.2
Current liabilities	=	2,000,000
Inventory turnover ratio	=	5

What is the sales of the firm?

Solution:

Current assets	=	Current liabilities	x	Current ratio
	=	2,000,000	x	1.6 = 3,200,000
Current assets - Inventories	=	Current liabilities	x	Acid test ratio
	=	2,000,000	x	1.2 = 2,400,000
Inventories	=	800,000		
Sales	=	Inventories	x	Inventory turnover ratio
	=	800,000	x	5 = 4,000,000

19. Complete the balance sheet and sales data (fill in the blanks) using the following financial data:

Debt/equity ratio	=	0.80
Acid-test ratio	=	1.1
Total assets turnover ratio	=	2
Days' sales outstanding in Accounts receivable	=	30 days
Gross profit margin	=	30 percent
Inventory turnover ratio	=	6

Balance sheet

Equity capital	80,000	Plant and equipment	....
Retained earnings	50,000	Inventories	....
Short-term bank borrowings	....	Accounts receivable	....
		Cash	....
		
Sales	....		....
Cost of goods sold	.....	

Solution:

$$\text{Debt/equity} = 0.80$$

$$\text{Equity} = 80,000 + 50,000 = 130,000$$

$$\text{So Debt} = \text{Short-term bank borrowings} = 0.8 \times 130,000 = 104,000$$

$$\text{Hence Total assets} = 130,000 + 104,000 = 234,000$$

$$\text{Total assets turnover ratio} = 2$$

$$\text{So Sales} = 2 \times 234,000 = 468,000$$

$$\text{Gross profit margin} = 30 \text{ per cent}$$

$$\text{So Cost of goods sold} = 0.7 \times 468,000 = 327,600$$

$$\text{Day's sales outstanding in accounts receivable} = 30 \text{ days}$$

$$\begin{aligned} \text{So Accounts receivable} &= \frac{\text{Sales}}{360} \times 30 \\ &= \frac{468,000}{360} \times 30 = 39,000 \end{aligned}$$

$$\text{Inventory turnover ratio} = \frac{\text{Cost of goods sold}}{\text{Inventory}} = \frac{327,600}{\text{Inventory}} = 6$$

So Inventory = 54,600

As short-term bank borrowing is a current liability,

$$\text{Acid-test ratio} = \frac{\text{Cash} + \text{Accounts receivable}}{\text{Current liabilities}}$$

$$= \frac{\text{Cash} + 39,000}{104,000} = 1.1$$

So Cash = 75,400

$$\begin{aligned} \text{Plant and equipment} &= \text{Total assets} - \text{Inventories} - \text{Accounts receivable} - \text{Cash} \\ &= 234,000 - 54,600 - 39,000 - 75,400 \\ &= 65,000 \end{aligned}$$

Putting together everything we get

Balance Sheet

Equity capital	80,000	Plant & equipment	65,000
Retained earnings	50,000	Inventories	54,600
Short-term bank borrowings	104,000	Accounts receivable	39,000
		Cash	75,400
	234,000		234,000
Sales	468,000		
Cost of goods sold	327,600		

20. Complete the balance sheet and sales data (fill in the blanks) using the following financial data:

Debt/equity ratio	= 0.40
Acid-test ratio	= 0.9
Total assets turnover ratio	= 2.5
Days' sales outstanding in Accounts receivable	= 25 days
Gross profit margin	= 25 percent
Inventory turnover ratio	= 8

Balance sheet

Equity capital	160,000,000	Plant and equipment-----	
Retained earnings	30,000,000	Inventories	.....
Short-term bank borrowings	. . . . .	Accounts receivable	. . . . .
		Cash	. . . . .
		
Sales	. . . . .	
Cost of goods sold	. . . . .	

Solution:

$$\text{Debt/equity} = 0.40$$

$$\text{Equity} = 160,000,000 + 30,000,000 = 190,000,000$$

$$\text{So Debt} = \text{Short-term bank borrowings} = 0.4 \times 190,000,000 = 76,000,000$$

$$\text{Hence Total assets} = 190,000,000 + 76,000,000 = 266,000,000$$

$$\text{Total assets turnover ratio} = 2.5$$

$$\text{So Sales} = 2.5 \times 266,000,000 = 665,000,000$$

$$\text{Gross profit margin} = 25 \text{ per cent}$$

$$\text{So Cost of goods sold} = 0.75 \times 665,000,000 = 498,750,000$$

$$\text{Day's sales outstanding in accounts receivable} = 25 \text{ days}$$

$$\begin{aligned} \text{So Accounts receivable} &= \frac{\text{Sales}}{360} \times 25 \\ &= \frac{665,000,000}{360} \times 25 = 46,180,556 \end{aligned}$$

$$\text{Inventory turnover ratio} = \frac{\text{Cost of goods sold}}{\text{Inventory}} = \frac{498,750,000}{\text{Inventory}} = 8$$

$$\text{So Inventory} = 62,343,750$$

As short-term bank borrowings is a current liability,
Cash + Accounts receivable

$$\begin{aligned} \text{Acid-test ratio} &= \frac{\text{Cash} + \text{Accounts receivable}}{\text{Current liability}} \\ &= \frac{\text{Cash} + 46,180,556}{76,000,000} = 0.9 \end{aligned}$$

$$\text{So Cash} = 22,219,444$$

$$\begin{aligned} \text{Plant and equipment} &= \text{Total assets} - \text{Inventories} - \text{Accounts receivable} - \text{Cash} \\ &= 266,000,000 - 62,343,750 - 46,180,556 - 22,219,444 \\ &= 135,256,250 \end{aligned}$$

Putting together everything we get

Balance Sheet

Equity capital	160,000,000	Plant & equipment	135,256,250
Retained earnings	30,000,000	Inventories	62,343,750
Short-term bank borrowings	76,000,000	Accounts receivable	46,180,556
	<hr/>	Cash	<hr/>
	266,000,000		266,000,000
Sales	<hr/>		
	665,000,000		
Cost of goods sold	498,750,000		

21. Complete the balance sheet and sales data (fill in the blanks) using the following financial data:

Debt/equity ratio	= 1.5
Acid-test ratio	= 0.3
Total assets turnover ratio	= 1.9
Days' sales outstanding in Accounts receivable	= 25 days
Gross profit margin	= 28 percent
Inventory turnover ratio	= 7

Balance sheet

Equity capital	600,000	Plant and equipment	....
Retained earnings	100,000	Inventories	....
Short-term bank borrowings	...	Accounts receivable	....
		Cash	....
		
Sales	.....	
Cost of goods sold	.....	

Solution:

Debt/equity = 1.5

Equity = 600,000 + 100,000 = 700,000

So Debt = Short-term bank borrowings = 1.5 x 700,000 = 1050,000

Hence Total assets = 700,000 + 1050,000 = 1,750,000

Total assets turnover ratio = 1.9

So Sales = 1.9 x 1,750,000 = 3,325,000

Gross profit margin = 28 per cent

So Cost of goods sold = 0.72 x 3,325,000 = 2,394,000

Day's sales outstanding in accounts receivable = 25 days

$$\text{So Accounts receivable} = \frac{\text{Sales}}{360} \times 25$$

$$= \frac{3,325,000}{360} \times 25 = 230,903$$

$$\text{Inventory turnover ratio} = \frac{\text{Cost of goods sold}}{\text{Inventory}} = \frac{2,394,000}{\text{Inventory}} = 7$$

So Inventory = 342,000

As short-term bank borrowings is a current liability ,
Cash + Accounts receivable

$$\text{Acid-test ratio} = \frac{\text{Cash + Accounts receivable}}{\text{Current liabilities}}$$

$$= \frac{\text{Cash} + 230,903}{1050,000} = 0.3$$

So Cash = 84,097

$$\begin{aligned} \text{Plant and equipment} &= \text{Total assets} - \text{Inventories} - \text{Accounts receivable} - \text{Cash} \\ &= 1,750,000 - 342,000 - 230,903 - 84,097 \\ &= 1,093,000 \end{aligned}$$

Putting together everything we get

Balance Sheet

Equity capital	600,000	Plant & equipment	1,093,000
Retained earnings	100,000	Inventories	342,000
Short-term bank borrowings	1050,000	Accounts receivable	230,903
		Cash	84,097
	1,750,000		1,750,000
Sales	3,325,000		
Cost of goods sold	2,394,000		

22. Compute the financial ratios for Acme Ltd. Evaluate Acme's performance with reference to the standards.

Acme Limited Balance Sheet, March 31, 20X7

Liabilities and Equity

Equity capital	Rs.60,000,000
Reserves and surplus	45,000,000
Long-term debt	72,000,000
Short-term bank borrowing	40,000,000
Trade creditors	30,000,000
Provisions	15,000,000
Total	62,000,000

Assets

Fixed assets (net)	Rs.110,000,000
Current assets	
Cash and bank	30,000,000
Receivables	45,000,000

Inventories	61,000,000
Pre-paid expenses	10,000,000
Others	6,000,000
Total	<u>262,000,000</u>

Acme Limited Profit and Loss Account for the Year Ended March 31, 20X7

Net sales	Rs.320,000,000
Cost of goods sold	204,000,000
Gross profit	116,000,000
Operating expenses	50,000,000
Operating profit	66,000,000
Non-operating surplus	4,000,000
Profit before interest and tax	70,000,000
Interest	12,000,000
Profit before tax	58,000,000
Tax	20,000,000
Profit after tax	38,000,000
Dividends	4,000,000
Retained earnings	34,000,000

	<i>Acme</i>	<i>Standard</i>
Current ratio		1.3
Acid-test ratio		0.70
Debt-equity ratio		2.0
Times interest covered ratio		4.5
Inventory turnover ratio		5.0
Average collection period		45 days
Total assets turnover ratio		1.5
Net profit margin ratio		8 %
Earning power		20 %
Return on equity		18 %

Solution:

<p>For purposes of ratio analysis, we may recast the balance sheet as under. Let assume that 'Others' in the balance sheet represents other current assets.</p>	
<i>Liabilities and Equity</i>	
Equity capital	.60,000,000
Reserves and surplus	45,000,000
Long-term debt	72,000,000
Short-term bank borrowing	40,000,000
Total	217,000,000

Assets

	110,000,000
Fixed assets (net)	
Current assets	
Cash and bank	30,000,000
Receivables	45,000,000
Inventories	61,000,000
Pre-paid expenses	10,000,000
Others	6,000,000
	152,000,000
Less:	
Current liabilities	
Trade creditors	30,000,000
Provisions	15,000,000
Net current assets	45,000,000
	107,000,000
Total	217,000,000

$$(i) \text{ Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

$$= \frac{152,000,000}{85,000,000} = 1.8$$

(Current liabilities here includes short-term bank borrowing also)

$$(ii) \text{ Acid-test ratio} = \frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}} = \frac{91,000,000}{85,000,000} = 1.1$$

(Current liabilities here includes short-term bank borrowing also)

$$(iii) \text{ Debt-equity ratio} = \frac{\text{Long-term debt} + \text{Short-term bank borrowing}}{\text{Equity capital} + \text{Reserves \& surplus}}$$

$$= \frac{72,000,000 + 40,000,000}{60,000,000 + 45,000,000} = 1.1$$

$$(iv) \text{ Times interest coverage ratio} = \frac{\text{Profit before interest and tax}}{\text{Interest}}$$

$$= \frac{70,000,000}{12,000,000} = 5.83$$

$$(v) \text{ Inventory turnover period} = \frac{\text{Cost of goods sold}}{\text{Inventory}} = \frac{204,000,000}{61,000,000} = 3.34$$

$$(vi) \text{ Average collection period} = \frac{365}{\frac{\text{Net sales} / \text{Accounts receivable}}{365}} = \frac{365}{\frac{320,000,000}{45,000,000}} = 51.3 \text{ days}$$

(vii)

$$\text{Total assets} = \text{Equity} + \text{Total debt} = (60,000,000 + 45,000,000) + (72,000,000 + 40,000,000) = 217,000,000$$

$$\text{Total assets turnover ratio} = \frac{\text{Net sales}}{\text{Total assets}} = \frac{320,000,000}{217,000,000} = 1.5$$

$$(ix) \text{ Net profit margin} = \frac{\text{Profit after tax}}{\text{Net sales}} = \frac{38,000,000}{320,000,000} = 11.9\%$$

$$(x) \text{ Earning power} = \frac{\text{PBIT}}{\text{Total assets}} = \frac{70,000,000}{217,000,000} = 32.3\%$$

$$(xi) \text{ Return on equity} = \frac{\text{Equity earning}}{\text{Net worth}} = \frac{38,000,000}{105,000,000} = 36.2\%$$

The comparison of the Acme's ratios with the standard is given below

	<i>Acme</i>	<i>Standard</i>
Current ratio	1.8	1.3
Acid-test ratio	1.1	0.7
Debt-equity ratio	1.1	2.0
Times interest covered ratio	5.8	4.5
Inventory turnover ratio	3.3	5.0
Average collection period	51.3 days	45 days
Total assets turnover ratio	1.5	1.5
Net profit margin ratio	11.9 %	8 %
Earning power	32.3 %	20 %
Return on equity	36.2 %	18 %

23. Compute the financial ratios for Nainar Ltd. Evaluate Nainar's performance with reference to the standards.

Nainar Limited Balance Sheet, March 31, 20X7

<i>Liabilities and Equity</i>	
Equity capital	Rs.100,000,000
Reserves and surplus	65,000,000
Long-term debt	140,000,000
Short-term bank borrowing	70,000,000
Trade creditors	24,000,000
Provisions	<u>19,000,000</u>
Total	418,000,000
<i>Assets</i>	
Fixed assets (net)	Rs.206,000,000
Current assets	
Cash and bank	25,000,000
Receivables	70,000,000
Inventories	85,000,000
Pre-paid expenses	20,000,000
Others	<u>12,000,000</u>
Total	418,000,000

Nainar Limited Profit and Loss Account for the Year Ended March 31, 20X7

Net sales	Rs.740,000,000
Cost of goods sold	520,000,000
Gross profit	220,000,000
Operating expenses	102,000,000
Operating profit	118,000,000
Non-operating surplus	12,000,000
Profit before interest and tax	130,000,000
Interest	22,000,000
Profit before tax	108,000,000
Tax	46,000,000
Profit after tax	62,000,000
Dividends	20,000,000
Retained earnings	42,000,000

	<i>Nainar</i>	<i>Standard</i>
Current ratio		1.7
Acid-test ratio		1.0
Debt-equity ratio		1.4
Times interest covered ratio		5.5
Inventory turnover ratio		6.0
Average collection period		40 days
Total assets turnover ratio		2.0
Net profit margin ratio		8 %
Earning power		30 %
Return on equity		35 %

Solution:

For purposes of ratio analysis, we may recast the balance sheet as under.
Let assume that 'Others' in the balance sheet represents other current assets.

<i>Liabilities and Equity</i>		
Equity capital		100,000,000
Reserves and surplus		65,000,000
Long-term debt		140,000,000
Short-term bank borrowing		70,000,000
	Total	375,000,000
<i>Assets</i>		
Fixed assets (net)		206,000,000
Current assets		
Cash and bank	25,000,000	
Receivables	70,000,000	
Inventories	85,000,000	
Pre-paid expenses	20,000,000	
Others	12,000,000	212,000,000
Less:		
Current liabilities		
Trade creditors	24,000,000	
Provisions	19,000,000	43,000,000
Net current assets		169,000,000
	Total	<u>375,000,000</u>

$$(i) \text{ Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

$$= \frac{212,000,000}{113,000,000} = 1.9$$

(Current liabilities here includes short-term bank borrowing also)

$$(ii) \text{ Acid-test ratio} = \frac{\text{Current assets} - \text{Inventories}}{\text{Current liabilities}} = \frac{127,000,000}{113,000,000} = 1.1$$

(Current liabilities here includes short-term bank borrowing also)

$$(iii) \text{ Debt-equity ratio} = \frac{\text{Long-term debt} + \text{Short-term bank borrowing}}{\text{Equity capital} + \text{Reserves \& surplus}}$$

$$= \frac{140,000,000 + 70,000,000}{100,000,000 + 65,000,000} = 1.3$$

$$(iv) \text{ Times interest coverage ratio} = \frac{\text{Profit before interest and tax}}{\text{Interest}}$$

$$= \frac{130,000,000}{22,000,000} = 5.9$$

$$(v) \text{ Inventory turnover period} = \frac{\text{Cost of goods sold}}{\text{Inventory}} = \frac{520,000,000}{85,000,000} = 6.1$$

$$(vi) \text{ Average collection period} = \frac{\text{Net sales} / \text{Accounts receivable}}{365}$$

$$= \frac{740,000,000/70,000,000}{365} = 34.5 \text{ days}$$

$$(vii) \text{ Total assets} = \text{Equity} + \text{Total debt} = (100,000,000 + 65,000,000) + (140,000,000 + 70,000,000) = 375,000,000$$

$$\text{Total assets turnover ratio} = \frac{\text{Net sales}}{\text{Total assets}} = \frac{740,000,000}{375,000,000} = 2.0$$

$$(ix) \text{ Net profit margin} = \frac{\text{Profit after tax}}{\text{Net sales}} = \frac{62,000,000}{740,000,000} = 8.4 \%$$

$$(x) \text{ Earning power} = \frac{PBIT}{\text{Total assets}} = \frac{130,000,000}{375,000,000} = 34.7 \%$$

$$(xi) \text{ Return on equity} = \frac{\text{Equity earning}}{\text{Net worth}} = \frac{62,000,000}{165,000,000} = 37.6 \%$$

The comparison of the Nainar's ratios with the standard is given below

	<i>Nainar</i>	<i>Standard</i>
Current ratio	1.9	1.7
Acid-test ratio	1.1	1.0
Debt-equity ratio	1.3	1.4
Times interest covered ratio	5.9	5.5
Inventory turnover ratio	6.1	6.0
Average collection period	34.5 days	40 days
Total assets turnover ratio	2.0	2.0
Net profit margin ratio	8.4 %	8 %
Earning power	34.7 %	30 %
Return on equity	37.6 %	35 %

24. The comparative balance sheets and comparative Profit and Loss accounts for Nalvar Limited, are given below:

Comparative Balance Sheets, Nalvar Limited

(Rs. in million)

	20X3	20X4	20X5	20X6	20X7
Share capital	1.6	1.6	1.8	1.8	2
Reserves and surplus	1.0	1.6	2.4	2.3	3
Long-term debt	1.4	1.5	1.8	1.6	1.4
Short-term bank borrowing	1.3	1.5	1.7	1.5	1.2
Current liabilities	1.1	1.3	1.5	1.6	1.8
Total	6.4	7.5	9.2	8.8	9.4
<i>Assets</i>					
Net fixed assets	1.2	1.4	2	1.7	2
Current assets					
Cash and bank	0.3	0.3	0.2	0.4	0.3
Receivables	1.8	2.1	2.5	2.4	2.5
Inventories	1.8	2.2	2.8	2.4	2.8
Other assets	1.3	1.5	1.7	1.9	1.8
Total	6.4	7.5	9.2	8.8	9.4

Comparative Profit and Loss Accounts, Nalvar Limited
(Rs. in million)

	<u>20X3</u>	<u>20X4</u>	<u>20X5</u>	<u>20X6</u>	<u>20X7</u>
Net sales	3.8	4.2	5.3	6.5	7.8
Cost of goods sold	2.6	3.1	3.9	4	4.8
Gross profit	1.2	1.1	1.4	2.5	3
Operating expenses	0.3	0.3	0.4	0.6	0.6
Operating profit	0.9	0.8	1	1.9	2.4
Non-operating surplus deficit	0.1	0.2	0.1	0.3	0.3
Profit before interest and tax	1	1	1.1	2.2	2.7
Interest	0.1	0.1	0.2	0.1	0.1
Profit before tax	0.9	0.9	0.9	2.1	2.6
Tax	0.05	0.08	1	1.2	1.2
Profit after tax	0.85	0.82	-0.1	0.9	1.4

Required: Compute the important ratios for Nalvar Limited for the years 20X3-20X7. You may assume that other assets in the balance sheet represent other current assets.

- Current ratio
- Debt-equity ratio
- Total assets turnover ratio
- Net profit margin
- Earning power
- Return on equity

Solution:

We will rearrange the balance sheets as under for ratio analysis. It is assumed that 'Other assets' are other current assets

<i>Liabilities and Equity</i>	<u>20X3</u>	<u>20X4</u>	<u>20X5</u>	<u>20X6</u>	<u>20X7</u>
Share capital	1.6	1.6	1.8	1.8	2
Reserves and surplus	1	1.6	2.4	2.3	3
Long-term debt	1.4	1.5	1.8	1.6	1.4
Short-term bank borrowing	1.3	1.5	1.7	1.5	1.2
Total	5.3	6.2	7.7	7.2	7.6
<i>Assets</i>					
Net fixed assets	1.2	1.4	2	1.7	2
Current assets					
Cash and bank	0.3	0.3	0.2	0.4	0.3
Receivables	1.8	2.1	2.5	2.4	2.5

Inventories	1.8		2.2		2.8		2.4		2.8	
Other current assets	1.3	5.2	1.5	6.1	1.7	7.2	1.9	7.1	1.8	7.4
Less: Current liabilities										
Other current liabilities	1.1	1.1	1.3	1.3	1.5	1.5	1.6	1.6	1.8	1.8
Net current assets		4.1		4.8		5.7		5.5		5.6
Total		5.3		6.2		7.7		7.2		7.6

The required ratios are as under:

	<u>20X3</u>	<u>20X4</u>	<u>20X5</u>	<u>20X6</u>	<u>20X7</u>
• Current ratio	2.2	2.2	2.3	2.3	2.5
• Debt-equity ratio	1.0	0.9	0.8	0.8	0.5
• Total assets turnover ratio	0.7	0.7	0.7	0.9	1.0
• Net profit margin(%)	22.4	19.5	-1.9	13.8	17.9
• Earning power (%)	18.9	16.1	14.3	30.6	35.5
• Return on equity (%)	32.7	25.6	-2.4	22.0	28.0

25. The comparative balance sheets and comparative Profit and Loss accounts for Somani Limited, a machine tool manufacturer, are given below:

Comparative Balance Sheets, Somani Limited (Rs. in million)

	<u>20X3</u>	<u>20X4</u>	<u>20X5</u>	<u>20X6</u>	<u>20X7</u>
Share capital	41	50	50	50	55
Reserves and surplus	16	36	72	118	150
Long-term debt	28	25	30	29	22
Short-term bank borrowing	35	30	36	38	38
Current liabilities	24	28	30	30	25
Total	144	169	218	265	290
<i>Assets</i>					
Net fixed assets	72	80	75	102	103
Current assets					
Cash and bank	8	9	15	12	11
Receivables	24	30	59	62	85
Inventories	35	42	55	75	79
Other Assets	5	8	14	14	12
Total	144	169	218	265	290

Comparative Profit & Loss Account of Somani Ltd

(Rs. in million)

	20X3	20X4	20X5	20X6	20X7
Net sales	285	320	360	350	355
Cost of goods sold	164	150	170	175	174
Gross profit	121	170	190	175	181
Operating expenses	64	66	68	68	64
Operating profit	57	104	122	107	117
Non-operating surplus deficit	3	4	4	3	3
Profit before interest and tax	60	108	126	110	120
Interest	8	6	10	12	12
Profit before tax	52	102	116	98	108
Tax	15	26	30	26	29
Profit after tax	37	76	86	72	79

Compute the following ratios for years 20X3-20X7:

- Current ratio
- Debt-equity ratio
- Total assets turnover ratio
- Net profit margin
- Earning power
- Return on equity

For ratio analysis purpose, we will rearrange the balance sheet as under. It is assumed that 'Other assets' are other current assets

	20X3	20X4	20X5	20X6	20X7
Share capital	41	50	50	50	55
Reserves and surplus	16	36	72	118	150
Long-term debt	28	25	30	29	22
Short-term bank borrowing	35	30	36	38	38
Total	120	141	188	235	265
<i>Assets</i>					
Net fixed assets	72	80	75	102	103
Current assets					
Cash and bank	8	9	15	12	11
Receivables	24	30	59	62	85
Inventories	35	42	55	75	79
Other assets	5	72	8	89	14
Less : Current liabilities	24	24	28	28	30
Net current assets	48	61	113	133	162
Total	120	141	188	235	265

The ratios worked out are as under:

	<u>20X3</u>	<u>20X4</u>	<u>20X5</u>	<u>20X6</u>	<u>20X7</u>
• Current ratio	1.2	1.5	2.2	2.4	3.0
• Debt-equity ratio	1.1	0.6	0.5	0.4	0.3
• Total assets turnover ratio	2.4	2.3	1.9	1.5	1.3
• Net profit margin (%)	13.0	23.8	23.9	20.6	22.3
• Earning power (%)	50.0	76.6	67.0	46.8	45.3
• Return on equity (%)	64.9	88.4	70.5	42.9	38.5

26. The Balance sheets and Profit and Loss accounts of LKG Corporation are given below.

Prepare the common size and common base financial statements

Balance Sheets	(Rs. in million)	
	<u>20x6</u>	<u>20x7</u>
Shareholders' funds	256	262
Loan funds	156	212
Total	412	474
Fixed assets	322	330
Investments	15	15
Net current assets	75	129
Total	412	474

Profit & Loss Accounts	(Rs. in million)	
	<u>20x6</u>	<u>20x7</u>
Net sales	623	701
Cost of goods sold	475	552
Gross profit	148	149
PBIT	105	89
Interest	22	21
PBT	83	68
Tax	41	34
PAT	42	34

Solution:

Common Size statements:

Profit and Loss Account

	Regular (in Rs. million)		Common Size(%)	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
Net sales	623	701	100	100
Cost of goods sold	475	552	76	79
Gross profit	148	149	24	21
PBIT	105	89	17	13
Interest	22	21	4	3
PBT	83	68	13	10
Tax	41	34	7	5
PAT	42	34	7	5

Balance Sheet

	Regular (in million)		Common Size(%)	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
Shareholders' funds	256	262	62	55
Loan funds	<u>156</u>	<u>212</u>	<u>38</u>	<u>45</u>
Total	412	474	100	100
Fixed assets	322	330	78	70
Investments	15	15	4	3
Net current assets	<u>75</u>	<u>129</u>	<u>18</u>	<u>27</u>
Total	412	474	100	100

27. The Balance sheets and Profit and Loss accounts of Grand Limited are given below. Prepare the common size and common base financial statements

Balance Sheet		
	<u>20x6</u>	<u>20x7</u>
Shareholders' fund	85	85
Loan funds	<u>125</u>	<u>180</u>
Total	<u>210</u>	<u>265</u>
Fixed assets	127	170
Investments	8	10
Net current assets	<u>75</u>	<u>85</u>
Total	<u>210</u>	<u>265</u>

Profit & Loss Account		
	<u>20x6</u>	<u>20x7</u>
Net sales	450	560
Cost of goods sold	320	410
Gross profit	130	150
PBIT	85	98
Interest	12	17
PBT	73	81
Tax	22	38
PAT	51	43

Solution:

<u>Balance Sheet</u>	<u>Regular (Rs. in million)</u>		<u>Common Size(%)</u>	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
Shareholders' funds	85	85	40	32
Loan funds	<u>125</u>	<u>180</u>	<u>60</u>	<u>68</u>
Total	<u>210</u>	<u>265</u>	<u>100</u>	<u>100</u>
Fixed assets	127	170	60	64
Investments	8	10	4	4
Net current assets	<u>75</u>	<u>85</u>	<u>36</u>	<u>32</u>
Total	210	265	<u>100</u>	<u>100</u>

<u>Profit & Loss Account</u>	<u>Regular (Rs. in million)</u>		<u>Common Size(%)</u>	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
Net sales	450	560	100	100
Cost of goods sold	320	410	71	73
Gross profit	130	150	29	27
PBIT	85	98	19	18
Interest	12	17	3	3
PBT	73	81	16	14
Tax	22	38	5	7
PAT	51	43	11	8

Common base year statements

<u>Balance Sheet</u>	<u>Regular (Rs. in million)</u>		<u>Common base year (%)</u>	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
	Shareholders' funds	85	85	100	100
Loan funds	<u>125</u>	<u>180</u>	<u>100</u>	<u>144</u>
Total	<u>210</u>	<u>265</u>	<u>100</u>	<u>126</u>
Fixed assets	127	170	100	134
Investments	8	10	100	125
Net current assets	<u>75</u>	<u>85</u>	<u>100</u>	<u>113</u>
Total	<u>210</u>	<u>265</u>	<u>100</u>	<u>126</u>

<u>Profit & Loss Account</u>	<u>Regular (Rs. in million)</u>		<u>Common base year (%)</u>	
	<u>20x6</u>	<u>20x7</u>	<u>20x6</u>	<u>20x7</u>
	Net sales	450	560	100	124
Cost of goods sold	320	410	100	128
Gross profit	130	150	100	115
PBIT	85	98	100	115
Interest	12	17	100	142
PBT	73	81	100	111
Tax	22	38	100	173
PAT	51	43	100	84

CHAPTER 5

- The profit and loss account of Sasi Industires Limited for years 1 and 2 is given below:
Using the percent of sales method, prepare the *pro forma* profit and loss account for year 3. Assume that the sales will be 3500 in year 3. If dividends are raised to 40, what amount of retained earnings can be expected for year 3?

	<u>Year</u>	
	<u>1</u>	<u>2</u>
Net sales	2300	2700
Cost of goods sold	1760	2000
Gross profit	540	700
Selling expenses	150	180
General and administration expenses	120	124
Depreciation	94	84
Operating profit	176	312
Non-operating surplus deficit	12	10

Earnings before interest and tax	188	322
Interest	30	38
Earnings before tax	158	284
Tax	56	96
Earnings after tax	102	188
Dividends	35	35
Retained earnings	67	153

Solution:

	<i>Year</i>		Average percent of sales	Proforma Profit & Loss account for year 3 assuming sales of 3500
	1	2		
Net sales	2300	2700	100	3500
Cost of goods sold	1760	2000	75.30	2635.43
Gross profit	540	700	24.70	864.57
Selling expenses	150	180	6.59	230.80
General and administration expenses	120	124	4.90	171.67
Depreciation	94	84	3.60	125.97
Operating profit	176	312	9.60	336.14
Non-operating surplus deficit	12	10	0.45	15.61
Earnings before interest and tax	188	322	10.05	351.75
Interest	30	38	1.36	47.46
Earnings before tax	158	284	8.69	304.29
Tax	56	96	3.00	104.83
Earnings after tax	102	188	5.70	199.46
Dividends(given)	35	35		40
Retained earnings	67	153		159.46

2. The profit and loss account of KG Electronics Limited for years 1 and 2 is given below:

Using the percent of sales method, prepare the *pro forma* profit and loss account for year 3. Assume that the sales will be 26,000 in year 3. If dividends are raised to 500, what amount of retained earnings can be expected for year 3 .

	<i>Year</i>	
	<u>1</u>	<u>2</u>
Net sales	18,230	22,460
Cost of goods sold	13,210	16100
Gross profit	5020	6360
Selling expenses	820	890
General and administration expenses	1200	1210
Depreciation	382	364
Operating profit	2618	3896
Non-operating surplus deficit	132	82
Earnings before interest and tax	2750	3978
Interest	682	890
Earnings before tax	2068	3088
Tax	780	980
Earnings after tax	1288	2108
Dividends(given)	320	450
Retained earnings	968	1658

Solution:

	<i>Year</i>		Average percent of sales	Proforma Profit & Loss account for year 3 assuming sales of 26,000
	<u>1</u>	<u>2</u>		
Net sales	18,230	22,460	100	26000
Cost of goods sold	13,210	16100	72.07	18738.98
Gross profit	5020	6360	27.93	7261.02
Selling expenses	820	890	4.23	1099.89
General and administration expenses	1200	1210	5.98	1556.09
Depreciation	382	364	1.86	483.09
Operating profit	2618	3896	15.85	4121.95

Non-operating surplus deficit	132	82	0.54	141.59
Earnings before interest and tax	2750	3978	16.40	4263.55
Interest	682	890	3.85	1001.48
Earnings before tax	2068	3088	12.55	3262.07
Tax	780	980	4.32	1123.46
Earnings after tax	1288	2108	8.23	2138.61
Dividends(given)	320	450		500
Retained earnings	968	1658		1638.61

3. Re-work problem 1 assuming the following budgeted amounts:

General and administration expenses	135
Selling expenses	200
Interest	42
Dividends	40

Solution:

	<i>Year</i>		Average percent of sales	Proforma Profit & Loss account for year 3 assuming sales of 3,500
	<u>1</u>	<u>2</u>		
Net sales	2300	2,700	100	3500
Cost of goods sold	1760	2000	75.30	2635.43
Gross profit	540	700	24.70	864.57
Selling expenses	150	180	Budgeted	200.00
General and administration expenses	120	124	Budgeted	135.00
Depreciation	94	84	3.60	125.97
Operating profit	176	312	9.60	336.14
Non-operating surplus deficit	12	10	0.45	15.61
Earnings before interest and tax	188	322	10.05	351.75
Interest	30	38	Budgeted	42.00
Earnings before tax	158	284	8.69	304.29
Tax	56	96	3.00	104.83
Earnings after tax	102	188	5.70	199.46
Dividends(given)	35	35	Budgeted	40
Retained earnings	67	153		159.46

4. Re-work problem 2 assuming the following budgeted amounts:

General and administration expenses	1620
Depreciation	520
Interest	120
Dividends	560

Solution:

	<i>Year</i>		Average percent of sales	Proforma Profit & Loss account for year 3 assuming sales of 26,000
	<u>1</u>	<u>2</u>		
Net sales	18,230	22,460	100	26000
Cost of goods sold	13,210	16100	72.07	18738.98
Gross profit	5020	6360	27.93	7261.02
Selling expenses	820	890	4.23	1099.89
General and administration expenses	1200	1210	Budgeted	1620.00
Depreciation	382	364	Budgeted	520.00
Operating profit	2618	3896	15.85	4121.95
Non-operating surplus deficit	132	82	0.54	141.59
Earnings before interest and tax	2750	3978	16.40	4263.55
Interest	682	890	Budgeted	120.00
Earnings before tax	2068	3088	12.55	3262.07
Tax	780	980	4.32	1123.46
Earnings after tax	1288	2108	8.23	2138.61
Dividends(given)	320	450	Budgeted	560
Retained earnings	968	1658		1578.61

5. The profit and loss account and balance sheet for the years 2006 and 2007 of Radiant Corporation are as under. For the year 2008 , the following are the budgeted figures.

Sales	3000
General and Administration expenses	150
Depreciation	100
Non operating surplus	80
Dividend	50

Investments	110
Pre-paid expenses	80
Unsecured bank borrowings	100

There will be no change in the levels of share capital, secured bank borrowings and miscellaneous expenditure and losses. All other figures both in the proforma profit and loss account as well as balance sheet, will change in proportion to the average its proportion to sales of that year for the past two years. It is also assumed that any extra funds needed to achieve the desired financial position for 2008 will be raised by way of debentures. Prepare the proforma financial statements for the year 2008 using the excel model given in the text.

	<i>Year</i>	
	<u>2006</u>	<u>2007</u>
Net sales	2300	2,700
Cost of goods sold	1760	2000
Gross profit	540	700
Selling expenses	150	180
General and administration expenses	120	124
Depreciation	94	84
Operating profit	176	312
Non-operating surplus deficit	12	10
Earnings before interest and tax	188	322
Interest	30	38
Earnings before tax	158	284
Tax	56	96
Earnings after tax	102	188
Dividends(given)	35	35
Retained earnings	67	153

	<i>Year</i>	
	2006	2007
Balance Sheets		
Fixed assets (net	1460	1520
Investments	75	90
Current assets, loans and advances		
· Cash and bank	61	58
· Receivables	438	510
· Inventories	620	710
· Pre-paid expenses	78	84

Miscellaneous expenditures & losses	38	42
Total	2770	3014
<i>Liabilities</i>		
Share capital		
Equity	540	540
Preference	80	80
Reserves and surplus	460	527
Secured loans		
Debentures	690	642
Bank borrowings	580	625
Unsecured loans		
Bank borrowings	120	200
Current liabilities and provision		
Trade creditors	200	320
Provisions	100	80
Total	2770	3014

Solution:

	Year		Average percent of sales	Projected	Before iteration	After iteration
	2006	2007			Proforma profit and loss account for 2008	Proforma profit and loss account for 2008
Net sales	2300	2,700	100.0	Budgeted	3000.0	3000.0
Cost of goods sold	1760	2000	75.2		2256.0	2256.0
Gross profit	540	700	24.8		744.0	744.0
Selling expenses	150	180	6.6		198.0	198.0
General and administration expenses	120	124		Budgeted	150.0	150.0
Depreciation	94	84		Budgeted	100.0	100.0
Operating profit	176	312		@	296.0	296.0
Non-operating surplus deficit	50	70		Budgeted	80.0	80.0
Earnings before interest and tax	226	382		@	376.0	376.0
Interest on bank borrowings	77	82.5	3.2		95.7	95.7
Interest on debentures	30	27.5			27.5	80.6
Earnings before tax	119	272		@	252.8	199.7
Tax	56	96	3.0		91.2	91.2

Earnings after tax	119	272		@	252.8	199.7
Dividends(given)	35	35		Budgeted	50.0	50.0
Retained earnings	28	141		@	111.6	58.5
Balance Sheets	2006	2007	0.1			
Fixed assets (net	1460	1520	59.6		1788.0	1788.0
Investments	75	90		Budgeted	110.0	110.0
Current assets, loans and advances						
· Cash and bank	61	58	2.4		71.4	71.4
· Receivables	438	612	21.0		630.0	630.0
· Inventories	620	710	26.6		798.0	798.0
· Pre-paid expenses	78	84		Budgeted	80.0	80.0
Miscellaneous expenditures & losses	38	42		No change	42.0	42.0
Total	2770	3116			3519.4	3519.4
<i>Liabilities</i>						
Share capital						
Equity	540	540		No change	540.0	540.0
Preference	80	80		No change	80.0	80.0
Reserves and surplus	910	1051		@	1162.6	1109.5
Secured loans						
Debentures	240	220			591.8	644.9
Bank borrowings	580	625		No change	625.0	625.0
Unsecured loans						
Bank borrowings	120	200		Budgeted	100.0	100.0
Current liabilities and provisions						
Trade creditors	200	320	10.4		312.0	312.0
Provisions	100	80	3.6		108.0	108.0
Total	2770	3116			3519.4	3519.4

6. The following information is available for ABC Limited : $A/S = 0.6$, $S = \text{Rs.}300$ million, $L/S = 0.30$, $m = 0.08$, $S_1 = \text{Rs.}350$ million, and $d = 0.5$. What is the external funds requirement for the forthcoming year?

Solution:

<p>The external funds requirement of Olympus is:</p> $EFR = A*/S_0 (\Delta S) - L*/S (\Delta S) - mS_1 (r)$ $= 0.6 \times 50 - 0.3 \times 50 - .08 \times 350 \times 0.5$ $= \text{Rs.}1 \text{ million}$

7. The following information is available for XYZ Limited : $A/S = 0.5$, $S = \text{Rs.}35$ million, $L/S = 0.20$, $m = 0.04$, $S_1 = \text{Rs.}55$ million, and $d = 0.6$. What is the external funds requirement for the forthcoming year?

Solution:

The external funds requirement of Olympus is:

$$\begin{aligned} EFR &= A^*/S_0 (\Delta S) - L^*/S (\Delta S) - mS_1 (r) \\ &= 0.5 \times 20 - 0.2 \times 20 - .04 \times 55 \times 0.4 \\ &= \text{Rs.}5.12 \text{ million} \end{aligned}$$

8. The balance sheet of Vasundhara Corporation as at March 31, 2007 is shown below:

Share capital	500	Fixed assets	750
Retained Earnings	120	Inventories	400
Term Loans	360	Receivables	330
Short-term Bank Borrowings	300	Cash	90
Accounts Payable	210		
Provisions	80		
	<u>1570</u>		<u>1570</u>

The sales of the firm for the year ending on March 31, 2007 were 2,800. Its profit margin on sales was 8 percent and its dividend payout ratio was 30 percent. The tax rate was 40 percent. Vasundhara Corporation expects its sales to increase by 40 percent in the year ending March 31, 2008. The ratio of assets to sales and spontaneous current liabilities to sales would remain unchanged. Likewise the profit margin ratio, the tax rate, and the dividend payout ratio would remain unchanged.

- Required:
- Estimate the external funds requirement for the year 2008.
 - Prepare the following statements, assuming that the external funds requirement would be raised equally from term loans and short-term bank borrowings: (i) projected balance sheet and (ii) projected profit and loss account.

Solution:

a

$$\begin{aligned}
 EFR &= \left[\frac{A}{S} - \frac{L}{S} \right] \Delta S - m S_1 (1-d) \\
 &= \left[\frac{1570}{2800} - \frac{290}{2800} \right] 1120 - 0.08 \times 3920 (1-0.3) \\
 &= \text{Rs.}292
 \end{aligned}$$

b. (i)

Projected Income Statement for Year Ending 31st March , 2008

Sales	3,920
Profits before tax	523
Taxes	209
Profit after tax (8% on sales)	314
Dividends	94
Retained earnings	220

(ii)

Projected Balance Sheet as at 31.12 2001

<i>Liabilities</i>		<i>Assets</i>	
Share capital	500	Fixed assets	1050
Retained earnings	340	Inventories	560
Term loans (360+146)	506	Receivables	462
Short-term bank borrowings (300 + 146)	446	Cash	126
Accounts payable	294		
Provisions	112		
	2198		2198

9. The balance sheet of MGM Limited as at March 31, 2007 is shown below:

Share capital	4,200	Fixed assets	8,870
Retained Earnings	2,480	Inventories	3,480
Term Loans	3,920	Receivables	2,580
Short-term Bank Borrowings	2,490	Cash	180
Accounts Payable	1,240		
Provisions	780		
	<u>15,110</u>		<u>15,110</u>

The sales of the firm for the year ending on March 31, 2007 were 31,410. Its profit margin on sales was 7 percent and its dividend payout ratio was 50 percent. The tax rate was 34 percent. MGM Limited expects its sales to increase by 30 percent (i.e. by 9,423) in the year 20X8. The ratio of assets to sales and spontaneous current liabilities to sales would remain unchanged. Likewise the profit margin ratio, the tax rate, and the dividend payout ratio would remain unchanged.

Required: a. Estimate the external funds requirement for the year 2008.

b. Prepare the following statements, assuming that the external funds requirement would be raised from term loans and short-term bank borrowings in the ratio 1:2 (i) projected balance sheet and (ii) projected profit and loss account.

Solution:

a.

$$\begin{aligned}
 EFR &= \left[\begin{array}{cc} A & L \\ \text{---} & \text{---} \\ S & S \end{array} \right] \Delta S - m S_1 (1-d) \\
 &= \left[\begin{array}{cc} \frac{15,110}{31,410} & - \frac{2020}{31,410} \end{array} \right] 9,423 - 0.07 \times 40,833 (1-0.5) \\
 &= 2498
 \end{aligned}$$

b.(i)

Projected Income Statement for Year Ending 31st March , 2008

Sales	40,833
Profits before tax	4,330
Taxes	1,472
Profit after tax (7% on sales)	2,858
Dividends	1,429
Retained earnings	1,429

(ii)

Projected Balance Sheet as at 31.3 2008

<i>Liabilities</i>		<i>Assets</i>	
Share capital	4,200	Fixed assets	11,531
Retained earnings	3,909	Inventories	4,524
Term loans (3920+2498x1/3)	4,753	Receivables	3,354
Short-term bank borrowings (2490 + 2498x2/3)	4,155	Cash	234
Accounts payable	1,612		
Provisions	1,014		
	<u>19,643</u>		<u>19,643</u>

10. The balance sheet of Ganesh Associates as at March 31, 20x7 is shown below:

Share capital	6,258	Fixed assets	15,721
Retained Earnings	6,780	Inventories	5,984
Term Loans	5,320	Receivables	3,586
Short-term Bank Borrowings	4,378	Cash	254
Accounts Payable	1,873		
Provisions	936		
	<u>25,545</u>		<u>25,545</u>

The sales of the firm for the year ending on March 31, 20x7 were 58,436. Its profit margin on sales was 10 percent and its dividend payout ratio was 45 percent. The tax rate was 33 percent. Ganesh Associates expects its sales to increase by 50 percent in the year 20X8. The ratio of assets to sales and spontaneous current liabilities to sales would remain unchanged. Likewise the profit margin ratio, the tax rate, and the dividend payout ratio would remain unchanged.

Required: a. Estimate the external funds requirement for the year 20x8.

b. Prepare the following statements, assuming that the external funds requirement would be raised entirely from short-term bank borrowings :
(i) projected balance sheet and (ii) projected profit and loss account.

Solution:

$$EFR = \left[\begin{array}{cc} A & L \\ \text{-----} & \text{-----} \\ S & S \end{array} \right] \Delta S - m S_I (1-d)$$

$$= \left[\begin{array}{cc} \frac{25,545}{58,436} & - \frac{2,809}{58,436} \end{array} \right] 29,218 - 0.10 \times 87,654 (1-0.45)$$

$$= \text{Rs.6,547}$$

Projected Income Statement for Year Ending 31st March , 2008

Sales	87,654
Profits before tax	13,082
Taxes	4,317
Profit after tax (10% on sales)	8,765
Dividends	3,944
Retained earnings	4,821

Projected Balance Sheet as at 31.3 2008

<i>Liabilities</i>		<i>Assets</i>	
Share capital	6,258	Fixed assets	23,581
Retained earnings	11,601	Inventories	8,976
Term loans	5,320	Receivables	5,379
Short-term bank borrowings (4378 + 6547)	10,925	Cash	381
Accounts payable	2,809		
Provisions	1,404		
	<u>38,317</u>		<u>38,317</u>

11. The following information is given for ABC Company:

Assets to sales ratio	= 0.80
Spontaneous liabilities to sales ratio	= 0.40
Profit margin	= 8 per cent
Dividend payout ratio	= 0.5
Previous year's sales	= 24,000

What is the maximum sales growth rate that can be financed without raising external funds?

Solution:

$$\frac{EFR}{\Delta S} = \left(\frac{A}{S} - \frac{L}{S} \right) - \frac{m(1+g)(1-d)}{g}$$

Given $A/S = 0.8$, $L/S = 0.4$, $m = 0.08$, $d = 0.5$ and $EFR = 0$ we have,

$$(0.8-0.4) - \frac{(0.08)(1+g)(0.5)}{g} = 0$$

$$0.04(1+g) = 0.4g$$

$$(0.4 - 0.04)g = 0.04 \text{ or } g = 0.04/0.36 = 0.1111 \text{ i.e. } 11.11\%$$

12. The following information is given for Rahul Associates.:

Assets to sales ratio	= 0.90
Spontaneous liabilities to sales ratio	= 0.50
Profit margin	= 11 per cent
Dividend payout ratio	= 0.7
Previous year's sales	= 45,360

What is the maximum sales growth rate that can be financed without raising external funds?

Solution:

$$\frac{EFR}{\Delta S} = \left(\frac{A}{S} - \frac{L}{S} \right) - \frac{m(1+g)(1-d)}{g}$$

Given $A/S = 0.9$, $L/S = 0.5$, $m = 0.11$, $d = 0.7$ and $EFR = 0$ we have,

$$(0.9-0.5) - \frac{(0.11)(1+g)(0.3)}{g} = 0$$

$$0.033(1+g) = 0.4g$$

$$(0.4 - 0.033)g = 0.033 \text{ or } g = 0.033/0.367 = 0.0899 \text{ i.e. } 8.99\%$$

13. The following information is given for Ahuja Enterprises.

Assets to sales ratio	= 0.50
Spontaneous liabilities to sales ratio	= 0.20
Profit margin	= 6 per cent
Dividend payout ratio	= 0.1
Previous year's sales	= 12,000

What is the maximum sales growth rate that can be financed without raising external funds?

Solution:

$$\frac{EFR}{\Delta S} = \left(\frac{A}{S} - \frac{L}{S} \right) - \frac{m(1+g)(1-d)}{g}$$

Given $A/S = 0.5$, $L/S = 0.2$, $m = 0.06$, $d = 0.1$ and $EFR = 0$ we have,

$$(0.5 - 0.2) - \frac{(0.06)(1+g)(0.9)}{g} = 0$$

$$0.054(1+g) = 0.3g$$

$$(0.3 - 0.054)g = 0.054 \text{ or } g = 0.054/0.246 = 0.2195 \text{ i.e. } 21.95\%$$

14. The balance sheet of Arvind Company at the end of year 20 x 7, which is just over, is given below:

Share capital	200	Fixed assets	280
Retained earnings	120	Inventories	230
Long-term borrowings	210	Receivables	210
Short-term borrowings	150	Cash	60
Trade creditors	70		
Provisions	30		
	<u>780</u>		<u>780</u>

The sales for the year just ended were 1480. The expected sales for the year 20x8 are 1702. The profit margin is 8 percent and the dividend payout ratio is 30 percent.

Required:

- Determine the external funds requirement for Arvind for the year 20x8.
- How should the company raise its external funds requirement, if the following restrictions apply? (i) Current ratio should not be less than 1.3. (ii) The ratio of fixed assets to long-term loans should be greater than 1.3. Assume that the company wants to tap external funds in the following order: short-term bank borrowing, long-term loans, and additional equity issue.

Solution:

$$(a) \quad EFR = \frac{A}{S} - \frac{L}{S} - \Delta S - mS_1(1-d)$$

$$= \left[\frac{780}{1480} - \frac{100}{1480} \right] \times 222 - (0.08) (1702) (0.3)$$

$$= 61$$

- (b) Let CA = denote Current assets
 CL = Current liabilities
 SCL = Spontaneous current liabilities
 STL = Short-term bank borrowings
 FA = Fixed assets
and LTL = Long-term loans

i. Current ratio ≥ 1.3

i.e $\frac{CA}{CL}$ greater than or equal to 1.3 or

$$\frac{CA}{STL + SCL} \geq 1.3$$

As at the end of 20X8, $CA = 500 \times 1.15 = 575$
 $SCL = 100 \times 1.15 = 115$
Substituting these values, we get
 $1.3 (STL + 115) \leq 575$
or $1.3 STL \leq 575 - (115 \times 1.3) \leq 425.5$

$$\text{or } STL \leq \frac{425.5}{1.3}$$

i.e $STL = 327.3$

ii. Ratio of fixed assets to long term loans ≥ 1.3

$$\frac{FA}{LTL} \geq 1.3$$

At the end of 20X8, $FA = 280 \times 1.15 = 322$

$$\therefore LTL \leq \frac{322}{1.3} \text{ or } LTL = 247.7$$

If ΔSTL and ΔLTL denote the maximum increase in ST borrowings & LT

borrowings, we have :

$$\Delta STL = STL (20X8) - STL (20X7) = 327.3 - 150 = 177.3$$

$$\Delta LTL = LTL (20X8) - LTL (20X7) = 247.7 - 210 = 37.7$$

Hence, the suggested mix for raising external funds will be :

Short-term borrowings	61
Long-term loans	-----
Additional equity issue	--
	61

15. The balance sheet of Kamath Enterprises at the end of year 20 x 7, which is just over, is given below:

Share capital	35,000	Fixed assets	37,880
Retained earnings	1,160	Inventories	25,420
Long-term borrowings	28,360	Receivables	18,540
Short-term borrowings	16,520	Cash	560
Trade creditors	380		
Provisions	980		
	82,400		82,400

The sales for the year just ended were 162,800. The expected sales for the year 20x8 are 227,920. The profit margin is 10 percent and the dividend payout ratio is 40 percent.

Required:

- a Determine the external funds requirement for Kamath Enterprises for the year 20x8.
- b How should the company raise its external funds requirement, if the following restrictions apply? (i) Current ratio should remain unchanged. (ii) The ratio of fixed assets to long-term loans should be greater than 1.5. Assume that the company wants to tap external funds in the following order: short-term bank borrowing, long-term loans, and additional equity issue.

Solution:

$$\begin{aligned}
 \text{(a) } EFR &= \frac{A}{S} - \frac{L}{S} \Delta S - mS_1(1-d) \\
 &= \left[\frac{82,400}{162,800} - \frac{1,360}{162,800} \right] \times 65,120 - (0.10)(227,920)(0.4) \\
 &= 23,299
 \end{aligned}$$

b

(i) The current ratio will remain unchanged when the assets and liabilities rise in the same proportion. The Short term borrowing as on March 31, 2008 should therefore be
 $= 16,520 \times 1.4 = 23,128$

(ii)

Let

FA = Fixed assets

STL = Short-term loans

and LTL = Long-term loans

Ratio of fixed assets to long term loans ≥ 1.5

$$\frac{FA}{LTL} \geq 1.5$$

At the end of 20X8, $FA = 37,880 \times 1.4 = 53,032$

$$\therefore LTL \leq \frac{53,032}{1.5} \text{ or } LTL = 35,355$$

If ΔSTL and ΔLTL denote the maximum increase in ST borrowings & LT

borrowings, we have :

$$\Delta STL = STL (20x8) - STL (20X7) = 23,128 - 16,520 = 6,608$$

$$\Delta LTL = LTL (20X8) - LTL (20X7) = 35,355 - 28,360 = 6,995$$

Hence, the suggested mix for raising external funds will be:

Short-term borrowings	6,608
Long-term loans	6,995
Additional equity issue	9,696
	<hr/>
	23,299

16. The following information is available about Headstrong Limited:

Sales of this year	= 48,240
Projected sales increase for next year	= 25 percent
Profit after tax this year	= 4,824
Dividend payout ratio	= 40 percent
Projected surplus funds available next year	= 2,000
Present level of spontaneous current liabilities	= 12,380
What is the level of total assets for Headstrong now?	

Solution:

$$EFR = \left[\frac{A}{S} - \frac{L}{S} \right] \Delta S - m S_1 (1-d)$$

Therefore, $mS_1(1-d) - \left[\frac{A}{S} - \frac{L}{S} \right] \Delta S$ represents surplus funds

Given $m= 0.10$, $S_1 = 60,300$, $d= 0.4$, $L= 12,380$ $S= 48,240$ and surplus funds = 2,000 we have

$$(0.10) \times 60,300 \times (1-0.4) - \left[\frac{A}{48,240} - \frac{12,380}{48,240} \right] \times 12,060 = 2,000$$

$$\frac{A - 12,380}{4} = 3618 - 2000 = 1618$$

$$\text{or } A = 4 \times 1618 + 12,380 = 18,852$$

\therefore The total assets of Headstrong must be 18,852

17. The following information is available about Meridian Corporation:

Sales of this year	= 100,780
Projected sales increase for next year	= 30 percent
Profit after tax this year	= 15,117
Dividend payout ratio	= 50 percent
Projected surplus funds available next year	= 7,000
Present level of spontaneous current liabilities	= 14,300
What is the level of total assets for Meridian now?	

Solution:

$$EFR = \left[\frac{A}{S} - \frac{L}{S} \right] \Delta S - m S_1 (1-d)$$

Therefore, $mS_1(1-d) - \left[\frac{A}{S} - \frac{L}{S} \right] \Delta S$ represents surplus funds

Given $m= 0.15$, $S_1 = 131,014$, $d= 0.5$, $L= 14,300$, $S= 100,780$ and surplus funds = 7,000 we have

$$(0.15) \times 131,014 \times (1-0.5) - \left[\frac{A}{100,780} - \frac{14,300}{100,780} \right] \times 30,234 = 7,000$$

$$\frac{(A - 14,300) \times 30,234}{100,780} = 9826 - 7000 = 2,826$$

$$\text{or } A = 2,826 \times 100,780 / 30,234 + 14,300 = 23,720$$

\therefore The total assets of Meridian must be 23,720

18. Maharaja Limited has the following financial ratios:

Net profit margin ratio = 8 percent

Target dividend payout ratio = 40 percent

Assets-to-equity ratio = 3.0

Assets-to-sales ratio = 1.8

- What is the rate of growth that can be sustained with internal equity?
- If Maharaja Limited wants to achieve a 8 percent growth rate with internal equity, what change must be made in the dividend payout ratio, other ratios remaining unchanged?
- If Maharaja Limited wants to achieve a 8 percent growth rate with internal equity, what change must be made in the assets-to-equity ratio, other ratios remaining unchanged?
- If Maharaja Limited wants to achieve a 7 percent growth rate with internal equity, what should be the improvement in the profit margin, other ratios remaining unchanged?
- If Maharaja Limited wants to achieve a 7 percent growth rate with internal equity, what change must occur in the assets-to-sales ratio, other ratios remaining unchanged?

Solution:

$m = .08, d = 0.4, A/E = 3.0, A/S = 1.8$

(a)
$$g = \frac{m(1-d)A/E}{A/S - m(1-d)A/E} = \frac{.08(1-0.4)3.0}{1.8 - .08(1-0.4)3.0} = 8.7 \text{ per cent}$$

(b)
$$0.08 = \frac{.08(1-d) \times 3.0}{1.8 - .08(1-d)3.0}$$

$0.144 - 0.0192 + 0.0192d = 0.24 - 0.24d$
 $d(0.24 + 0.0192) = 0.24 + 0.0192 - 0.144 = 0.1152$
 $d = 0.4444 \text{ or } 44.44 \%$

The dividend payout ratio must be raised by 4.4 percent.

(c)
$$0.08 = \frac{0.08(1-0.4) \times A/E}{1.8 - .08(1-0.4)A/E}$$

$0.144 - 0.00384A/E = 0.048A/E, A/E = 0.144/0.05184 = 2.78$
 Assets to equity ratio should be reduced by 0.22

(d)
$$.07 = \frac{m(1-0.4)3}{1.8 - m(1-0.4) \times 3}$$

$$0.126 - 0.126m = 1.8m, \quad m = 0.126/1.926 = 6.54\%$$

The net profit margin must be reduced from 8 per cent to 6.54 per cent

$$(e) \quad .07 = \frac{.08(1-0.4)3}{A/S - .08(1-0.4)3}$$

$$0.07 A/S - 0.01 = 0.144, \quad A/S = 0.154/0.07 = 2.2$$

The asset to sales ratio must increase from 1.8 to 2.2

19. Majestic Corporation has the following financial ratios:

Net profit margin ratio	=	7 percent
Target dividend payout ratio	=	35 percent
Assets-to-equity ratio	=	1.8
Assets-to-sales ratio	=	1.0

- What is the rate of growth that can be sustained with internal equity?
- If Majestic Corporation wants to achieve a 10 percent growth rate with internal equity, what change must be made in the dividend payout ratio, other ratios remaining unchanged?
- If Majestic Corporation wants to achieve a 11 percent growth rate with internal equity, what change must be made in the assets-to-equity ratio, other ratios remaining unchanged?
- If Majestic Corporation wants to achieve a 12 percent growth rate with internal equity, what should be the improvement in the profit margin, other ratios remaining unchanged?
- If Majestic Corporation wants to achieve a 6 percent growth rate with internal equity, what change must occur in the assets-to-sales ratio, other ratios remaining unchanged?

Solution:

$$m = .07, \quad d = 0.35, \quad A/E = 1.8, \quad A/S = 1.0$$

$$(a) \quad g = \frac{m(1-d)A/E}{A/S - m(1-d)A/E} = \frac{.07(1-0.35)1.8}{1.0 - .07(1-0.35)1.8} = 8.9 \text{ per cent}$$

$$(b) \quad g = \frac{.07(1-d)1.8}{1.0 - .07(1-d)1.8} = 0.10$$

$$0.10 - 0.0126 + 0.0126d = 1.26 - 1.26d$$

$$d = (1.26 + 0.0126 - 0.10)/(1.26 + 0.0126) = 0.921 \text{ or } 92.1\%$$

The dividend payout ratio must be raised from 35 % to 92.1%.

(c)

$$\frac{.07 (1-0.0.35) A/E}{1.0 -.07 (1-0.35) A/E} = 0.11$$

$$0.11 - 0.005005 A/E = 0.0455 A/E$$

$$A/E = 0.11/(0.0455+0.005005) = 2.2$$

Assets to equity ratio should be raised from 1.8 to 2.2. .

(d)

$$0.12 = \frac{m (1-0.0.35) 1.8}{1.0 -m (1-0.35) 1.8}$$

$$0.12 - 0.1404 m = 1.17 m , m = 0.09 \text{ or } 9 \%$$

The net profit margin should be changed from 7 percent to 9 percent.

(e)

$$0.06 = \frac{.07 (1-0.0.35) 1.8}{A/S -.07 (1-0.35) 1.8}$$

$$0.06 A/S - 0.0049 = 0.0819, A/S = 1.38$$

The assets to sales ratio should be raised from 1.0 to 1.38

CHAPTER 6

1. Calculate the value 10 years hence of a deposit of Rs.20,000 made today if the interest rate is (a) 4 percent, (b) 6 percent, (c) 8 percent, and (d) 9 percent.

Solution:

Value 10 years hence of a deposit of Rs.20,000 at various interest rates is as follows:

r	=	4 %	FV_5	=	20,000 x FVIF (4%, 10 years)
				=	20,000 x 1.480 = Rs.29,600
r	=	6 %	FV_5	=	20,000 x FVIF (6 %, 10 years)
				=	20,000 x 1.791 =Rs.35,820
r	=	8 %	FV_5	=	20,000 x FVIF (8 %, 10 years)
				=	20,000 x 2.159 =Rs.43,180
r	=	9 %	FV_5	=	20,000 x FVIF (9 %, 10 years)
				=	20,000 x 2.367 =Rs. 47,340

2. Calculate the value 3 years hence of a deposit of Rs.5,800 made today if the interest rate is (a) 12 percent, (b)14 percent, (c) 15 percent, and (d) 16 percent.

Solution:

Value 3 years hence of a deposit of Rs. 5,800 at various interest rates is as follows:

$$\begin{array}{l} r = 12 \% \quad FV_5 = 5,800 \times \text{FVIF} (12\%, 3 \text{ years}) \\ \quad \quad \quad \quad \quad \quad = 5,800 \times 1.405 = \text{Rs.}8,149 \end{array}$$

$$\begin{array}{l} r = 14 \% \quad FV_5 = 5,800 \times \text{FVIF} (14\%, 3 \text{ years}) \\ \quad \quad \quad \quad \quad \quad = 5,800 \times 1.482 = \text{Rs.}8,596 \end{array}$$

$$\begin{array}{l} r = 15 \% \quad FV_5 = 5,800 \times \text{FVIF} (15\%, 3 \text{ years}) \\ \quad \quad \quad \quad \quad \quad = 5,800 \times 1.521 = \text{Rs.}8,822 \end{array}$$

$$\begin{array}{l} r = 16 \% \quad FV_5 = 5,800 \times \text{FVIF} (16\%, 3 \text{ years}) \\ \quad \quad \quad \quad \quad \quad = 5,800 \times 1.561 = \text{Rs.} 9,054 \end{array}$$

3. If you deposit Rs.2,000 today at 6 percent rate of interest in how many years (roughly) will this amount grow to Rs.32,000 ? Work this problem using the *rule of 72*—do not use tables.

Solution:

$$\text{Rs.}32,000 / \text{Rs.} 2,000 = 16 = 2^4$$

According to the Rule of 72 at 6 percent interest rate doubling takes place approximately in $72 / 6 = 12$ years

So Rs.2,000 will grow to Rs.32,000 in approximately 4×12 years = 48 years

4. If you deposit Rs.3,000 today at 8 percent rate of interest in how many years (roughly) will this amount grow to Rs.1,92,000 ? Work this problem using the *rule of 72*—do not use tables.

Solution:

$$\text{Rs.}192,000 / \text{Rs.} 3,000 = 64 = 2^6$$

According to the Rule of 72 at 8 percent interest rate doubling takes place approximately in $72 / 8 = 9$ years

So Rs.3000 will grow to Rs.192,000 in approximately 6×9 years = 54 years

5. A finance company offers to give Rs.20,000 after 14 years in return for Rs.5,000 deposited today. Using the *rule of 69*, figure out the approximate interest rate offered.

Solution:

In 14 years Rs.5,000 grows to Rs.20,000 or 4 times. This is 2^2 times the initial deposit. Hence doubling takes place in $14 / 2 = 7$ years.

According to the Rule of 69, the doubling period is $0.35 + 69 / \text{Interest rate}$
We therefore have

$$0.35 + 69 / \text{Interest rate} = 7$$
$$\text{Interest rate} = 69 / (7 - 0.35) = 10.38 \%$$

6. Someone offers to give Rs.80,000 to you after 18 years in return for Rs.10,000 deposited today. Using the *rule of 69*, figure out the approximate interest rate offered.

Solution:

In 18 years Rs.10,000 grows to Rs.80,000 or 8 times. This is 2^3 times the initial deposit. Hence doubling takes place in $18 / 3 = 6$ years.

According to the Rule of 69, the doubling period is $0.35 + 69 / \text{Interest rate}$. We therefore have

$$0.35 + 69 / \text{Interest rate} = 6$$
$$\text{Interest rate} = 69 / (6 - 0.35) = 12.21 \%$$

7. You can save Rs.5,000 a year for 3 years, and Rs.7,000 a year for 7 years thereafter. What will these savings cumulate to at the end of 10 years, if the rate of interest is 8 percent?

Solution:

Saving Rs.5000 a year for 3 years and Rs.6000 a year for 7 years thereafter is equivalent to saving Rs.5000 a year for 10 years and Rs.2000 a year for the years 4 through 10.

Hence the savings will cumulate to:

$$5000 \times \text{FVIFA} (8\%, 10 \text{ years}) + 2000 \times \text{FVIFA} (8\%, 7 \text{ years})$$
$$= 5000 \times 14.487 + 2000 \times 8.923 = \text{Rs.90281}$$

8. Krishna saves Rs.24,000 a year for 5 years, and Rs.30,000 a year for 15 years thereafter. If the rate of interest is 9 percent compounded annually, what will be the value of his savings at the end of 20 years?

Solution:

Saving Rs.24,000 a year for 5 years and Rs.30,000 a year for 15 years thereafter is equivalent to saving Rs.24,000 a year for 20 years and Rs.6,000 a year for the years 6 through 20.

Hence the savings will cumulate to:
 $24,000 \times \text{FVIFA}(9\%, 20 \text{ years}) + 6,000 \times \text{FVIFA}(9\%, 15 \text{ years})$
 $= 24,000 \times 51.160 + 6,000 \times 29.361 = \text{Rs. } 1,404,006$

9. You plan to go abroad for higher studies after working for the next five years and understand that an amount of Rs.2,000,000 will be needed for this purpose at that time. You have decided to accumulate this amount by investing a fixed amount at the end of each year in a safe scheme offering a rate of interest at 10 percent. What amount should you invest every year to achieve the target amount?

Solution:

Let A be the annual savings.

$$\begin{aligned} A \times \text{FVIFA}(10\%, 5 \text{ years}) &= 2,000,000 \\ A \times 6.105 &= 2,000,000 \end{aligned}$$

$$\text{So, } A = 2,000,000 / 6.105 = \text{Rs. } 327,600$$

10. How much should Vijay save each year, if he wishes to purchase a flat expected to cost Rs.80 lacs after 8 years, if the investment option available to him offers a rate of interest at 9 percent? Assume that the investment is to be made in equal amounts at the end of each year.

Solution:

Let A be the annual savings.

$$\begin{aligned} A \times \text{FVIFA}(9\%, 8 \text{ years}) &= 80,00,000 \\ A \times 11.028 &= 80,00,000 \end{aligned}$$

$$\text{So, } A = 80,00,000 / 11.028 = \text{Rs. } 7,25,426$$

11. A finance company advertises that it will pay a lump sum of Rs.100,000 at the end of 5 years to investors who deposit annually Rs.12,000. What interest rate is implicit in this offer?

Solution:

$12,000 \times \text{FVIFA}(r, 5 \text{ years}) = 100,000$	
$\text{FVIFA}(r, 5 \text{ years}) = 100,000 / 12,000 = 8.333$	
From the tables we find that	
$\text{FVIFA}(24\%, 5 \text{ years}) = 8.048$	
$\text{FVIFA}(28\%, 5 \text{ years}) = 8.700$	
Using linear interpolation in the interval, we get:	
$r = 24\% + \frac{(8.333 - 8.048)}{(8.700 - 8.048)} \times 4\% = 25.75\%$	

12. Someone promises to give you Rs.5,000,000 after 6 years in exchange for Rs.2,000,000 today. What interest rate is implicit in this offer?

Solution:

$2,000,000 \times \text{FVIF}(r, 6 \text{ years}) = 5,000,000$
$\text{FVIF}(r, 6 \text{ years}) = 5,000,000 / 2,000,000 = 2.5$
From the tables we find that
$\text{FVIF}(16\%, 6 \text{ years}) = 2.436$
$\text{FVIF}(17\%, 6 \text{ years}) = 2.565$
Using linear interpolation in the interval, we get:
$r = 16\% + \frac{(2.5 - 2.436) \times 1\%}{(2.565 - 2.436)} = 16.5\%$

13. At the time of his retirement, Rahul is given a choice between two alternatives: (a) an annual pension of Rs120,000 as long as he lives, and (b) a lump sum amount of Rs.1,000,000. If Rahul expects to live for 20 years and the interest rate is expected to be 10 percent throughout, which option appears more attractive

Solution:

The present value of an annual pension of Rs.120,000 for 20 years when $r = 10\%$ is:
 $120,000 \times \text{PVIFA} (10\%, 20 \text{ years})$
 $= 120,000 \times 8.514 = \text{Rs.}1,021,680$

The alternative is to receive a lumpsum of Rs 1,000,000

Rahul will be better off with the annual pension amount of Rs.120,000.

14. A leading bank has chosen you as the winner of its quiz competition and asked you to choose from one of the following alternatives for the prize: (a) Rs. 60,000 in cash immediately or (b) an annual payment of Rs. 10,000 for the next 10 years. If the interest rate you can look forward to for a safe investment is 9 percent, which option would you choose?

Solution:

The present value of an annual payment of Rs.10,000 for 10 years when $r = 9\%$ is:
 $10,000 \times \text{PVIFA} (9\%, 10 \text{ years})$
 $= 10,000 \times 6.418 = \text{Rs.}64,180$

The annual payment option would be the better alternative

15. What is the present value of an income stream which provides Rs.30,000 at the end of year one, Rs.50,000 at the end of year three, and Rs.100,000 during each of the years 4 through 10, if the discount rate is 9 percent ?

Solution:

The present value of the income stream is:
 $30,000 \times \text{PVIF} (9\%, 1 \text{ year}) + 50,000 \times \text{PVIF} (9\%, 3 \text{ years})$
 $+ 100,000 \times \text{PVIFA} (9\%, 7 \text{ years}) \times \text{PVIF}(9\%, 3 \text{ years})$

$= 30,000 \times 0.917 + 50,000 \times 0.772 + 100,000 \times 5.033 \times 0.0.772 = \text{Rs.}454,658.$

16. What is the present value of an income stream which provides Rs.25,000 at the end of year one, Rs.30,000 at the end of years two and three, and Rs.40,000 during each of the years 4 through 8 if the discount rate is 15 percent ?

Solution:

The present value of the income stream is:
 $25,000 \times \text{PVIF} (15\%, 1 \text{ year}) + 30,000 \times \text{PVIF} (15\%, 2 \text{ years})$

$$\begin{aligned}
&+ 30,000 \times \text{PVIF} (15\%, 3 \text{ years}) \\
&+ 40,000 \times \text{PVIFA} (15\%, 5 \text{ years}) \times \text{PVIF} (15\%, 3 \text{ years}) \\
&= 25,000 \times 0.870 + 30,000 \times 0.756 + 30,000 \times 0.658 \\
&+ 40,000 \times 3.352 \times 0.658 = \text{Rs.}152,395.
\end{aligned}$$

17. What is the present value of an income stream which provides Rs.1,000 a year for the first three years and Rs.5,000 a year forever thereafter, if the discount rate is 12 percent?

Solution:

$$\begin{aligned}
&\text{The present value of the income stream is:} \\
&1,000 \times \text{PVIFA} (12\%, 3 \text{ years}) + (5,000/0.12) \times \text{PVIF} (12\%, 3 \text{ years}) \\
&= 1,000 \times 2.402 + (5000/0.12) \times 0.712 \\
&= \text{Rs.}32,069
\end{aligned}$$

18. What is the present value of an income stream which provides Rs.20,000 a year for the first 10 years and Rs.30,000 a year forever thereafter, if the discount rate is 14 percent ?

Solution:

$$\begin{aligned}
&\text{The present value of the income stream is:} \\
&20,000 \times \text{PVIFA} (14\%, 10 \text{ years}) + (30,000/0.14) \times \text{PVIF} (14\%, 10 \text{ years}) \\
&= 20,000 \times 5.216 + (30,000/0.14) \times 0.270 \\
&= \text{Rs.}162,177
\end{aligned}$$

19. Mr. Ganapathi will retire from service in five years .How much should he deposit now to earn an annual income of Rs.240,000 forever beginning from the end of 6 years from now ? The deposit earns 12 percent per year.

Solution:

$$\begin{aligned}
&\text{To earn an annual income of Rs.}240,000 \text{ forever , beginning from the end of 6 years} \\
&\text{from now, if the deposit earns 12\% per year a sum of} \\
&\quad \text{Rs.}240,000 / 0.12 = \text{Rs.}2,000,000 \\
&\text{is required at the end of 5 years. The amount that must be deposited to get this} \\
&\text{sum is:} \\
&\quad \text{Rs.}2,000,000 \text{ PVIF} (12\%, 5 \text{ years}) = \text{Rs.}2,000,000 \times 0.567 \\
&\quad \quad \quad = \text{Rs.} 1,134,000
\end{aligned}$$

20. Suppose someone offers you the following financial contract. If you deposit Rs.100,000 with him he promises to pay Rs.50,000 annually for 3 years. What interest rate would you earn on this deposit?

Solution:

Rs.100,000 =- Rs.50,000 x PVIFA (r, 3 years)
 PVIFA (r,3 years) = 2.00

From the tables we find that:
 PVIFA (20 %, 3 years) = 2.106
 PVIFA (24 %, 3 years) = 1.981

Using linear interpolation we get:

$$r = 20 \% + \left[\frac{2.106 - 2.00}{2.106 - 1.981} \right] \times 4\%$$

$$= 23.39 \%$$

21. If you invest Rs.600,000 with a company they offer to pay you Rs.100,000 annually for 10 years. What interest rate would you earn on this investment?

Solution:

Rs.600,000 =- Rs.100,000 x PVIFA (r, 10 years)
 PVIFA (r,10 years) = 6.00

From the tables we find that:
 PVIFA (10 %, 10 years) = 6.145
 PVIFA (11 %, 10 years) = 5.889

Using linear interpolation we get:

$$r = 10 \% + \left[\frac{6.145 - 6.00}{6.145 - 5.889} \right] \times 1\%$$

$$= 10.57 \%$$

- 22 What is the present value of the following cash flow streams?

End of year	Stream X	Stream Y	Stream Z
1	500	750	600
2	550	700	600
3	600	650	600
4	650	600	600
5	700	550	600
6	750	500	600

 The discount rate is 18 percent.

Solution:

$$\begin{aligned} \text{PV(Stream X)} &= 500 \text{ PV(18\%, 1yr)} + 550 \text{ PV(18\%, 2yrs)} + 600 \text{ PV(18\%, 3yrs)} + 650 \\ &\text{PV(18\%, 4yrs)} + 700 \text{ PV(18\%, 5yrs)} + 750 \text{ PV(18\%, 6yrs)} \\ &= 500 \times 0.847 + 550 \times 0.718 + 600 \times 0.609 + 650 \times 0.516 + 700 \times 0.437 + 750 \times 0.370 = \\ &2102.6 \end{aligned}$$

$$\begin{aligned} \text{PV(Stream X)} &= 750 \text{ PV(18\%, 1yr)} + 700 \text{ PV(18\%, 2yrs)} + 650 \text{ PV(18\%, 3yrs)} + 600 \\ &\text{PV(18\%, 4yrs)} + 550 \text{ PV(18\%, 5yrs)} + 500 \text{ PV(18\%, 6yrs)} \\ &= 750 \times 0.847 + 700 \times 0.718 + 650 \times 0.609 + 600 \times 0.516 + 550 \times 0.437 + 500 \times 0.370 \\ &= 2268.65 \end{aligned}$$

$$\text{PV (Stream X)} = 600 \text{ PVIFA (18\%, 6yrs)} = 600 \times 3.498 = 2098.8$$

23. Suppose you deposit Rs.200,000 with an investment company which pays 12 percent interest with compounding done once in every two months, how much will this deposit grow to in 10 years?

Solution:

$$\begin{aligned} \text{FV}_{10} &= \text{Rs.}200,000 [1 + (0.12 / 6)]^{10 \times 6} \\ &= \text{Rs.}200,000 (1.02)^{60} \\ &= \text{Rs.}200,000 \times 3.281 \\ &= \text{Rs.}656,200 \end{aligned}$$

24. A bank pays interest at 5 percent on US dollar deposits, compounded once in every six months. What will be the maturity value of a deposit of US dollars 15,000 for three years?

Solution:

$$\begin{aligned} \text{Maturity value} &= \text{USD } 15,000 [1 + (0.05 / 2)]^{3 \times 2} \\ &= 15,000 (1.025)^6 \\ &= 15,000 \times 1.1597 \\ &= 17,395.50 \end{aligned}$$

25. What is the difference between the effective rate of interest and stated rate of interest in the following cases:

Case A: Stated rate of interest is 8 percent and the frequency of compounding is six times a year.

Case B: Stated rate of interest is 10 percent and the frequency of compounding is four times a year.

Case C: Stated rate of interest is 12 percent and the frequency of compounding is twelve times a year.

Solution:

	<i>A</i>	<i>B</i>	<i>C</i>
Stated rate (%)	8	10	12
Frequency of compounding	6 times	4 times	12 times
Effective rate (%)	$(1 + 0.08/6)^6 - 1$ = 8.27	$(1+0.10/4)^4 - 1$ = 10.38	$(1 + 0.12/12)^{12} - 1$ = 12.68
Difference between the effective rate and stated rate (%)	0.27	0.38	0.68

26. You have a choice between Rs.200,000 now and Rs.600,000 after 8 years. Which would you choose? What does your preference indicate?

Solution:

<p>The interest rate implicit in the offer of Rs.600,000 after 8 years in lieu of Rs.200,000 now is: Rs.200,000 x FVIF (<i>r</i>, 8 years) = Rs.600,000</p> $\text{FVIF } (r, 8 \text{ years}) = \frac{\text{Rs.600,000}}{\text{Rs.200,000}} = 3.000$ <p>From the tables we find that FVIF (15%, 8years) = 3.059</p> <p>This means that the implied interest rate is nearly 15%. I would choose Rs.600,000 after 8 years from now because I find a return of 15% quite attractive.</p>

27. Ravikiran deposits Rs.500,000 in a bank now. The interest rate is 9 percent and compounding is done quarterly. What will the deposit grow to after 5 years? If the inflation rate is 3 percent per year, what will be the value of the deposit after 5 years in terms of the current rupee?

Solution:

$\begin{aligned} \text{FV}_5 &= \text{Rs.500,000} [1 + (0.09 / 4)]^{5 \times 4} \\ &= \text{Rs.500,000} (1.0225)^{20} \\ &= \text{Rs.500,000} \times 2.653 \\ &= \text{Rs.780,255} \end{aligned}$

If the inflation rate is 3 % per year, the value of Rs.780,255 5 years from now, in terms of the current rupees is:
 $Rs.780,255 \times PVIF (3\%, 5 \text{ years})$
 $= Rs.780,255 \times 0.863 = Rs.673,360$

28. A person requires Rs.100,000 at the beginning of each year from 2015 to 2019. Towards this, how much should he deposit (in equal amounts) at the end of each year from 2007 to 2011, if the interest rate is 10 percent.

Solution:

The discounted value of Rs.100,000 receivable at the beginning of each year from 2015 to 2019, evaluated as at the beginning of 2014 (or end of 2013) is:
 $Rs.100,000 \times PVIFA (10\%, 5 \text{ years})$
 $= Rs.100,000 \times 3.791 = Rs.379,100$

The discounted value of Rs.379,100 evaluated at the end of 2011 is
 $Rs.379,100 \times PVIF (10\%, 2 \text{ years})$
 $= Rs.379,100 \times 0.826 = Rs.313,137$

If A is the amount deposited at the end of each year from 2007 to 2011 then
 $A \times FVIFA (10\%, 5 \text{ years}) = Rs.313,137$
 $A \times 6.105 = Rs.313,137$
 $A = Rs.313,137 / 6.105 = Rs.51,292$

29. You require Rs.250 ,000 at the beginning of each year from 2010 to 2012. How much should you deposit(in equal amounts) at the beginning of each year in 2007 and 2008 ? The interest rate is 8 percent.

Solution:

The discounted value of Rs.250,000 receivable at the beginning of each year from 2010 to 2012, evaluated as at the beginning of 2009 (or end of 2008) is:
 $Rs.250,000 \times PVIFA (8\%, 3 \text{ years})$
 $= Rs.250,000 \times 2.577 = Rs.644,250$

To have Rs. 644,250 at the end of 2008, let A be the amount that needs to be deposited at the beginning of 2007 and 2008. We then have
 $A \times (1+0.08) \times FVIFA (8\%, 2 \text{ years}) = 644,250$
 $A \times 1.08 \times 2.080 = 644,250$ or $A = 286,792$

30. What is the present value of Rs.120,000 receivable annually for 20 years if the first receipt occurs after 8 years and the discount rate is 12 percent.

Solution:

The discounted value of the annuity of Rs.120,000 receivable for 20 years, evaluated as at the end of 7th year is:

$$\text{Rs.120,000} \times \text{PVIFA (12\%, 20 years)} = \text{Rs.120,000} \times 7.469 = \text{Rs.896,290}$$

The present value of Rs. 896,290 is:

$$\begin{aligned} & \text{Rs. 896,290} \times \text{PVIF (12\%, 7 years)} \\ = & \text{Rs. 896,290} \times 0.452 \\ = & \text{Rs.405,119} \end{aligned}$$

31. What is the present value of Rs.89,760 receivable annually for 10 years if the first receipt occurs after 5 years and the discount rate is 9 percent.

Solution:

The discounted value of the annuity of Rs.89,760 receivable for 10 years, evaluated as at the end of 4th year is:

$$\text{Rs. 89,760} \times \text{PVIFA (9\%, 10 years)} = \text{Rs. 89,760} \times 6.418 = \text{Rs.576,080}$$

The present value of Rs. 576,080 is:

$$\begin{aligned} & \text{Rs. 576,080} \times \text{PVIF (9\%, 4 years)} \\ = & \text{Rs. 576,080} \times 0.708 \\ = & \text{Rs.407,865} \end{aligned}$$

32. After eight years Mr.Tiwari will receive a pension of Rs.10,000 per month for 20 years. How much can Mr. Tiwari borrow now at 12 percent interest so that the borrowed amount can be paid with 40 percent of the pension amount? The interest will be accumulated till the first pension amount becomes receivable.

Solution:

$$\begin{aligned} & \text{40 per cent of the pension amount is} \\ & 0.40 \times \text{Rs.10,000} = \text{Rs.4,000} \end{aligned}$$

Assuming that the monthly interest rate corresponding to an annual interest rate of 12% is 1%, the discounted value of an annuity of Rs.4,000 receivable at the end of each month for 240 months (20 years) is:

$$\begin{aligned} & \text{Rs.4,000} \times \text{PVIFA (1\%, 240)} \\ & \text{Rs.4,000} \times \frac{(1.01)^{240} - 1}{.01 (1.01)^{240}} = \text{Rs.363,278} \end{aligned}$$

If Mr. Tiwari borrows Rs. P today on which the monthly interest rate is 1%

$$\begin{aligned}
 P \times (1.01)^{96} &= \text{Rs. } 363,278 \\
 P \times 2.60 &= \text{Rs. } 363,278 \\
 \\
 P &= \frac{\text{Rs. } 363,278}{2.60} = \text{Rs. } 139,722
 \end{aligned}$$

33. After one year Mr. Khanna will receive a pension of Rs.15,000 per month for 30 years. How much can Mr. Khanna borrow now at 12 percent interest so that the borrowed amount can be paid with 25 percent of the pension amount? The interest will be accumulated till the first pension amount becomes receivable.

Solution:

25 per cent of the pension amount is
 $0.25 \times \text{Rs. } 15,000 = \text{Rs. } 3,750$

Assuming that the monthly interest rate corresponding to an annual interest rate of 12% is 1%, the discounted value of an annuity of Rs.3,750 receivable at the end of each month for 360 months (30 years) is:

$$\begin{aligned}
 &\text{Rs. } 3,750 \times \text{PVIFA}(1\%, 360) \\
 &\text{Rs. } 3,750 \times \frac{(1.01)^{360} - 1}{.01 (1.01)^{360}} = \text{Rs. } 364,569
 \end{aligned}$$

If Mr. Khanna borrows Rs. P today on which the monthly interest rate is 1%

$$\begin{aligned}
 P \times (1.01)^{12} &= \text{Rs. } 364,569 \\
 P \times 1.127 &= \text{Rs. } 364,569 \\
 \\
 P &= \frac{\text{Rs. } 364,569}{1.127} = \text{Rs. } 323,486
 \end{aligned}$$

34. You buy a car with a bank loan of Rs.525,000. An instalment of Rs.25,000 is payable to the bank for each of 30 months towards the repayment of loan with interest. What interest rate does the bank charge?

Solution:

$$\begin{aligned}
 \text{Rs. } 25,000 \times \text{PVIFA}(r, 30 \text{ months}) &= \text{Rs. } 525,000 \\
 \text{PVIFA}(r, 30 \text{ months}) &= \text{Rs. } 525,000 / \text{Rs. } 25,000 = 21
 \end{aligned}$$

From the tables we find that:

$$\begin{aligned} \text{PVIFA}(3\%, 30) &= 19.600 \\ \text{PVIFA}(2\%, 30) &= 22.397 \end{aligned}$$

Using a linear interpolation

$$\begin{aligned} r &= 2\% + \left(\frac{22.397 - 21.000}{22.397 - 19.600} \right) \times 1\% \\ &= 2.50\% \end{aligned}$$

Thus, the bank charges an interest rate of 2.50 % per month.

The corresponding effective rate of interest per annum is

$$[(1.0250)^{12} - 1] \times 100 = 34.49 \%$$

35. You take a bank loan of Rs.174,000 repayable with interest in 18 monthly instalments of Rs.12,000. What is the effective annual interest rate charged by the bank ?

Solution:

$$\text{Rs.12,000} \times \text{PVIFA}(r, 18 \text{ months}) = \text{Rs.174,000}$$

$$\text{PVIFA}(r, 18 \text{ months}) = \text{Rs.174,000} / \text{Rs.12,000} = 14.5$$

From the tables we find that:

$$\begin{aligned} \text{PVIFA}(2\%, 18) &= 14.992 \\ \text{PVIFA}(3\%, 18) &= 13.754 \end{aligned}$$

Using a linear interpolation

$$\begin{aligned} r &= 2\% + \left(\frac{14.992 - 14.500}{14.992 - 13.754} \right) \times 1\% \\ &= 2.397\% \end{aligned}$$

Thus, the bank charges an interest rate of 2.397 % per month.

The corresponding effective rate of interest per annum is

$$[(1.02397)^{12} - 1] \times 100 = 32.88 \%$$

36. Metro Corporation has to retire Rs.20 million of debentures each at the end of 6, 7, and 8 years from now. How much should the firm deposit in a sinking fund account annually for 5 years, in order to meet the debenture retirement need? The net interest rate earned is 10 percent.

Solution:

The discounted value of the debentures to be redeemed between 6 to 8 years evaluated at the end of the 5th year is:

$$\begin{aligned} \text{Rs.20 million} \times \text{PVIFA (10\%, 3 years)} &= \text{Rs.20 million} \times 2.487 \\ &= \text{Rs.49.74million} \end{aligned}$$

If A is the annual deposit to be made in the sinking fund for the years 1 to 5, then

$$\begin{aligned} A \times \text{FVIFA (10\%, 5 years)} &= \text{Rs.49.74 million} \\ A \times 6.105 &= \text{Rs.49.74 million} \\ A &= \text{Rs.8,147,420} \end{aligned}$$

37. Ankit Limited has to retire Rs.30 million of debentures each at the end of 7, 8, 9 and 10 years from now. How much should the firm deposit in a sinking fund account annually for 5 years, in order to meet the debenture retirement need? The net interest rate earned is 12 percent.

Solution:

The discounted value of the debentures to be redeemed between 7 to 10 years evaluated at the end of the 6th year is:

$$\begin{aligned} \text{Rs.30 million} \times \text{PVIFA (12\%, 4 years)} &= \text{Rs.30 million} \times 3.037 \\ &= \text{Rs.91.11 million} \end{aligned}$$

If A is the annual deposit to be made in the sinking fund for the years 1 to 6, then

$$\begin{aligned} A \times \text{FVIFA (12\%, 6 years)} &= \text{Rs.91.11 million} \\ A \times 8.115 &= \text{Rs. 91.11 million} \\ A &= \text{Rs.11,227,357} \end{aligned}$$

38. Mr.Mehta receives a provident fund amount or Rs.800,000. He deposits it in a bank which pays 9 percent interest. If he plans to withdraw Rs.100,000 at the end of each year, how long can he do so ?

Solution:

Let 'n' be the number of years for which a sum of Rs.100,000 can be withdrawn annually.

$$\begin{aligned} \text{Rs.100,000} \times \text{PVIFA}(9\%, n) &= \text{Rs.800,000} \\ \text{PVIFA}(9\%, n) &= \text{Rs.800,000} / \text{Rs.100,000} = 8.000 \end{aligned}$$

From the tables we find that

$$\begin{aligned} \text{PVIFA}(9\%, 14 \text{ years}) &= 7.786 \\ \text{PVIFA}(9\%, 15 \text{ years}) &= 8.060 \end{aligned}$$

Using a linear interpolation we get

$$n = 14 + \left(\frac{8.000 - 7.786}{8.060 - 7.786} \right) \times 1 = 14.78 \text{ years}$$

39. Mr. Naresh wants to invest an amount of Rs. 400,000, in a finance company at an interest rate of 12 percent, with instructions to the company that the amount with interest be repaid to his son in equal instalments of Rs.100,000, for his education expenses. How long will his son get the amount ?

Solution:

Let 'n' be the number of years for which a sum of Rs.100,000 can be withdrawn annually.

$$\begin{aligned} \text{Rs.100,000} \times \text{PVIFA}(12\%, n) &= \text{Rs.400,000} \\ \text{PVIFA}(12\%, n) &= \text{Rs.400,000} / \text{Rs.100,000} = 4 \end{aligned}$$

From the tables we find that

$$\begin{aligned} \text{PVIFA}(12\%, 5 \text{ years}) &= 3.605 \\ \text{PVIFA}(12\%, 6 \text{ years}) &= 4.111 \end{aligned}$$

Using a linear interpolation we get

$$n = 5 + \left(\frac{4.000 - 3.605}{4.111 - 3.605} \right) \times 1 = 5.78 \text{ years}$$

40. Your company is taking a loan of 1,000,000, carrying an interest rate of 15 percent. The loan will be amortised in five equal instalments. What fraction of the instalment at the end of second year will represent principal repayment ?

Solution:

$$\text{Annual instalment} = \frac{1,000,000}{3.352} = 298,329$$

Loan Amortisation Schedule

<i>Year</i>	<i>Beg.</i>	<i>Instalment</i>	<i>Interest</i>	<i>Principal repayment</i>	<i>Balance</i>
1	1,000,000	298,329	150,000	148,329	851,671
2	851,671	298,329	127,751	170,578	681,093
			$170,578 / 298,329 = 0.572$ or 57.2%		

41. Anurag Limited borrows Rs.2,000,000 at an interest rate of 12 percent. The loan is to be repaid in 5 equal annual instalments payable at the end of each of the next 5 years. Prepare the loan amortisation schedule

Solution:

$$\begin{aligned} \text{Equated annual installment} &= 2,000,000 / \text{PVIFA}(12\%, 5) \\ &= 2,000,000 / 3.605 \\ &= \text{Rs.}554,785 \end{aligned}$$

Loan Amortisation Schedule

<i>Year</i>	<i>Beginning amount</i>	<i>Annual installment</i>	<i>Interest</i>	<i>Principal repaid</i>	<i>Remaining balance</i>
1	2,000,000	554,785	240,000	314,785	1,685,215
2	1,685,215	554,785	202,226	352,559	1,332,656
3	1,332,656	554,785	159,919	394,866	937,790
4	937,790	554,785	112,535	442,250	495,540
5	495,540	554,785	59,465	495,320	220*

(*) rounding off error

42. You want to borrow Rs.3,000,000 to buy a flat. You approach a housing company which charges 10 percent interest. You can pay Rs.400,000 per year toward loan amortisation. What should be the maturity period of the loan?

Solution:

Let n be the maturity period of the loan. The value of n can be obtained from the equation.

$$\begin{aligned} 400,000 \times \text{PVIFA}(10\%, n) &= 3,000,000 \\ \text{PVIFA}(10\%, n) &= 7.5 \end{aligned}$$

From the tables we find that

$$\text{PVIFA}(10\%, 14 \text{ years}) = 7.367$$

$$\text{PVIFA (10 \%, 15 years)} = 7.606$$

Using a linear interpolation we get

$$n = 14 + \left(\frac{7.500 - 7.367}{7.606 - 7.367} \right) \times 1 = 14.56 \text{ years}$$

43. You want to borrow Rs.5,000,000 to buy a flat. You approach a housing company which charges 11 percent interest. You can pay Rs.600,000 per year toward loan amortisation. What should be the maturity period of the loan?

Solution:

Let n be the maturity period of the loan. The value of n can be obtained from the equation.

$$\begin{aligned} 600,000 \times \text{PVIFA}(11\%, n) &= 5,000,000 \\ \text{PVIFA}(11\%, n) &= 8.333 \end{aligned}$$

From the tables we find that

$$\begin{aligned} \text{PVIFA}(11\%, 20 \text{ years}) &= 7.963 \\ \text{PVIFA}(11\%, 25 \text{ years}) &= 8.422 \end{aligned}$$

Using linear interpolation we get

$$n = 20 + \left(\frac{8.333 - 7.963}{8.422 - 7.963} \right) \times 5 = 24.03 \text{ years}$$

44. You are negotiating with the government the right to mine 160,000 tons of iron ore per year for 20 years. The current price per ton of iron ore is Rs.3500 and it is expected to increase at the rate of 8 percent per year. What is the present value of the iron ore that you can mine if the discount rate is 15 percent

Solution:

Expected value of iron ore mined during year 1 = $160,000 \times 3500 = \text{Rs.}560 \text{ million}$

Expected present value of the iron ore that can be mined over the next 20 years assuming a price escalation of 8% per annum in the price per ton of iron

$$= \text{Rs.}560 \text{ million} \times \left(\frac{1 - (1 + g)^n / (1 + i)^n}{i - g} \right)$$

$$= \text{Rs.}560 \text{ million} \times \left(\frac{1 - (1.08)^{20} / (1.15)^{20}}{0.15 - 0.08} \right)$$

$$= \text{Rs.}560 \text{ million} \times 10.2173$$

$$= \text{Rs.}5,721,688,000$$

45. You are negotiating with the government the right to mine 300,000 tons of iron ore per year for 25 years. The current price per ton of iron ore is Rs.3200 and it is expected to increase at the rate of 7 percent per year. What is the present value of the iron ore that you can mine if the discount rate is 18 percent

Solution:

Expected value of iron ore mined during year 1 = 300,000x3200 = Rs.960 million

Expected present value of the iron ore that can be mined over the next 25 years assuming a price escalation of 7% per annum in the price per ton of iron

$$= \text{Rs.}960 \text{ million} \times \left(\frac{1 - (1 + g)^n / (1 + i)^n}{i - g} \right)$$

$$= \text{Rs.}960 \text{ million} \times \left(\frac{1 - (1.07)^{25} / (1.18)^{25}}{0.18 - 0.07} \right)$$

$$= \text{Rs.}960 \text{ million} \times 8.3036$$

$$= \text{Rs.}7,971,456,000$$

46. As a winner of a competition, you can choose one of the following prizes:
- Rs. 800,000 now
 - Rs. 2,000,000 at the end of 8 years
 - Rs. 100,000 a year forever
 - Rs. 130,000 per year for 12 years
 - Rs. 32,000 next year and rising thereafter by 8 percent per year forever.

If the interest rate is 12 percent, which prize has the highest present value?

Solution:

- PV = Rs.800,000
- PV = 2,000,000PVIF_{12%,8yrs} = 2,000,000 x 0.0.404 = Rs.808,000
- PV = 100,000/r = 100,000/0.12 = Rs. 833,333
- PV = 130,000 PVIFA_{12%,12yrs} = 130,000 x 6.194 = Rs.805,220

$$(e) \quad PV = C/(r-g) = 32,000/(0.12-0.08) = \text{Rs.}800,000$$

Option c has the highest present value viz. Rs.833,333

47. Oil India owns an oil pipeline which will generate Rs. 20 million of cash income in the coming year. It has a very long life with virtually negligible operating costs. The volume of oil shipped, however, will decline over time and, hence, cash flows will decrease by 4 percent per year. The discount rate is 15 percent.
- If the pipeline is used forever, what is the present value of its cash flows?
 - If the pipeline is scrapped after 30 years, what is the present value of its cash flows?

Solution:

$$(a) \quad PV = c/(r - g) = 20/[0.15 - (-0.04)] = \text{Rs.}105.26 \text{ million}$$

$$(b) \quad PV = A(1+g) \left[\frac{1 - \frac{(1+g)^n}{1+r}}{r - g} \right] = 20 \times 0.96 \times 5.2398 = \text{Rs.}100.604 \text{ million}$$

48. Petrolite owns an oil pipeline which will generate Rs. 15 million of cash income in the coming year. It has a very long life with virtually negligible operating costs. The volume of oil shipped, however, will decline over time and, hence, cash flows will decrease by 6 percent per year. The discount rate is 18 percent.
- If the pipeline is used forever, what is the present value of its cash flows?
 - If the pipeline is scrapped after 10 years, what is the present value of its cash flows?

Solution:

$$(a) \quad PV = c/(r - g) = 15/[0.18 - (-0.06)] = \text{Rs.}62.5 \text{ million}$$

$$(b) \quad PV = A(1+g) \left[\frac{1 - \frac{(1+g)^n}{1+r}}{r - g} \right] = 15 \times 0.94 \times 3.7379 = \text{Rs.}52.704 \text{ million}$$

49. An oil well presently produces 80,000 barrels per year. It will last for 20 years more, but the production will fall by 6 percent per year. Oil prices are expected to increase by 5 percent per year. Presently the price of oil is \$80 per barrel. What is the present value of the well's production if the discount rate is 15 percent?

Solution:

The growth rate in the value of oil produced, $g = (1 - 0.06)(1 + 0.05) - 1 = - 0.013$

Present value of the well's production =

$$\begin{aligned} PV &= A(1+g) \left(\frac{1 - \left(\frac{1+g}{1+r} \right)^n}{r - g} \right) \\ &= (80,000 \times 80) \times (1 - 0.013) \times \left(\frac{1 - (0.987 / 1.15)^{20}}{0.15 + 0.013} \right) \\ &= \$ 36,930,756 \end{aligned}$$

MINICASE 1

1. As an investment advisor, you have been approached by a client called Vikas for your advice on investment plan. He is currently 40 years old and has Rs.600,000 in the bank. He plans to work for 20 years more and retire at the age of 60. His present salary is Rs.500,000 per year. He expects his salary to increase at the rate of 12 percent per year until his retirement.

Vikas has decided to invest his bank balance and future savings in a balanced mutual fund scheme that he believes will provide a return of 9 percent per year. You agree with his assessment.

Vikas seeks your help in answering several questions given below. In answering these questions, ignore the tax factor.

- (i) Once he retires at the age of 60, he would like to withdraw Rs.800,000 per year for his consumption needs from his investments for the following 15 years (He expects to live upto the age of 75 years). Each annual withdrawal will be made at the beginning of the year. How much should be the value of his investments when Vikas turns 60, to meet this retirement need?
- (ii) How much should Vikas save each year for the next 20 years to be able to withdraw Rs.800,000 per year from the beginning of the 21st year ? Assume that the savings will occur at the end of each year.
- (iii) Suppose Vikas wants to donate Rs.500,000 per year in the last 5 years of his life to a charitable cause. Each donation would be made at the beginning of the year. Further, he wants to bequeath Rs.1,000,000 to his son at the end of his life. How much should he have in his investment account when he reaches the age of 60 to meet this need for donation and bequeathing?

- (iv) Vikas is curious to find out the present value of his lifetime salary income. For the sake of simplicity, assume that his current salary of Rs.500,000 will be paid exactly one year from now, and his salary is paid annually. What is the present value of his life time salary income, if the discount rate applicable to the same is 7 percent? Remember that Vikas expects his salary to increase at the rate of 12 percent per year until retirement.

Solution:

(i)

This is an annuity due

Value of annuity due = Value of ordinary annuity $(1 + r)$

The value of investments when vikas turns 60 must be:

$$800,000 \times \text{PVIFA} (9\%, 15 \text{ years}) \times 1.09 \\ = 800,000 \times 8.060 \times 1.09 = \text{Rs.}7,028,320$$

(ii)

He must have Rs.7,092,800 at the end of the 20th year.

His current capital of Rs.600,000 will grow to:

$$\text{Rs.}600,000 \times \text{FVIF} (9\%, 20\text{yrs}) = 600,000 \times 5.604 \\ = \text{Rs.}3,362,400$$

So, what he saves in the next 15 years must cumulate to:

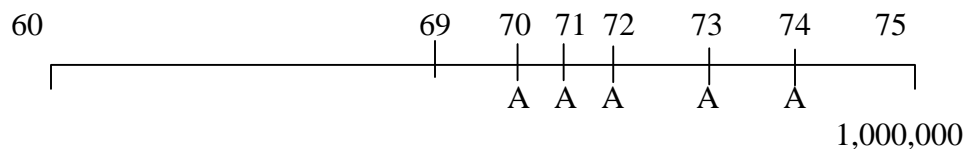
$$7,028,320 - 3,362,400 = \text{Rs.}3,665,920$$

$$A \times \text{FVIFA} (9\%, 20 \text{ yrs}) = \text{Rs.}3,665,920$$

$$A \times 51.160 = 3,665,920$$

$$A = 3,665,920/51.160 = \text{Rs.}71,656$$

(iii)



To meet his donation objective, Vikas will need an amount equal to:

$$500,000 \times \text{PVIFA} (9\%, 5\text{years}) \text{ when he turns } 69.$$

This means he will need

$$500,000 \times \text{PVIFA} (9\%, 5\text{yrs}) \times \text{PVIF} (9\%, 9\text{yrs}) \text{ when he turns } 60.$$

This works out to:

$$500,000 \times 3.890 \times 0.460 = \text{Rs.}894,700$$

To meet his bequeathing objective he will need

$$1,000,000 \times \text{PVIF} (15\%, 9\text{yrs}) \text{ when he turns } 60$$

This works out to:

$$1,000,000 \times 0.275 = \text{Rs.}275,000$$

So, his need for donation and bequeathing is: $894,700 + 275,000$

$$= \text{Rs.}1,169,700$$

(iv)

$$PVGA = A(1+g) \frac{1 - \left[\frac{(1+g)^n}{(1+r)^n} \right]}{r - g}$$

Where $A(1+g)$ is the cash flow a year from now. In this case $A(1+g) = \text{Rs.}500,000$,
 $g = 12\%$, $r = 7\%$, and $n = 20$

So,

$$PVGA = 500,000 \frac{1 - \frac{(1.12)^{20}}{(1.07)^{20}}}{0.07 - 0.12}$$
$$= \text{Rs.}14,925,065$$

MINICASE 2

2. As an investment advisor, you have been approached by a client called Ravi for advice on his investment plan. He is 35 years and has Rs.200,000 in the bank. He plans to work for 25 years more and retire at the age of 60. His present salary is 500,000 per year. He expects his salary to increase at the rate of 12 percent per year until his retirement.

Ravi has decided to invest his bank balance and future savings in a balanced mutual fund scheme that he believes will provide a return of 9 percent per year. You concur with his assessment.

Ravi seeks your help in answering several questions given below. In answering these questions, ignore the tax factor.

- (i) Once he retires at the age of 60, he would like to withdraw Rs. 900,000 per year for his consumption needs for the following 20 years (His life expectancy is 80 years). Each annual withdrawal will be made at the beginning of the year. How much should be the value of his investments when he turns 60, to meet his retirement need?
- (ii) How much should Ravi save each year for the next 25 years to be able to withdraw Rs.900,000 per year from the beginning of the 26th year for a period of 20 years?
Assume that the savings will occur at the end of each year. Remember that he already has some bank balance.
- (iii) Suppose Ravi wants to donate Rs.600,000 per year in the last 4 years of his life to a charitable cause. Each donation would be made at the beginning of the year. Further he wants to bequeath Rs. 2,000,000 to his daughter at the end of his life.

How much should he have in his investment account when he reaches the age of 60 to meet this need for donation and bequeathing?

- (iv) Ravi wants to find out the present value of his lifetime salary income. For the sake of simplicity, assume that his current salary of Rs 500,000 will be paid exactly one year from now, and his salary is paid annually. What is the present value of his lifetime salary income, if the discount rate applicable to the same is 8 percent? Remember that Ravi expects his salary to increase at the rate of 12 percent per year until retirement.

Solution:

(i)

$$900,000 \times \text{PVIFA} (9\%, 20) \times 1.09$$

$$900,000 \times 9.128 \times 1.09$$

$$= \text{Rs. } 8,954,568$$

(ii) Ravi needs Rs. 8,954,568 when he reaches the age of 60.

His bank balance of Rs. 200,000 will grow to : $200,000 (1.09)^{25}$

$$= 200,000 (8.623) = \text{Rs. } 1,724,600$$

This means that his periodic savings must grow to :

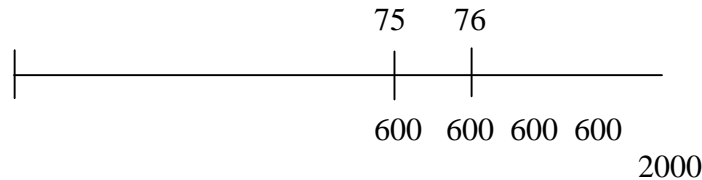
$$\text{Rs. } 8,954,568 - \text{Rs. } 1,724,600 = \text{Rs. } 7,229,968$$

His annual savings must be:

$$A = \frac{7,229,968}{\text{FVIFA} (25, 9\%)} = \frac{7,229,968}{84.701}$$

$$= \text{Rs. } 85,359$$

(iii)



Amount required for the charitable cause:

$$600,000 \times \text{PVIFA} (9\%, 4\text{yrs}) \times \text{PVIF} (9\%, 15\text{yrs})$$

$$= 600,000 \times 3.240 \times 0.275$$

$$\text{Rs. } 534,600$$

Amount required for bequeathing

$$2,000,000 \times \text{PVIF} (9\%, 20\text{yrs})$$

$$= 2,000,000 \times 0.178 = \text{Rs. } 356,000$$

(iv)

$$\begin{array}{c} \begin{array}{ccc} & A(1+g) & A(1+g)^n \\ & | & | \\ 0 & & n \end{array} \\ \\ PVGA = A(1+g) \left(\frac{1 - \frac{(1+g)^n}{(1+r)^n}}{r - g} \right) \\ \\ = 500,000 \left(\frac{1 - \frac{(1.12)^{25}}{(1.08)^{25}}}{0.08 - 0.12} \right) \\ \\ = \text{Rs. } 18,528,922 \end{array}$$

CHAPTER 7

1. The price of a Rs.1,000 par bond carrying a coupon rate of 8 percent and maturing after 5 years is Rs.1020.
- What is the approximate YTM?
 - What will be the realised YTM if the reinvestment rate is 7 percent?

Solution:

(i)

$$YTM \sim \frac{80 + (1000 - 1020) / 5}{0.6 \times 1020 + 0.4 \times 1000} = 7.51\%$$

(ii)

The terminal value will be

$$\begin{aligned} & 80 \times FVIFA(7\%, 5\text{yrs}) + 1000 \\ & 80 \times 5.751 + 1000 = 1460.08 \end{aligned}$$

The realised YTM will be:

$$\left(\frac{1460.08^{1/5}}{1020} \right) - 1 = 7.44\%$$

2. The price of a Rs.1,000 par bond carrying a coupon rate of 7 percent and maturing after 5 years is Rs.1040.
- (i) What is the approximate YTM?
- (ii) What will be the realised YTM if the reinvestment rate is 6 percent?

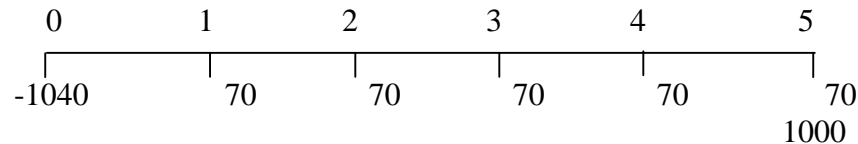
Solution:

(i)

The approximate YTM is:

$$\frac{70 + (1000 - 1040)/5}{0.6 \times 1040 + 0.4 \times 1000} = 0.0605 \text{ or } 6.05 \text{ percent}$$

(ii)



The terminal value at 6 percent reinvestment rate is:

$$70 \times \text{FVIFA}(6\%, 5\text{yrs}) + 1000$$

$$70 \times 5.637 + 1000 = \text{Rs.}1394.59$$

$$\text{Realised yield to maturity} = \frac{1394.59^{1/5}}{1040} - 1 = 6.04\%$$

3. A Rs.1000 par value bond, bearing a coupon rate of 12 percent will mature after 6 years. What is the value of the bond, if the discount rate is 16 percent?

Solution:

$$P = \sum_{t=1}^6 \frac{120}{(1.16)^t} + \frac{1000}{(1.16)^6}$$

$$= \text{Rs.}120 \times \text{PVIFA}(16\%, 6 \text{ years}) + \text{Rs.}1000 \times \text{PVIF}(16\%, 6 \text{ years})$$

$$= \text{Rs.}120 \times 3.685 + \text{Rs.}1000 \times 0.410$$

$$= \text{Rs.} 852.20$$

4. A Rs.100 par value bond, bearing a coupon rate of 9 percent will mature after 4 years. What is the value of the bond, if the discount rate is 13 percent?

Solution:

$$P = \sum_{t=1}^4 \frac{9}{(1.13)^t} + \frac{100}{(1.13)^4}$$

$$= \text{Rs.}9 \times \text{PVIFA}(13\%, 4 \text{ years}) + \text{Rs.}100 \times \text{PVIF}(13\%, 4 \text{ years})$$

$$= \text{Rs.}9 \times 2.974 + \text{Rs.}100 \times 0.613$$

$$= \text{Rs.} 88.07$$

5. The market value of a Rs.1,000 par value bond, carrying a coupon rate of 10 percent and maturing after 5 years, is Rs.850. What is the yield to maturity on this bond?

Solution:

The yield to maturity is the value of r that satisfies the following equality.

$$\text{Rs.}850 = \sum_{t=1}^5 \frac{100}{(1+r)^t} + \frac{1,000}{(1+r)^5}$$

Try $r = 14\%$. The right hand side (RHS) of the above equation is:
 $\text{Rs.}100 \times \text{PVIFA}(14\%, 5 \text{ years}) + \text{Rs.}1,000 \times \text{PVIF}(14\%, 5 \text{ years})$
 $= \text{Rs.}100 \times 3.433 + \text{Rs.}1,000 \times 0.519$
 $= \text{Rs.}862.30$

Try $r = 15\%$. The right hand side (RHS) of the above equation is:
 $\text{Rs.}100 \times \text{PVIFA}(15\%, 5 \text{ years}) + \text{Rs.}1,000 \times \text{PVIF}(15\%, 5 \text{ years})$
 $= \text{Rs.}100 \times 3.352 + \text{Rs.}1,000 \times 0.497$
 $= \text{Rs.}832.20$

Thus the value of r at which the RHS becomes equal to Rs.850 lies between 14% and 15%.

Using linear interpolation in this range, we get

$$\text{Yield to maturity} = 14\% + \left[\frac{862.30 - 850.00}{862.30 - 832.20} \right] \times 1\%$$

$$= 14.41\%$$

6. The market value of a Rs.100 par value bond, carrying a coupon rate of 8.5 percent and maturing after 8 years, is Rs.95. What is the yield to maturity on this bond?

Solution:

The yield to maturity is the value of r that satisfies the following equality.

$$95 = \sum_{t=1}^8 \frac{8.5}{(1+r)^t} + \frac{100}{(1+r)^8}$$

Try $r = 10\%$. The right hand side (RHS) of the above equation is:

$$\begin{aligned} & 8.5 \times \text{PVIFA} (10\%, 8 \text{ years}) + \text{Rs.}100 \times \text{PVIF} (10\%, 8 \text{ years}) \\ = & \text{Rs.}8.5 \times 5.335 + \text{Rs.}100 \times 0.467 \\ = & \text{Rs.}92.05 \end{aligned}$$

Try $r = 9\%$. The right hand side (RHS) of the above equation is:

$$\begin{aligned} & 8.5 \times \text{PVIFA} (9\%, 8 \text{ years}) + \text{Rs.}100 \times \text{PVIF} (9\%, 8 \text{ years}) \\ = & 8.5 \times 5.535 + \text{Rs.}100 \times 0.502 \\ = & 47.04 + 50.20 = 97.24 \end{aligned}$$

Thus the value of r at which the RHS becomes equal to Rs.95 lies between 9% and 10%.

Using linear interpolation in this range, we get

$$\begin{aligned} \text{Yield to maturity} &= 9\% + \left[\frac{97.24 - 95.00}{97.24 - 92.05} \right] \times 1\% \\ &= 9.43\% \end{aligned}$$

7. A Rs.1000 par value bond bears a coupon rate of 10 percent and matures after 5 years. Interest is payable semi-annually. Compute the value of the bond if the required rate of return is 18 percent.

Solution:

$$\begin{aligned} P &= \sum_{t=1}^{10} \frac{50}{(1.09)^t} + \frac{1000}{(1.09)^{10}} \\ &= 50 \times \text{PVIFA} (9\%, 10 \text{ years}) + 1000 \times \text{PVIF} (9\%, 10 \text{ years}) \\ &= 50 \times 6.418 + \text{Rs.}1000 \times 0.422 \\ &= \text{Rs.} 742.90 \end{aligned}$$

8. A Rs.100 par value bond bears a coupon rate of 8 percent and matures after 10 years. Interest is payable semi-annually. Compute the value of the bond if the required rate of return is 12 percent.

Solution:

$$P = \sum_{t=1}^{20} \frac{4}{(1.06)^t} + \frac{100}{(1.06)^{20}}$$

= 4 x PVIFA (6%, 20 years) + Rs.100 x PVIF (6%, 20 years)
 = 6 x 11.470 + Rs.100 x 0.312
 = Rs.100.02

9. You are considering investing in one of the following bonds:

	<i>Coupon rate</i>	<i>Maturity</i>	<i>Price/Rs.100 par value</i>
Bond A	11%	8 yrs	Rs.80
Bond B	9%	9 yrs	Rs.70

Your income tax rate is 34 percent and your capital gains tax is effectively 10 percent. Capital gains taxes are paid at the time of maturity on the difference between the purchase price and par value. What is your post-tax yield to maturity from these bonds?

Solution:

The post-tax interest and maturity value are calculated below:

	<i>Bond A</i>	<i>Bond B</i>
* Post-tax interest (C)	11(1 - 0.34) =Rs.7.26	9 (1 - 0.34) =Rs.5.94
* Post-tax maturity value (M)	100 - [(100-80)x 0.1] =Rs.98	100 - [(100 - 70)x 0.1] =Rs.97

The post-tax YTM, using the approximate YTM formula is calculated below

Bond A :	Post-tax YTM =	$\frac{7.26 + (98-80)/8}{0.6 \times 80 + 0.4 \times 98}$
	=	10.91%
Bond B :	Post-tax YTM =	$\frac{5.94 + (97 - 70)/9}{0.6 \times 70 + 0.4 \times 97}$
	=	11.06 %

10. You are considering investing in one of the following bonds:

	<i>Coupon rate</i>	<i>Maturity</i>	<i>Price/Rs.1000 par value</i>
Bond A	12%	7 yrs	Rs. 930
Bond B	8 %	5 yrs	Rs. 860

Your income tax rate is 33 percent and your capital gains tax is effectively 10 percent. Capital gains taxes are paid at the time of maturity on the difference between the purchase price and par value. What is your post-tax yield to maturity from these bonds?

Solution:

The post-tax interest and maturity value are calculated below:

	<i>Bond A</i>	<i>Bond B</i>
* Post-tax interest (C)	120(1 – 0.33) =Rs.80.40	80 (1 – 0.33) =Rs.53.6
* Post-tax maturity value (M)	1000 - [(1000-930) x 0.1] =Rs. 993	1000 - [(1000 – 860)x 0.1] =Rs.986

The post-tax YTM, using the approximate YTM formula is calculated below

$$\text{Bond A : Post-tax YTM} = \frac{80.40 + (993-930)/7}{0.6 \times 930 + 0.4 \times 993} = 9.36 \%$$

$$\text{Bond B : Post-tax YTM} = \frac{53.6 + (986 - 860)/5}{0.6 \times 860 + 0.4 \times 986} = 8.66 \%$$

11. A company's bonds have a par value of Rs.100, mature in 5 years, and carry a coupon rate of 10 percent payable semi-annually. If the appropriate discount rate is 14 percent, what price should the bond command in the market place?

Solution:

$$\begin{aligned}
 P &= \sum_{t=1}^{10} \frac{5}{(1.07)^t} + \frac{100}{(1.07)^{10}} \\
 &= \text{Rs.}5 \times \text{PVIFA}(7\%, 10) + \text{Rs.}100 \times \text{PVIF}(7\%, 10) \\
 &= \text{Rs.}5 \times 7.024 + \text{Rs.}100 \times 0.508 \\
 &= \text{Rs.} 85.92
 \end{aligned}$$

12. A company's bonds have a par value of Rs.1000, mature in 8 years, and carry a coupon rate of 14 percent payable semi-annually. If the appropriate discount rate is 12 percent, what price should the bond command in the market place?

Solution:

$$\begin{aligned}
 P &= \sum_{t=1}^{16} \frac{70}{(1.06)^t} + \frac{1000}{(1.06)^{16}} \\
 &= \text{Rs.}70 \times \text{PVIFA}(6\%, 16) + \text{Rs.}1000 \times \text{PVIF}(6\%, 16) \\
 &= \text{Rs.}70 \times 10.106 + \text{Rs.}1000 \times 0.394 \\
 &= \text{Rs.} 1101.42
 \end{aligned}$$

13. The share of a certain stock paid a dividend of Rs.3.00 last year. The dividend is expected to grow at a constant rate of 8 percent in the future. The required rate of return on this stock is considered to be 15 percent. How much should this stock sell for now? Assuming that the expected growth rate and required rate of return remain the same, at what price should the stock sell 3 years hence?

Solution:

$$\begin{aligned}
 D_0 &= \text{Rs.}3.00, g = 0.08, r = 0.15 \\
 P_0 &= D_1 / (r - g) = D_0 (1 + g) / (r - g) \\
 &= \text{Rs.}3.00 (1.08) / (0.15 - 0.08) \\
 &= \text{Rs.}46.29
 \end{aligned}$$

Assuming that the growth rate of 8% applies to market price as well, the market price at the end of the 3rd year will be:

$$\begin{aligned}
 P_2 &= P_0 \times (1 + g)^3 = \text{Rs.}46.29 (1.08)^3 \\
 &= \text{Rs.} 58.31
 \end{aligned}$$

14. The share of a certain stock paid a dividend of Rs.10.00 last year. The dividend is expected to grow at a constant rate of 15 percent in the future. The required rate of return on this stock is considered to be 18 percent. How much should this stock sell for now? Assuming that the expected growth rate and required rate of return remain the same, at what price should the stock sell 4 years hence?

Solution:

$$D_0 = \text{Rs.}10.00, g = 0.15, r = 0.18$$

$$P_0 = D_1 / (r - g) = D_0 (1 + g) / (r - g)$$

$$= \text{Rs.}10.00 (1.15) / (0.18 - 0.15)$$

$$= \text{Rs.}383.33$$

Assuming that the growth rate of 15% applies to market price as well, the market price at the end of the 4th year will be:

$$P_2 = P_0 \times (1 + g)^4 = \text{Rs.}383.33 (1.15)^4$$

$$= \text{Rs.} 669.87$$

15. The equity stock of Hansa Limited is currently selling for Rs.280 per share. The dividend expected next is Rs.10.00. The investors' required rate of return on this stock is 14 percent. Assume that the constant growth model applies to Hansa Limited. What is the expected growth rate of Hansa Limited?

Solution:

$$P_0 = D_1 / (r - g)$$

$$\text{Rs.}280 = \text{Rs.}10 / (0.14 - g)$$

$$0.14 - g = 10/280 = 0.0357$$

$$g = 0.14 - 0.0357 = 0.1043 \text{ or } 10.43 \%$$

16. The equity stock of Amulya Corporation is currently selling for Rs.1200 per share. The dividend expected next is Rs.25.00. The investors' required rate of return on this stock is 12 percent. Assume that the constant growth model applies to Amulya Corporation. What is the expected growth rate of Amulya Corporation?

Solution:

$$P_0 = D_1 / (r - g)$$

$$\text{Rs.}1200 = \text{Rs.}25 / (0.12 - g)$$

$$0.12 - g = 25/1200 = 0.0208$$

$$g = 0.12 - 0.0208 = 0.0992 \text{ or } 9.92 \%$$

17. Sloppy Limited is facing gloomy prospects. The earnings and dividends are expected to decline at the rate of 5 percent. The previous dividend was Rs.2.00. If the current market price is Rs.10.00, what rate of return do investors expect from the stock of Sloppy Limited?

Solution:

$$\begin{aligned}
 P_o &= D_1 / (r - g) = D_o(1+g) / (r - g) \\
 D_o &= \text{Rs.2.00}, g = -0.05, P_o = \text{Rs.10} \\
 \text{So} \\
 10 &= 2.00 (1 - .05) / (r - (-.05)) = 1.90 / (r + .05) \\
 r + 0.05 &= 1.90/10 = 0.19 \\
 r &= 0.19 - 0.05 = 0.14
 \end{aligned}$$

18. Mammoth Corporation is facing gloomy prospects. The earnings and dividends are expected to decline at the rate of 10 percent. The previous dividend was Rs.3.00. If the current market price is Rs.25.00, what rate of return do investors expect from the stock of Mammoth Limited?

Solution:

$$\begin{aligned}
 P_o &= D_1 / (r - g) = D_o(1+g) / (r - g) \\
 D_o &= \text{Rs.3.00}, g = -0.10, P_o = \text{Rs.25} \\
 \text{So} \\
 25 &= 3.00 (1 - .10) / (r - (-.10)) = 2.7 / (r + .10) \\
 r + 0.10 &= 2.7/25 = 0.108 \\
 r &= 0.108 - 0.10 = 0.008 \text{ or } 0.8 \text{ percent}
 \end{aligned}$$

19. The current dividend on an equity share of Omega Limited is Rs.8.00 on an earnings per share of Rs. 30.00.

- (i) Assume that the dividend per share will grow at the rate of 20 percent per year for the next 5 years. Thereafter, the growth rate is expected to fall and stabilise at 12 percent.

Investors require a return of 15 percent from Omega's equity shares. What is the intrinsic value of Omega's equity share?

Solution:

$$g_1 = 20\%, \quad g_2 = 12\%, \quad n = 5 \text{ yrs}, \quad r = 15\%$$

$$D_1 = 8 (1.20) = \text{Rs. } 9.60$$

$$\begin{aligned}
 P_0 &= D_1 \left(\frac{1 - \left(\frac{1+g_1}{1+r} \right)^n}{r - g_1} \right) + \frac{D_1 (1+g_1)^{n-1} (1+g_2)}{r - g_2} \times \frac{1}{(1+r)^n} \\
 &= 9.60 \left(\frac{1 - \left(\frac{1.20}{1.15} \right)^5}{0.15 - 0.20} \right) + \frac{9.60 (1.20)^4 (1.12)}{0.15 - 0.12} \times \frac{1}{(1.15)^5} \\
 &= 45.53 + 369.49 = \text{Rs. } 415.02
 \end{aligned}$$

- (ii) Assume that the growth rate of 20 percent will decline linearly over a five year period and then stabilise at 12 percent. What is the intrinsic value of Omega's share if the investors' required rate of return is 15 percent?

Solution:

$$\begin{aligned}
 P_0 &= \frac{D_0 [(1+g_n) + H(g_a - g_n)]}{r - g_n} \\
 &= \frac{8 [(1.12) + 2.5 (0.20 - 0.12)]}{0.15 - 0.12} \\
 &= \text{Rs. } 352
 \end{aligned}$$

20. The current dividend on an equity share of Magnum Limited is Rs.4.00.
- (i) Assume that Magnum's dividend will grow at the rate of 18 percent per year for the next 5 years. Thereafter, the growth rate is expected to fall and stabilise at 10 percent. Equity investors require a return of 15 percent from Magnum's equity shares. What is the intrinsic value of Magnum's equity share?

Solution:

$$g_1 = 18\%, g_2 = 10\%, n = 5 \text{ yrs}, r = 15\% \\ D_1 = 4 (1.18) = \text{Rs.}4.72$$

$$P_0 = D_1 \left(\frac{1 - \left(\frac{1 + g_1}{1 + r} \right)^n}{r - g_1} \right) + \frac{D_1 (1 + g_1)^{n-1} (1 + g_2)}{r - g_2} \times \frac{1}{(1 + r)^n}$$

$$= 4.72 \left(\frac{1 - \left(\frac{1.18}{1.15} \right)^5}{0.15 - 0.18} \right) + \frac{4.72 (1.18)^4 (1.10)}{0.15 - 0.10} \times \frac{1}{(1.15)^5}$$

$$= 21.62 + 100.12$$

$$= 121.74$$

- (ii) Assume now that the growth rate of 18 percent will decline linearly over a period of 4 years and then stabilise at 10 percent . What is the intrinsic value per share of Magnum, if investors require a return of 15 percent ?

Solution:

$$P_0 = D_0 \left(\frac{(1 + g_n) + H (g_a - g_n)}{r - g_n} \right)$$

$$= 4.00 \left(\frac{(1.10) + 2 (0.18 - 0.10)}{0.15 - 0.10} \right)$$

$$= \text{Rs.}100.8$$

21. The current dividend on an equity share of Omex Limited is Rs. 5.00 on an earnings per share of Rs. 20.00.

- (i) Assume that the dividend will grow at a rate of 18 percent for the next 4 years. Thereafter, the growth rate is expected to fall and stabilize at 12 percent. Equity investors require a return of 15 percent from Omex's equity share. What is the intrinsic value of Omex's equity share?

Solution:

$$\begin{aligned}
 g_1 &= 18\%, \quad g_2 = 12\%, \quad n = 4\text{yrs}, \quad r = 15\% \\
 D_1 &= 5(1.18) = \text{Rs. } 5.90 \\
 P_0 &= D_1 \left(\frac{1 - \left(\frac{1+g_1}{1+r} \right)^n}{r - g_1} \right) + \frac{D_1 (1+g_1)^{n-1} (1+g_2)}{r - g_2} \times \frac{1}{(1+r)^n} \\
 &= 5.90 \left(\frac{1 - \left(\frac{1.18}{1.15} \right)^4}{0.15 - 0.18} \right) + \frac{5.90 (1.18)^3 (1.12)}{0.15 - 0.12} \times \frac{1}{(1.15)^4} \\
 &= 21.34 + 206.92 = \text{Rs. } 228.35
 \end{aligned}$$

22. You can buy a Rs.1000 par value bond carrying an interest rate of 10 percent (payable annually) and maturing after 5 years for Rs.970. If the re-investment rate applicable to the interest receipts from this bond is 15 percent, what will be your yield to maturity?

Solution:

$$\begin{aligned}
 &\text{Terminal value of the interest proceeds} \\
 &= 100 \times \text{FVIFA}(15\%, 5) \\
 &= 100 \times 6.742 \\
 &= 674.20 \\
 &\text{Redemption value} = 1,000 \\
 &\text{Terminal value of the proceeds from the bond} = 1,674.20
 \end{aligned}$$

let r be the yield to maturity. The value of r can be obtained from the equation

$$\begin{aligned} 970(1+r)^5 &= 1,674.20 \\ r &= (1,674.20/970)^{1/5} - 1 \\ &= 0.1153 \text{ or } 11.53\% \end{aligned}$$

23. You can buy a Rs.100 par value bond carrying an interest rate of 8 percent (payable annually) and maturing after 8 years for Rs.90. If the re-investment rate applicable to the interest receipts from this bond is 10 percent, what will be your yield to maturity?

Solution:

$$\begin{aligned} &\text{Terminal value of the interest proceeds} \\ &= 8 \times \text{FVIFA}(10\%, 8) \\ &= 8 \times 11.436 \\ &= 91.49 \end{aligned}$$

Redemption value = 100

Terminal value of the proceeds from the bond = 191.49

let r be the yield to maturity. The value of r can be obtained from the equation

$$\begin{aligned} 90(1+r)^8 &= 191.49 \\ r &= (191.49/90)^{1/8} - 1 \\ &= 0.099 \text{ or } 9.9\% \end{aligned}$$

24. Keerthi Limited is expected to give a dividend of Rs.5 next year and the same would grow by 12 percent per year forever. Keerthi pays out 60 percent of its earnings. The required rate of return on Keerthi's stock is 15 percent. What is the PVGO?

Solution:

$$\begin{aligned} P_o &= \frac{D_1}{r-g} \\ P_o &= \frac{5}{0.15-0.12} = \text{Rs. } 166.67 \\ P_o &= \frac{E_1}{r} + \text{PVGO} \\ P_o &= \frac{8.33}{0.15} + \text{PVGO} \\ 166.67 &= 55.53 + \text{PVGO} \end{aligned}$$

So, PVGO = 111.14

25. Adinath Limited is expected to give a dividend of Rs.3 next year and the same would grow by 15 percent per year forever. Adinath pays out 30 percent of its earnings. The required rate of return on Adinath's stock is 16 percent. What is the PVGO?

Solution:

$$P_o = \frac{D_1}{r - g}$$

$$P_o = \frac{3}{0.16 - 0.15} = \text{Rs. } 300$$

$$P_o = \frac{E_1}{r} + \text{PVGO}$$

$$P_o = \frac{10}{0.16} + \text{PVGO}$$

$$300 = 62.5 + \text{PVGO}$$

So, PVGO = 237.5

CHAPTER 8

1. You are considering purchasing the equity stock of Electra Limited. The current price per share is Rs.20. You expect the dividend a year hence to be Re.2.00. You expect the price per share of Electra stock a year hence to have the following probability distribution.

Price a year hence	Rs.19	20	22
Probability	0.5	0.3	0.2

- (a) What is the expected price per share a year hence?
 (b) What is the probability distribution of the rate of return on Electra's equity stock?

Solution:

(a) Expected price per share a year hence will be:
 $= 0.5 \times \text{Rs.}19 + 0.3 \times \text{Rs.}20 + 0.2 \times \text{Rs.}22 = \text{Rs. } 19.90$

(b) Probability distribution of the rate of return is

Rate of return (R_i)	5%	10 %	20 %
Probability (p_i)	0.5	0.3	0.2

Note that the rate of return is defined as:

$$\frac{\text{Dividend} + \text{Terminal price}}{\text{Initial price}} - 1$$

2. You are considering purchasing the equity stock of Empire Corporation. The current price per share is Rs.180. You expect the dividend a year hence to be Re.8.00. You expect the price per share of Empire Corporation stock a year hence to have the following probability distribution.

Price a year hence	Rs.175	180	200
Probability	0.2	0.3	0.5

- (a) What is the expected price per share a year hence?
 (b) What is the probability distribution of the rate of return on Empire Corporation's equity stock?

Solution:

- (a) Expected price per share a year hence will be:

$$= 0.2 \times \text{Rs.}175 + 0.3 \times \text{Rs.}180 + 0.5 \times \text{Rs.}200 = \text{Rs.} 189$$

- (c) Probability distribution of the rate of return is

Rate of return (R_i)	1.7 %	4.4 %	15.6 %
Probability (p_i)	0.2	0.3	0.5

3. The stock of South India Corporation (SIC) performs well relative to other stocks during recessionary periods. The stock of North India Corporation (NIC), on the other hand, does well during growth periods. Both the stocks are currently selling for Rs.100 per share. The rupee return (dividend plus price change) of these stocks for the next year would be as follows:

	<i>Economic condition</i>			
	<i>High growth</i>	<i>Low growth</i>	<i>Stagnation</i>	<i>Recession</i>
Probability	0.4	0.3	0.1	0.2
Return on SIC stock	40	60	70	80
Return on NIC stock	65	60	50	35

Calculate the expected return and standard deviation of:

- (a) Rs.5,000 in the equity stock of SIC;
 (b) Rs.5,000 in the equity stock of NIC;
 (c) Rs.2,500 in the equity stock of SIC and Rs.2,500 in the equity stock of NIC;
 (d) Rs.3,000 in the equity stock of SIC and Rs.2,000 in the equity of NIC.

Which of the above four options would you choose? Why?

Solution:

- (a) For Rs.5,000, 50 shares of SIC's stock can be acquired. The probability distribution of the return on 50 shares is

<i>Economic Condition</i>	<i>Return (Rs)</i>	<i>Probability</i>
High Growth	50 x 40 = 2,000	0.4
Low Growth	50x 60 = 3,000	0.3
Stagnation	50x 70 = 3,500	0.1
Recession	50x 80 = 4,000	0.2

$$\begin{aligned} \text{Expected return} &= (2,000 \times 0.4) + (3,000 \times 0.3) + (3,500 \times 0.1) + (4,000 \times 0.2) \\ &= \text{Rs.2,850} \end{aligned}$$

$$\begin{aligned} \text{Standard deviation of the return} &= [(2,000 - 2,850)^2 \times 0.4 + (3,000 - 2,850)^2 \times 0.3 + (3,500 - 2,850)^2 \times 0.1 + (4,000 - 2,850)^2 \times 0.2]^{1/2} \\ &= \text{Rs. 776.21} \end{aligned}$$

- (b) For Rs.5,000, 50 shares of NIC's stock can be acquired. The probability distribution of the return on 50 shares is:

<i>Economic condition</i>	<i>Return (Rs)</i>	<i>Probability</i>
High growth	50 x 65 = 3,250	0.4
Low growth	50 x 60 = 3,000	0.3
Stagnation	50 x 50 = 2,500	0.1
Recession	50 x 35 = 1,750	0.2

$$\begin{aligned} \text{Expected return} &= (3,250 \times 0.4) + (3,000 \times 0.3) + (2,500 \times 0.1) + (1,750 \times 0.2) \\ &= \text{Rs. 2,800} \end{aligned}$$

$$\begin{aligned} \text{Standard deviation of the return} &= [(3,250 - 2,800)^2 \times .4 + (3,000 - 2,800)^2 \times .3 + (2,500 - 2,800)^2 \times .1 + (1,750 - 2,800)^2 \times .2]^{1/2} = \text{Rs. 567.89} \end{aligned}$$

- (c) For Rs.2,500, 25 shares of SIC's stock can be acquired; likewise for Rs.2,500, 25 shares of NIC's stock can be acquired. The probability distribution of this option is:

<i>Return (Rs)</i>	<i>Probability</i>
(25 x 40) + (25 x 65) = 2,625	0.4
(25x 60) + (25x 60) = 3,000	0.3
(25 x 70) + (25x 50) = 3,000	0.1
(25x 80) + (25 x 35) = 2,875	0.2

$$\begin{aligned}
 \text{Expected return} &= (2,625 \times 0.4) + (3,000 \times 0.3) + (3,000 \times 0.1) + (2,875 \times 0.2) \\
 &= \text{Rs. } 2825 \\
 \text{Standard deviation} &= [(2,625 - 2825)^2 \times 0.4 + (3,000 - 2825)^2 \times 0.3 + \\
 &\quad (3,000 - 2825)^2 \times 0.1 + (2,875 - 2825)^2 \times 0.2]^{1/2} \\
 &= \text{Rs. } 169.56
 \end{aligned}$$

- d. For Rs.3000, 30 shares of SIC's stock can be acquired; likewise for Rs.2000, 20 shares of NIC's stock can be acquired. The probability distribution of this option is:

<i>Return (Rs)</i>	<i>Probability</i>
$(30 \times 40) + (20 \times 65) =$	2,500 0.4
$(30 \times 60) + (20 \times 60) =$	3,000 0.3
$(30 \times 70) + (20 \times 50) =$	3,100 0.1
$(30 \times 80) + (20 \times 35) =$	3,100 0.2

$$\begin{aligned}
 \text{Expected return} &= (2,500 \times 0.4) + (3,000 \times 0.3) + (3,100 \times 0.1) + (3,100 \times 0.2) \\
 &= \text{Rs. } 2,830 \\
 \text{Standard deviation} &= [(2,500 - 2,830)^2 \times 0.4 + (3,000 - 2,830)^2 \times 0.3 + \\
 &\quad (3,100 - 2,830)^2 \times 0.1 + (3,100 - 2,830)^2 \times 0.2]^{1/2} \\
 &= \text{Rs. } 272.21
 \end{aligned}$$

The expected return to standard deviation of various options are as follows :

<i>Option</i>	<i>Expected return (Rs)</i>	<i>Standard deviation (Rs)</i>	<i>Expected / Standard return deviation</i>
a	2,850	776.21	3.67
b	2,800	567.89	4.93
c	2,825	169.56	16.66
d	2,830	272.21	10.40

Option 'c' is the most preferred option because it has the highest return to risk ratio.

4. The following table, gives the rate of return on stock of Apple Computers and on the market portfolio for five years

<i>Year</i>	<i>Return on the stock Apple Computers (%)</i>	<i>Return Market Portfolio (%)</i>
1	-13	-3
2	5	2
3	15	8
4	27	12
5	10	7

- (i) What is the beta of the stock of Apple Computers?
(ii) Establish the characteristic line for the stock of Apple Computers.

Solution:

<i>Year</i>	R_A	R_M	$R_A - \bar{R}_A$	$R_M - \bar{R}_M$	$(R_A - \bar{R}_A)(R_M - \bar{R}_M)$	$(R_M - \bar{R}_M)^2$
1	-13	-3	-21.8	-8.2	178.76	67.24
2	5	2	-3.8	-3.2	12.16	10.24
3	15	8	6.2	2.8	17.36	7.84
4	27	12	18.2	6.8	123.76	46.24
5	10	7	1.2	1.8	2.16	3.24
Sum	44	26			334.2	134.8
Mean	8.8	5.2				

$$\sigma_M^2 = \frac{134.8}{5 - 1} = 33.7 \qquad \text{Cov}_{A,M} = \frac{334.2}{5 - 1} = 83.55$$

$$\beta_A = \frac{83.55}{33.7} = 2.48$$

(ii) Alpha = $\bar{R}_A - \beta_A \bar{R}_M$
= $8.8 - (2.48 \times 5.2) = -4.1$

Equation of the characteristic line is

$$R_A = -4.1 + 2.48 R_M$$

5. The rate of return on the stock of Sigma Technologies and on the market portfolio for 6 periods has been as follows:

<i>Period</i>	<i>Return on the stock of Sigma Technologies (%)</i>	<i>Return on the market portfolio (%)</i>
1	16	14
2	12	10
3	-9	6
4	32	18
5	15	12
6	18	15

- (i) What is the beta of the stock of Sigma Technologies?
(ii) Establish the characteristic line for the stock of Sigma Technologies

Solution:

(i)

Year	R _A (%)	R _M (%)	R _A -R _A	R _M -R _M	(R _A -R _A) x(R _M -R _M)	(R _M -R _M) ²
1	36	28	8.8	2.4	21.12	5.76
2	24	20	-3.2	-5.6	17.92	31.36
3	-20	-8	-47.2	-33.6	1585.92	1128.96
4	46	52	18.8	26.4	496.32	696.96
5	50	36	22.8	10.4	237.12	108.16

$$\Sigma R_A = 136$$

$$\Sigma R_M = 128$$

$$\bar{R}_A = 27.2$$

$$\bar{R}_M = 25.6$$

$$\text{Cov}_{A,M} = \frac{2358.4}{5 - 1}$$

$$\sigma_M^2 = \frac{1971.2}{5 - 1}$$

$$\beta_A = \frac{2358.4 / (5-1)}{1971.2 / (5-1)} = 1.196$$

(ii) Alpha = $\bar{R}_A - \beta_A \bar{R}_M$
= 27.2 - (1.196 x 25.6) = -3.42

Equation of the characteristic line is

$$R_A = -3.42 + 1.196 R_M$$

6. The rate of return on the stock of Omega Electronics and on the market portfolio for 6 periods has been as follows :

<i>Period</i>	<i>Return on the stock of Omega Electronics (%)</i>	<i>Return on the market portfolio (%)</i>
1	18%	15%
2	10%	12%
3	-5%	5%
4	20%	14%
5	9%	-2%
6	18%	16%

- (i) What is the beta of the stock of Omega Electronics?
(ii) Establish the characteristic line for the stock of Omega Electronics.

Solution:

Period	R ₀ (%)	R _M (%)	(R ₀ - R ₀)	(R _M - R _M)	(R ₀ - R ₀) (R _M - R _M)	(R _M - R _M) ²
1	18	15	6.33	5	31.65	25
2	10	12	-1.67	2	- 3.34	4
3	- 5	5	-16.67	-5	83.35	25
4	20	14	8.33	4	33.32	16
5	9	- 2	- 2.67	-12	32.04	144
6	18	16	6.33	6	37.98	36
$\sum R_0 = 70$		$\sum R_M = 60$	$\sum (R_0 - \bar{R}_0) (R_M - \bar{R}_M) = 215$		250	
$\bar{R}_0 = 11.67$		$\bar{R}_M = 10$				
$\sigma_M^2 = \frac{250}{5} = 50$		$Cov_{O,M} = \frac{215}{5} = 43.0$				
$\beta_0 = \frac{43.0}{50.0} = 0.86$						

(ii) Alpha = $\bar{R}_O - \beta_A \bar{R}_M$
= 11.67 - (0.86 x 10) = 3.07

Equation of the characteristic line is

$$R_A = 3.07 + 0.86 R_M$$

7. The risk-free return is 8 percent and the return on market portfolio is 16 percent. Stock X's beta is 1.2; its dividends and earnings are expected to grow at the constant rate of 10 percent. If the previous dividend per share of stock X was Rs.3.00, what should be the intrinsic value per share of stock X ?

Solution:

The required rate of return on stock A is:

$$\begin{aligned} R_X &= R_F + \beta_X (R_M - R_F) \\ &= 0.08 + 1.2 (0.16 - 0.08) \\ &= 0.176 \end{aligned}$$

Intrinsic value of share = $D_1 / (r - g) = D_0 (1+g) / (r - g)$

Given $D_0 = \text{Rs.}3.00$, $g = 0.10$, $r = 0.176$

$$\begin{aligned} \text{Intrinsic value per share of stock X} &= \frac{3.00 (1.10)}{0.176 - 0.10} \\ &= \text{Rs. } 43.42 \end{aligned}$$

8. The risk-free return is 7 percent and the return on market portfolio is 13 percent. Stock P's beta is 0.8 ; its dividends and earnings are expected to grow at the constant rate of 5 percent. If the previous dividend per share of stock P was Rs.1.00, what should be the intrinsic value per share of stock P ?

Solution:

The required rate of return on stock P is:

$$\begin{aligned} R_P &= R_F + \beta_P (R_M - R_F) \\ &= 0.07 + 0.8 (0.13 - 0.07) \\ &= 0.118 \end{aligned}$$

Intrinsic value of share = $D_1 / (r - g) = D_0 (1+g) / (r - g)$

Given $D_0 = \text{Rs.}1.00$, $g = 0.05$, $r = 0.118$

$$\begin{aligned} \text{Intrinsic value per share of stock P} &= \frac{1.00 (1.05)}{0.118 - 0.05} \\ &= \text{Rs. } 15.44 \end{aligned}$$

9. The risk-free return is 6 percent and the expected return on a market portfolio is 15 percent. If the required return on a stock is 18 percent, what is its beta?

Solution:

The SML equation is $R_A = R_F + \beta_A (R_M - R_F)$

Given $R_A = 18\%$, $R_F = 6\%$, $R_M = 15\%$, we have

$$0.18 = .06 + \beta_A (0.15 - 0.06)$$
$$\text{i.e. } \beta_A = \frac{0.12}{0.09} = 1.33$$

Beta of stock = 1.33

10. The risk-free return is 9 percent and the expected return on a market portfolio is 12 percent. If the required return on a stock is 14 percent, what is its beta?

Solution:

The SML equation is $R_A = R_F + \beta_A (R_M - R_F)$

Given $R_A = 14\%$, $R_F = 9\%$, $R_M = 12\%$, we have

$$0.14 = .09 + \beta_A (0.12 - 0.09)$$
$$\text{i.e. } \beta_A = \frac{0.05}{0.03} = 1.67$$

Beta of stock = 1.67

11. The risk-free return is 5 percent. The required return on a stock whose beta is 1.1 is 18 percent. What is the expected return on the market portfolio?

Solution:

The SML equation is: $R_X = R_F + \beta_X (R_M - R_F)$

We are given $0.18 = 0.05 + 1.1 (R_M - 0.05)$ i.e., $1.1 R_M = 0.185$
or $R_M = 0.1681$

Therefore return on market portfolio = 16.81 %

12. The risk-free return is 10 percent. The required return on a stock whose beta is 0.50 is 14 percent. What is the expected return on the market portfolio?

Solution:

The SML equation is: $R_X = R_F + \beta_X (R_M - R_F)$

We are given $0.14 = 0.10 + 0.50 (R_M - 0.10)$ i.e., $0.5 R_M = 0.09$
or $R_M = 0.18$

Therefore return on market portfolio = 18 %

13. The required return on the market portfolio is 15 percent. The beta of stock A is 1.5. The required return on the stock is 20 percent. The expected dividend growth on stock A is 6 percent. The price per share of stock A is Rs.86. What is the expected dividend per share of stock A next year?
What will be the combined effect of the following on the price per share of stock ?
- The inflation premium increases by 3 percent.
 - The decrease in the degree of risk-aversion reduces the differential between the return on market portfolio and the risk-free return by one-fourth.
 - The expected growth rate of dividend on stock A decrease to 3 percent.
 - The beta of stock A falls to 1.2

Solution:

$R_M = 15\%$ $\beta_A = 1.5$ $R_A = 20\%$ $g = 6\%$ $P_o = \text{Rs.}86$

$P_o = D_1 / (r - g)$

$\text{Rs.}86 = D_1 / (0.20 - .06)$

So $D_1 = \text{Rs.}12.04$ and $D_o = D_1 / (1+g) = 12.04 / (1.06) = \text{Rs.}11.36$

$R_A = R_f + \beta_A (R_M - R_f)$

$0.20 = R_f + 1.5 (0.15 - R_f)$

$0.5R_f = 0.025$

So $R_f = 0.05$ or 5%.

	<i>Original</i>	<i>Revised</i>
R_f	5%	8%
$R_M - R_f$	10%	7.5%
g	6 %	3%
β_A	1.5	1.2

$$\text{Revised } R_A = 8 \% + 1.2 (7.5\%) = 17 \%$$

Price per share of stock A, given the above changes is

$$\frac{11.36 (1.03)}{0.17 - 0.03} = \text{Rs. } 83.58$$

14. The required return on the market portfolio is 16 percent. The beta of stock A is 1.6. The required return on the stock is 22 percent. The expected dividend growth on stock A is 12 percent. The price per share of stock A is Rs.260. What is the expected dividend per share of stock A next year?

What will be the combined effect of the following on the price per share of stock ?

- The inflation premium increases by 5 percent.
- The decrease in the degree of risk-aversion reduces the differential between the return on market portfolio and the risk-free return by one-half.
- The expected growth rate of dividend on stock A decrease to 10 percent.
- The beta of stock A falls to 1.1

Solution:

$$R_M = 16\% \quad \beta_A = 1.6 \quad R_A = 22\% \quad g = 12\% \quad P_0 = \text{Rs. } 260$$

$$P_0 = D_1 / (r - g)$$

$$\text{Rs. } 260 = D_1 / (0.22 - .12)$$

$$\text{So } D_1 = \text{Rs. } 26 \text{ and } D_0 = D_1 / (1+g) = 26 / (1.12) = \text{Rs. } 23.21$$

$$R_A = R_f + \beta_A (R_M - R_f)$$

$$0.22 = R_f + 1.6 (0.16 - R_f)$$

$$0.6R_f = 0.036$$

$$\text{So } R_f = 0.06 \text{ or } 6\%.$$

	<i>Original</i>	<i>Revised</i>
R_f	6 %	11%
$R_M - R_f$	10%	5%
g	12 %	10 %
β_A	1.6	1.1

$$\text{Revised } R_A = 11\% + 1.1 (5\%) = 16.5 \%$$

Price per share of stock A, given the above changes is

$$\frac{23.21 (1.10)}{0.165 - 0.10} = \text{Rs. } 392.78$$

CHAPTER 9

1. The returns of two assets under four possible states of nature are given below :

<i>State of nature</i>	<i>Probability</i>	<i>Return on asset 1</i>	<i>Return on asset 2</i>
1	0.40	-6%	12%
2	0.10	18%	14%
3	0.20	20%	16%
4	0.30	25%	20%

- What is the standard deviation of the return on asset 1 and on asset 2?
- What is the covariance between the returns on assets 1 and 2?
- What is the coefficient of correlation between the returns on assets 1 and 2?

Solution:

(a)

$$E(R_1) = 0.4(-6\%) + 0.1(18\%) + 0.2(20\%) + 0.3(25\%)$$

$$= 10.9\%$$

$$E(R_2) = 0.4(12\%) + 0.1(14\%) + 0.2(16\%) + 0.3(20\%)$$

$$= 15.4\%$$

$$\sigma(R_1) = [0.4(-6 - 10.9)^2 + 0.1(18 - 10.9)^2 + 0.2(20 - 10.9)^2 + 0.3(25 - 10.9)^2]^{1/2}$$

$$= 13.98\%$$

$$\sigma(R_2) = [0.4(12 - 15.4)^2 + 0.1(14 - 15.4)^2 + 0.2(16 - 15.4)^2 + 0.3(20 - 15.4)^2]^{1/2}$$

$$= 3.35\%$$

(b) The covariance between the returns on assets 1 and 2 is calculated below

<i>State of nature</i>	<i>Probability</i>	<i>Return on asset 1</i>	<i>Deviation of return on asset 1 from its mean</i>	<i>Return on asset 2</i>	<i>Deviation of the return on asset 2 from its mean</i>	<i>Product of deviation times probability</i>
(1)	(2)	(3)	(4)	(5)	(6)	(2)x(4)x(6)
1	0.4	-6%	-16.9%	12%	-3.4%	22.98
2	0.1	18%	7.1%	14%	-1.4%	-0.99
3	0.2	20%	9.1%	16%	0.6%	1.09
4	0.3	25%	14.1%	20%	4.6%	19.45
					Sum =	42.53

Thus the covariance between the returns of the two assets is 42.53.

(c) The coefficient of correlation between the returns on assets 1 and 2 is:

$$\frac{\text{Covariance}_{12}}{\sigma_1 \times \sigma_2} = \frac{42.53}{13.98 \times 3.35} = 0.91$$

2. The returns of 4 stocks, A, B, C, and D over a period of 5 years have been as follows:

	1	2	3	4	5
A	8%	10%	-6%	-1%	9%
B	10%	6%	-9%	4%	11%
C	9%	6%	3%	5%	8%
D	10%	8%	13%	7%	12%

Calculate the return on:

- portfolio of one stock at a time
- portfolios of two stocks at a time
- portfolios of three stocks at a time.
- a portfolio of all the four stocks.

Assume equiproportional investment.

Solution:

Expected rates of returns on equity stock A, B, C and D can be computed as follows:

$$A: \quad \frac{8 + 10 - 6 - 1 + 9}{5} = 4\%$$

$$B: \quad \frac{10 + 6 - 9 + 4 + 11}{5} = 4.4\%$$

$$C: \quad \frac{9 + 6 + 3 + 5 + 8}{5} = 6.2\%$$

$$D: \quad \frac{10 + 8 + 13 + 7 + 12}{5} = 10.0\%$$

(a) Return on portfolio consisting of stock A = 4%

(b) Return on portfolio consisting of stock A and B in equal proportions = $0.5(4) + 0.5(4.4)$
= 4.2%

$$\begin{aligned}
 \text{(c) Return on portfolio consisting of stocks A, B and C in equal proportions} &= \frac{1}{3}(4) + \frac{1}{3}(4.4) + \frac{1}{3}(6.2) \\
 &= 4.87\%
 \end{aligned}$$

$$\begin{aligned}
 \text{(d) Return on portfolio consisting of stocks A, B, C and D in equal proportions} &= 0.25(4) + 0.25(4.4) + 0.25(6.2) + 0.25(10) \\
 &= 6.15\%
 \end{aligned}$$

3. A portfolio consists of 4 securities, 1, 2, 3, and 4. The proportions of these securities are: $w_1=0.3$, $w_2=0.2$, $w_3=0.2$, and $w_4=0.3$. The standard deviations of returns on these securities (in percentage terms) are: $\sigma_1=5$, $\sigma_2=6$, $\sigma_3=12$, and $\sigma_4=8$. The correlation coefficients among security returns are: $\rho_{12}=0.2$, $\rho_{13}=0.6$, $\rho_{14}=0.3$, $\rho_{23}=0.4$, $\rho_{24}=0.6$, and $\rho_{34}=0.5$. What is the standard deviation of portfolio return?

Solution:

The standard deviation of portfolio return is:

$$\begin{aligned}
 \sigma_p &= [w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + w_3^2 \sigma_3^2 + w_4^2 \sigma_4^2 + 2 w_1 w_2 \rho_{12} \sigma_1 \sigma_2 + 2 w_1 w_3 \rho_{13} \sigma_1 \sigma_3 + 2 w_1 w_4 \rho_{14} \sigma_1 \sigma_4 + 2 w_2 w_3 \rho_{23} \sigma_2 \sigma_3 + 2 w_2 w_4 \rho_{24} \sigma_2 \sigma_4 + 2 w_3 w_4 \rho_{34} \sigma_3 \sigma_4]^{1/2} \\
 &= [0.3^2 \times 5^2 + 0.2^2 \times 6^2 + 0.2^2 \times 12^2 + 0.3^2 \times 8^2 + 2 \times 0.3 \times 0.2 \times 0.2 \times 5 \times 6 \\
 &\quad + 2 \times 0.3 \times 0.2 \times 0.6 \times 5 \times 12 + 2 \times 0.3 \times 0.3 \times 0.3 \times 5 \times 8 \\
 &\quad + 2 \times 0.2 \times 0.2 \times 0.4 \times 6 \times 12 + 2 \times 0.2 \times 0.3 \times 0.6 \times 6 \times 8 \\
 &\quad + 2 \times 0.2 \times 0.3 \times 0.5 \times 12 \times 8]^{1/2} \\
 &= 5.82 \%
 \end{aligned}$$

4. Assume that a group of securities has the following characteristics : (a) the standard deviation of each security is equal to σ_A ; (b) covariance of returns σ_{AB} is equal for each pair of securities in the group.
What is the variance of a portfolio containing six securities which are equally weighted ?

Solution:

When there are 6 securities, you have 6 variance terms and $6 \times 5 = 30$ covariance terms.

As all variance terms are the same, all covariance terms are the same, and all securities are equally weighted, the portfolio variance is:

$$6w_A^2 \sigma_A^2 + 30 w_A^2 \sigma_{AB}$$

5. The following information is given:
- | | |
|--|-------|
| Expected return for the market | = 15% |
| Standard deviation of the market return | = 25% |
| Risk-free rate | = 8% |
| Correlation coefficient between stock A and the market | = 0.8 |
| Correlation coefficient between stock B and the market | = 0.6 |
| Standard deviation for stock A | = 30% |
| Standard deviation for stock B | = 24% |

(i) What is the beta for stock A?

Solution:

$$\rho_{AM} = \frac{Cov(A,M)}{\sigma_A \sigma_M} ; 0.8 = \frac{Cov(A,M)}{30 \times 25} \Rightarrow Cov(A,M) = 600$$

$$\sigma_M^2 = 25^2 = 625$$

$$\beta_A = \frac{Cov(A,M)}{\sigma_M^2} = \frac{600}{625} = 0.96$$

(ii) What is the expected return for stock A ?

Solution:

$$E(R_A) = R_f + \beta_A (E(R_M) - R_f)$$

$$= 8\% + 0.96 (7\%) = 14.72\%$$

6. The following table gives an analyst's expected return on two stocks for particular market returns.

Market Return	Aggressive Stock	Defensive Stock
5%	- 5%	10%
25%	45%	16%

(i) What is the ratio of the beta of the aggressive stock to the beta of the defensive stock?

Solution:

$$\text{Beta of aggressive stock} = \frac{45 - (-5)}{25 - 5} = 2.5$$
$$\text{Beta of defensive stock} = \frac{16 - 10}{25 - 5} = 0.30$$
$$\text{Ratio} = 2.5/0.30 = 8.33$$

- (ii) If the risk-free rate is 7% and the market return is equally likely to be 5% and 25% what is the market risk premium?

Solution:

$$E(R_M) = 0.5 \times 5 + 0.5 \times 25 = 15\%$$
$$\text{Market risk premium} = 15\% - 7\% = 8\%$$

- (iii) What is the alpha of the aggressive stock?

Solution:

$$\text{Expected return} = 0.5 \times -5 + 0.5 \times 45 = 20\%$$
$$\text{Required return as per CAPM} = 7\% + 2.5 (8\%) = 27\%$$
$$\text{Alpha} = - 7\%$$

7. The following table gives an analyst's expected return on two stocks for particular market returns.

<i>Market Return</i>	<i>Aggressive Stock</i>	<i>Defensive Stock</i>
8%	2%	10%
20%	32%	16%

- (i) What is the beta of the aggressive stock?

Solution:

$$\text{Beta} = \frac{32\% - 2\%}{20\% - 8\%} = 2.5$$

- (ii) If the risk-free rate is 6% and the market return is equally likely to be 8% and 20%, what is the market risk premium?

Solution:

The expected return on the market portfolio is:
 $0.5 \times 8\% + 0.5 \times 20\% = 14\%$
Since the risk-free rate is 6%, the market risk premium is 8%

- (iii) What is the alpha of the aggressive stock?

Solution:

Expected return on the aggressive stock = $0.5 \times 2\% + 0.5 \times 32\% = 17\%$
Required return = $6\% + 8 \times 2.5 = 26\%$
Alpha = $17 - 26\% = -9\%$

MINICASE(1)

Mr. Nitin Gupta had invested Rs.8 million each in Ashok Exports and Biswas Industries and Rs. 4 million in Cinderella Fashions, only a week before his untimely demise . As per his will this portfolio of stocks were to be inherited by his wife alone . As the partition among the family members had to wait for one year as per the terms of the will, the portfolio of shares had to be maintained as they were for the time being. The will had stipulated that the job of administering the estate for the benefit of the beneficiaries and partitioning it in due course was to be done by the reputed firm of Chartered Accountants, Talwar Brothers. Meanwhile the widow of the deceased was very eager to know certain details of the securities and had asked the senior partner of Talwar Brothers to brief her in this regard. For this purpose the senior partner has asked you to prepare a detailed note to him with calculations using CAPM, to answer the following possible doubts.

1. What is the expected return and risk (standard deviation) of the portfolio?
2. What is the scope for appreciation in market price of the three stocks-are they overvalued or undervalued?

You find that out the three stocks, your firm has already been tracking two viz. Ashok Exports (A) and Biswas Industries (B)-their betas being 1.7 and 0.8 respectively.

Further, you have obtained the following historical data on the returns of Cinderella Fashions(C):

Period	Market return (%)	Return on Cinderella Fashions (%)
1	10	14
2	5	8
3	(2)	(6)
4	(1)	4
5	5	10
6	8	11
7	10	15

On the future returns of the three stocks, you are able to obtain the following forecast from a reputed firm of portfolio managers.

State of the Economy	Probability	Returns (in percentage)				
		Treasury Bills	Ashok Exports	Biswas Industries	Cinderella Fashions	Sensex
Recession	0.3	7	5	15	(10)	(2)
Normal	0.4	7	18	8	16	17
Boom	0.3	7	30	12	24	26

Required:

Prepare your detailed note to the senior partner.

Solution:

- (1) Calculation of beta of Cinderella Fashions stock from the historical data

Period	Return Rc (%)	Return Rm (%)	Rc- \bar{R}_c	Rm- \bar{R}_m	(Rm- \bar{R}_m) ²	(Rc- \bar{R}_c) x (Rm- \bar{R}_m)
1	14	10	6	5	25	30
2	8	5	0	0	0	0
3	(6)	(2)	(14)	(7)	49	98
4	4	(1)	(4)	(6)	36	24
5	10	5	2	0	0	0
6	11	8	3	3	9	9
7	15	10	7	5	25	35

$$\sum R_c = 56 \quad \sum R_m = 35 \quad \sum (R_m - \bar{R}_m)^2 = 144 \quad \sum (R_c - \bar{R}_c)(R_m - \bar{R}_m) = 196$$

$$\bar{R}_c = 8 \quad \bar{R}_m = 5 \quad \sigma_m^2 = 144/6 = 24 \quad \text{Cov}(c,m) = 196/6 = 32.7$$

$$\text{Beta of Cinderella Fashions } \beta_c = 32.7/24 = 1.36$$

- (2) Calculation of expected returns, standard deviations and covariances

$$E(A) = [0.3 \times 5] + [0.4 \times 18] + [0.3 \times 30] = 17.7$$

$$E(B) = [0.3 \times 15] + [0.4 \times 8] + [0.3 \times 12] = 11.3$$

$$E(C) = [0.3 \times (-10)] + [0.4 \times 16] + [0.3 \times 24] = 10.6$$

$$E(M) = [0.3 \times (-2)] + [0.4 \times 17] + [0.3 \times 26] = 14$$

$$\sigma_A = [0.3(5-17.7)^2 + 0.4(18-17.7)^2 + 0.3(30-17.7)^2]^{1/2}$$

$$= [48.4 + 0.1 + 45.4]^{1/2} = 9.7$$

$$\sigma_B = [0.3(15-11.3)^2 + 0.4(8-11.3)^2 + 0.3(12-11.3)^2]^{1/2}$$

$$= [4.11 + 4.36 + 0.15]^{1/2} = 2.94$$

$$\sigma_C = [0.3(-10-10.6)^2 + 0.4(16-10.6)^2 + 0.3(24-10.6)^2]^{1/2}$$

$$= [127.31 + 11.66 + 53.87]^{1/2} = 13.89$$

$$\sigma_M = [0.3(-2-14)^2 + 0.4(17-14)^2 + 0.3(26-14)^2]^{1/2}$$

$$= [76.8 + 3.6 + 43.2]^{1/2} = 11.1$$

Calculation of covariances between the stocks

State of the Economy (1)	Prob- ability (2)	R _A - \bar{R}_A (3)	R _B - \bar{R}_B (4)	R _C - \bar{R}_C (5)	(2)x(3) x (4)	(2)x(4)x(5)	(2)x(3)x(5)
Recession	0.3	-12.7	3.7	-20.6	-14.1	-22.9	78.5
Normal	0.4	0.3	-3.3	5.4	-0.1	-7.1	0.6
Boom	0.3	12.3	0.7	13.4	2.6	2.8	49.4

$$\sigma_{A,B} = -11.6 \quad \sigma_{B,C} = -27.2 \quad \sigma_{A,C} = 128.5$$

Expected return and standard deviation of the portfolio

$$E(P) = (0.4 \times 17.7) + (0.4 \times 11.3) + (0.2 \times 10.6) = 13.7$$

$$\sigma_p = [w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + w_C^2 \sigma_C^2 + 2w_A w_B \sigma_{A,B} + 2w_B w_C \sigma_{B,C} + 2w_A w_C \sigma_{A,C}]^{1/2}$$
$$= [15.1 + 1.4 + 7.7 - 3.7 - 4.4 + 20.6]^{1/2} = 6.1$$

(3) Determining overpricing and underpricing using CAPM

$$\beta_A = 1.7 \quad \beta_B = 0.8 \quad \beta_C = 1.36 \quad E(R_M) = 14 \quad R_f = 7\%$$

$$SML = 7 + (14 - 7) \times \text{Beta}$$

$$= 7 + 7 \times \text{Beta}$$

$$\text{Required return on Ashok Exports} = 7 + (7 \times 1.7) = 18.9 \%$$

$$\text{Required return on Biswas Industries} = 7 + (7 \times 0.8) = 12.6 \%$$

$$\text{Required return on Cinderella Fashions} = 7 + (7 \times 1.36) = 16.5 \%$$

As the expected return of 17.7 % on Ashok Exports is slightly less than the required return of 18.9 %, its expected return can be expected to go up to the fair return indicated by CAPM and for this to happen its market price should come down. So it is slightly overvalued.

In the case of Biswas Industries stock, as the expected return of 11.3% is again slightly less than the required return of 12.6 %, its expected return can be expected to go up and for this to happen its market price should come down. So it is also slightly overvalued.

In the case of Cinderella Fashions the expected return is 10.6 % against the required return of 16.5 %. So it is considerably overvalued.

MINICASE(2)

Seth Ratanlal, who was widower and issueless, had left his substantial wealth as legacy to his nephew and niece through a will. Detailed instructions had been left on how the estate should be shared between the two, once both of them attained the age of majority. A week before his demise he had taken a fancy to the capital market and had invested a sizeable amount in equity shares, specifically, Rs.6 million in Arihant Pharma, Rs.4.8 million in Best Industries and Rs. 1.2 million in Century Limited. As the partition among the siblings had to wait for at least one more year as the girl was still a minor, the portfolio of shares had to be maintained as they were for the time being. The will had entrusted the job of administering the estate for the benefit of the beneficiaries and partitioning in due course to the reputed firm of Chartered Accountants, Karaniwala and Karaniwala. Meanwhile the young beneficiaries were very eager to know certain details of the securities and had asked the senior partner of the firm to brief them in this regard. For this purpose the senior partner has asked you to prepare a detailed note to him with calculations using CAPM, to answer the following possible doubts.

1. What is the expected return and risk (standard deviation) of the portfolio?
2. What is the scope for appreciation in market price of the three stocks-are they overvalued or undervalued?

You find that out the three stocks, your firm has already been tracking two viz. Arihant Pharma (A) and Best Industries (B)-their betas being 1.2 and 0.8 respectively. Further, you have obtained the following historical data on the returns of Century Limited(C):

Period	Market return (%)	Return on Century Limited (%)
-----	-----	-----
1	8	10
2	(6)	8
3	12	25
4	10	(8)
5	9	14
6	9	11

On the future returns of the three stocks, you are able to obtain the following forecast from a reputed firm of portfolio managers.

State of the Economy	Probability	<u>Returns (in percentage) on</u>				
		Treasury Bills	Arihant Pharma	Best Industries	Century Limited	Nifty
-----	-----	-----	-----	-----	-----	-----
Recession	0.2	6	(10)	(8)	15	(8)
Normal	0.4	6	18	12	6	15
Boom	0.4	6	30	20	(10)	25

Prepare your report.

Solution:

(3) Calculation of beta of Century Limited stock from the historical data

Period	Return Rc (%)	Return Rm (%)	Rc- \bar{R}_c	Rm- \bar{R}_m	(Rm- \bar{R}_m) ²	(Rc- \bar{R}_c) x (Rm- \bar{R}_m)
1	10	8	0	1	1	0
2	8	(6)	(2)	(13)	169	26
3	25	12	15	5	25	75
4	(8)	10	(18)	3	9	(54)
5	14	9	4	2	4	8
6	11	9	1	2	4	2

$$\sum R_c = 60 \quad \sum R_m = 42 \quad \sum (R_m - \bar{R}_m)^2 = 212 \quad \sum (R_c - \bar{R}_c)(R_m - \bar{R}_m) = 57$$

$$\bar{R}_c = 10 \quad \bar{R}_m = 7 \quad \sigma_m^2 = 212/5 = 42.4 \quad \text{Cov}(c,m) = 57/5 = 11.4$$

Beta of Century Limited $\beta_c = 11.4/42.4 = 0.3$

(4) Calculation of expected returns, standard deviations and covariances

$$E(A) = [0.2 \times (-10)] + [0.4 \times 18] + [0.4 \times 30] = -2 + 7.2 + 12 = 17.2$$

$$E(B) = [0.2 \times (-8)] + [0.4 \times 12] + [0.4 \times 20] = -1.6 + 4.8 + 8 = 11.2$$

$$E(C) = [0.2 \times 15] + [0.4 \times 6] + [0.4 \times (-10)] = 3 + 2.4 - 4 = 1.4$$

$$E(M) = [0.2 \times (-8)] + [0.4 \times 15] + [0.4 \times 25] = -1.6 + 6.0 + 10 = 14.4$$

$$\sigma_A = [0.2(-10-17.2)^2 + 0.4(18-17.2)^2 + 0.4(30-17.2)^2]^{1/2}$$

$$= [148 + 0.3 + 65.5]^{1/2} = 14.6$$

$$\sigma_B = [0.2(-8-11.2)^2 + 0.4(12-11.2)^2 + 0.4(20-11.2)^2]^{1/2}$$

$$= [73.7 + 0.3 + 31.0]^{1/2} = 10.2$$

$$\sigma_C = [0.2(15-1.4)^2 + 0.4(6-1.4)^2 + 0.4(-10-1.4)^2]^{1/2}$$

$$= [37 + 8.5 + 52]^{1/2} = 9.9$$

$$\sigma_M = [0.2(-8-14.4)^2 + 0.4(15-14.4)^2 + 0.4(25-14.4)^2]^{1/2}$$

$$= [100.4 + 0.1 + 44.9]^{1/2} = 12.1$$

Calculation of covariances between the stocks

State of the Economy (1)	Probability (2)	R _A - \bar{R}_A (3)	R _B - \bar{R}_B (4)	R _C - \bar{R}_C (5)	(2)x(3)x(4)	(2)x(4)x(5)	(2)x(3)x(5)
Recession	0.2	(27.2)	(19.2)	13.6	104.4	(52.2)	(74.0)
Normal	0.4	0.8	0.8	4.6	0.3	1.5	1.5
Boom	0.4	12.8	8.8	(11.4)	45.1	(40.1)	(58.4)

$$\sigma_{A,B} = 149.8 \quad \sigma_{B,C} = (90.8) \quad \sigma_{A,C} = (130.9)$$

Expected return and standard deviations of the portfolio

$$E(P) = (0.5 \times 17.2) + (0.4 \times 11.2) + (0.1 \times 1.4) = 8.6 + 4.5 + 0.1 = 13.2\%$$

$$\sigma_p = [w_A^2 \sigma_A^2 + w_B^2 \sigma_B^2 + w_C^2 \sigma_C^2 + 2w_A w_B \sigma_{A,B} + 2w_B w_C \sigma_{B,C} + 2w_A w_C \sigma_{A,C}]^{1/2}$$

$$= [53.3 + 16.6 + 1.0 + 59.9 - 7.3 - 13.1]^{1/2} = 10.5$$

(3) Determining overpricing and underpricing using CAPM

$$\beta_A = 1.2 \quad \beta_B = 0.8 \quad \beta_C = 0.3 \quad E(R_M) = 14.4 \quad R_f = 6\%$$

$$SML = 6 + (14.4 - 6) \times \text{Beta}$$

$$= 6 + 8.4 \times \text{Beta}$$

$$\text{Required return on Arihant Pharma} = 6 + (8.44 \times 1.2) = 16.1\%$$

$$\text{Required return on Best Industries} = 6 + (8.44 \times 0.8) = 12.7\%$$

$$\text{Required return on Century Limited} = 6 + (8.44 \times 0.3) = 8.5\%$$

As the expected return of 17.2 % on Arihant Pharma is slightly more than the required return of 16.1 %, its expected return can be expected to come down to the fair return indicated by CAPM and for this to happen its market price should go up. So it is slightly undervalued.

In the case of Best Industries stock, as the expected return is slightly less than the required return of 12.7%, its expected return can be expected to go up and for this to happen its market price should go down. So it is slightly undervalued. Century Limited can be considered as overvalued as its required return is far in excess of the expected return which is likely to drive the market

CHAPTER 10

1. A stock is currently selling for Rs.80. In a year's time it can rise by 50 percent or fall by 20 percent. The exercise price of a call option is Rs.90.
 - (i) What is the value of the call option if the risk-free rate is 10 percent? Use the option-equivalent method.

Solution:

$S_0 = \text{Rs.}80$	$u = 1.5$	$d = 0.8$
$E = \text{Rs.}90$	$r = 0.10$	$R = 1.10$

$$\Delta = \frac{C_u - C_d}{(u - d) S} = \frac{30 - 0}{0.7 \times 80} = \frac{30}{56}$$

$$B = \frac{u C_d - d C_u}{(u - d) R} = \frac{1.5 \times 0 - 0.8 \times 30}{0.7 \times 1.10} = -31.17$$

$$C = \Delta S + B$$

$$= \frac{30}{56} \times 80 - 31.17$$

$$= 11.69$$

(ii) What is the value of the call option if the risk-free rate is 6 percent? Use the risk-neutral method.

Solution:

$$[P \times 50\%] + [(1 - P) \times -20\%] = 6\%$$

$$50P + 20P = 26 \Rightarrow P = 0.37$$

Expected future value of a call

$$0.37 \times 30 + 0.63 \times 0 = \text{Rs.}11.10$$

$$\text{Current value} = \frac{\text{Rs.}11.10}{1.06} = \text{Rs.}10.47$$

2. An equity share is currently selling for Rs 100. In a year's time it can rise by 30 percent or fall by 10 percent. The exercise price of call option on this share is Rs.110.

(i) What is the value of the call option if the risk – free rate is 7 percent ? Use the option – equivalent method.

Solution:

$$\begin{aligned} S_0 &= 100, & E &= 110, & u &= 1.3, & d &= 0.9, & R &= 1.07 \\ &= \frac{C_u - C_d}{(u - d) S_0} = \frac{20 - 0}{0.4 \times 100} = \frac{20}{40} = 0.5 \\ B &= \frac{uC_d - dC_u}{(u - d) R} = \frac{1.3 \times 0 - 0.9 \times 20}{0.4 \times 1.07} = -42.06 \\ C &= \Delta S + B = 0.5 \times 100 - 42.06 = 7.94 \end{aligned}$$

(ii) What is the value of the call option if the risk-free rate is 6 percent? Use the risk – neutral method.

Solution:

$$\begin{aligned} P \times 30\% + (1-P) \times -10\% &= 6\% \\ 30P + 10P - 10 &= 6 \Rightarrow P = 0.4 \\ \text{Expected future value of call} \\ 0.4 \times 20 + 0.6 \times 0 &= \text{Rs. } 8.00 \\ \text{Current value} &= \frac{8}{1.06} = \text{Rs. } 7.55 \end{aligned}$$

3. An equity share is currently selling for Rs.60. In a year's time, it can rise by 50 percent or fall by 10 percent. The exercise price of a call option on this share is Rs.70.
- a. What is the value of the call option if the risk-free rate is 8 percent? Use the option-equivalent method.

Solution:

$$S_0 = \text{Rs. } 60, E = \text{Rs. } 70, u = 1.5, d = 0.9, R = 1.08$$

$$\Delta = \frac{C_u - C_d}{(u - d) S_0} = \frac{20 - 0}{(0.6) 60} = \frac{20}{36}$$

$$B = \frac{u C_d - d C_u}{(u - d) R} = \frac{1.5 \times 0 - 0.9 \times 20}{0.6 \times 1.08} = -27.78$$

$$C = \Delta S + B = 20 / 36 \times 60 - 27.78 = \text{Rs. } 5.55$$

- b. What is the value of the call option, if the risk-free rate is 6 percent? Use the risk-neutral method.

Solution:

$$P \times 50\% + (1 - P) \times -10\% = 6\%$$

$$50P + 10P - 10 = 6 \Rightarrow P = 0.27$$

Expected future value of call

$$0.27 \times 20 + 0.73 \times 0 = 5.4$$

$$\text{Current value} = \frac{5.4}{1.06} = \text{Rs. } 5.09$$

4. The following information is available for a call option:

Time to expiration (months)	3
Risk free rate	8%
Exercise price	Rs.60
Stock price	Rs.70
Call price	Rs.14

What is the value of a put option if the time to expiration is 3 months, risk free rate is 8%, exercise price is Rs.60 and the stock price is Rs.70 ?

Hint : Use put-call parity theorem

Solution:

According to put-call parity theorem

$$\begin{aligned}
 P_0 &= C_0 + \frac{E}{e^{rt}} - S_0 \\
 &= 14 + \frac{60}{e^{.08 \times .25}} - 70 \\
 &= 14 + \frac{60}{1.0202} - 70 = \text{Rs.}2.812
 \end{aligned}$$

5. Consider the following data for a certain share:

Price of the stock now = $S_0 = \text{Rs.}80$

Exercise price = $E = \text{Rs.}90$

Standard deviation of continuously compounded annual return = $\sigma = 0.3$

Expiration period of the call option = 3 months

Risk-free interest rate per annum = 8 percent

(i) What is the value of the call option? Use the normal distribution table and resort to linear interpolation.

Solution:

$$S_0 = \text{Rs. } 80, \quad E = \text{Rs. } 90, \quad r = 0.08, \quad \sigma = 0.3, \quad t = 0.25$$

$$C_0 = S_0 N(d_1) - \frac{E}{e^{rt}} N(d_2)$$

$$d_1 = \frac{\ln \left(\frac{S_0}{E} \right) + \left(r + \frac{\sigma^2}{2} \right) t}{\sigma \sqrt{t}}$$

$$= \frac{-0.1178 + \left(0.08 + \frac{0.09}{2} \right) 0.25}{0.3 \sqrt{0.25}} = -0.577$$

$$d_2 = d_1 - \sigma \sqrt{t} = -0.577 - 0.3 \sqrt{0.25} = -0.727$$

$$\begin{aligned} N(d_1) &= N(-0.577) & N(-0.600) &= 0.2743 \\ & & N(-0.550) &= 0.2912 \\ & & N(-0.577) &= 0.2743 + (0.023 / 0.050) [0.2912 - 0.2743] \\ & & &= 0.2821 \end{aligned}$$

$$\begin{aligned} N(d_2) &= N(-0.727) & N(-0.750) &= 0.2264 \\ & & N(-0.700) &= 0.2420 \\ & & N(-0.727) &= 0.2264 + (0.023 / 0.050) [0.2420 - 0.2264] \\ & & &= 0.2336 \end{aligned}$$

$$\begin{aligned} C_o &= 80 \times 0.2821 - \frac{90}{e^{0.08 \times 0.25}} \times 0.2336 \\ &= 22.57 - 20.61 = \text{Rs. } 1.96 \end{aligned}$$

(ii) What is the value of a put option

Solution:

$$\begin{aligned} P_o &= C_o - S_o + \frac{E}{e^{rt}} \\ &= 1.96 - 80 + \frac{90}{e^{0.08 \times 0.25}} = \text{Rs. } 10.18 \end{aligned}$$

6. Consider the following data for a certain share.

Current Price = S_0 = Rs. 80

Exercise Price = E = Rs. 90

Standard deviation of continuously compounded annual return = $\sigma = 0.5$

Expiration period of the call option = 3 months

Risk – free interest rate per annum = 6 percent

(i) What is the value of the call option? Use the normal distribution table given at the end of this booklet and resort to linear interpolation.

Solution:

	$S_0 = \text{Rs. } 80$	$E = \text{Rs. } 90$
	$r = 0.06, \sigma = 0.5,$	$t = 0.25$
C_0	$= S_0 N(d_1) - \frac{E}{e^{rt}} N(d_2)$	
d_1	$= \frac{\ln\left(\frac{S_0}{E}\right) + \left(\frac{r + \sigma^2}{2}\right) t}{\sigma \sqrt{t}}$	
	$= \frac{-0.1178 + \left(\frac{0.06 + 0.25}{2}\right) 0.25}{0.5 \sqrt{0.25}}$	
	$= -0.2862$	
d_2	$= d_1 - \sigma \sqrt{t} = -0.2862 - 0.5 \sqrt{0.25} = -0.5362$	
$N(d_1)$	$= N(-0.2862)$	
	$N(-0.30) = 0.3821$	
	$N(-0.25) = 0.4013$	
	$= 0.3821 + 0.0138 \left[\frac{0.4013 - 0.3821}{0.05} \right]$	
	$= 0.3874$	
$N(d_2)$	$= N(-0.5362)$	
	$N(-0.55) = 0.2912$	
	$N(-0.50) = 0.3085$	
	$= 0.2912 + 0.0138 \left[\frac{0.3085 - 0.2912}{0.05} \right]$	
	$= 0.2960$	
C_0	$= 80 \times 0.3874 - \frac{90}{e^{0.06 \times 0.25}} \times 0.2960$	
	$= 30.99 - 26.24$	
	$= \text{Rs. } 4.75$	

(ii) What is the value of a put option?

Solution:

$$\begin{aligned}
 P_0 &= C_0 - S_0 + \frac{E}{e^{rt}} \\
 &= 4.75 - 80 + \frac{90}{e^{.06 \times 0.25}} \\
 &= \text{Rs. } 13.41
 \end{aligned}$$

7. Consider the following data for a certain stock:

Price of the stock now = $S_0 = \text{Rs. } 150$

Exercise price = $E = \text{Rs. } 140$

Standard deviation of continuously compounded annual return = $\sigma = 0.30$

Expiration period of the call option = 3 months

Risk-free interest rate per annum = 6 percent

(i) What is the value of the call option? Use normal distribution table and resort to linear interpolation?

Solution:

$$\begin{aligned}
 C_0 &= S_0 N(d_1) - \frac{E}{e^{rt}} N(d_2) && S_0 = \text{Rs. } 150, E = \text{Rs. } 140, r = 0.06, \\
 & && \sigma = 0.3, t = 0.25 \\
 d_1 &= \frac{\ln(S_0/E) + (r + \sigma^2/2) t}{\sigma \sqrt{t}} \\
 &= \frac{0.069 + (0.06 + 0.09/2) 0.25}{0.3 \sqrt{0.25}} = 0.635 \\
 d_2 &= d_1 - \sigma \sqrt{t} = 0.485 \\
 N(d_1) &= N(0.635) = 0.7373 && N(0.60) = 1 - 0.2743 = 0.7257 \\
 N(d_2) &= N(0.485) = 0.6861 && N(0.65) = 1 - 0.2578 = 0.7422 \\
 & && \quad \quad \quad .035 \\
 & && N(0.635) = 0.7257 + \frac{(.7422 - .7257)}{.05} \\
 & && \quad \quad \quad = 0.7373 \\
 C_0 &= 150 \times 0.7373 - \frac{140}{e^{.06 \times 0.25}} \times 0.6861 && N(0.45) = 1 - 0.3264 = 0.6736 \\
 & && N(0.50) = 1 - 0.3085 = 0.6915 \\
 & && \quad \quad \quad .035 \\
 & && N(0.485) = 0.6736 + \frac{(.6915 - 0.6736)}{.05} \\
 & && \quad \quad \quad = 0.6861 \\
 &= 110.60 - 94.62 = \text{Rs. } 15.98 &&
 \end{aligned}$$

(ii) What is the value of the put option?

Solution:

$$\begin{aligned}
 P_0 &= C_0 - S_0 + \frac{E}{e^{rt}} \\
 &= 15.98 - 150 + \frac{140}{e^{.06 \times .25}} \\
 &= \text{Rs.}3.90
 \end{aligned}$$

8. Lakshmi Limited has a current value of 8000. The face value of its outstanding bonds is 6000. These are 1 year discount bonds with an obligation of 6000 in year 1. The risk-free interest rate is 8 percent and the variance of the continuously compounded rate of return on the firm's assets is 16 percent.

What is the present value of Lakshmi Limited's equity, S_0 , and debt, B_0 ?

Solution:

$$\begin{aligned}
 S_0 &= V_0 N(d_1) - B_1 e^{-rt} N(d_2) \\
 &= 8000 N(d_1) - 6000 e^{-0.08} N(d_2) \\
 d_1 &= \frac{\ln(8000 / 6000) + (0.08 \times 1) + (0.16/2)}{\sqrt{0.16} \times \sqrt{1}} \\
 &= \frac{\ln(1.333) + 0.16}{0.4} \\
 &= (0.2874 + 0.16) / 0.4 = 1.1185 \\
 N(d_1) &= N(1.1185) \\
 &\text{From the tables} \\
 N(1.10) &= 1 - 0.1357 = 0.8643 \\
 N(1.15) &= 1 - 0.1251 = 0.8749 \\
 &\text{By linear extrapolation } N(1.1185) = 0.8643 + (1.1185 - 1.10)(0.8749 - 0.8643) / 0.05 \\
 &= 0.8643 + 0.003922 = 0.8682
 \end{aligned}$$

$$d_2 = 1.1185 - 0.4$$

$$= 0.7185$$

$$N(d_2) = N(0.7185)$$

From the tables

$$N(0.70) = 1 - 0.2420 = 0.7580$$

$$N(0.75) = 1 - 0.2264 = 0.7736$$

$$\text{By linear interpolation } N(0.7185) = 0.7580 + (0.7185 - 0.70)(0.7736 - 0.7580)/0.05$$

$$= 0.7580 + 0.005772 = 0.7638$$

$$S_0 = 8000 \times 0.8682 - (6000 \times 0.9231 \times 0.7638)$$

$$= 2715$$

$$B_0 = V_0 - S_0$$

$$= 8000 - 2715 = 5285$$

MINICASE

On majoring in finance you have got selected as the finance manager in Navin Exports, a firm owned by Navin Sharma a dynamic young technocrat. The firm has been registering spectacular growth in recent years. With a view to broad base its investments, the firm had applied for the shares of Universal Industries a month back during its IPO and got allotment of 5000 shares thereof. . Recently Mr. Sharma had attended a seminar on capital markets organised by a leading bank and had decided to try his hand in the derivatives market . So, the very next day you joined the firm, he has called you for a meeting to get a better understanding of the options market and to know the implications of some of the strategies he has heard about. For this he has placed before you the following chart of the option quotes of Universal Industries and requested you to advise him on his following doubts, based on the figures in the chart.

Universal Industries Option Quotes.

(All amounts are in rupees)

Stock Price :350

Strike Price	Calls			Puts		
	Jan	Feb	March	Jan	Feb	March
300	50	55	- *	-	-	-
320	36	40	43	3	5	7
340	18	20	21	8	11	-
360	6	9	16	18	21	23
380	4	5	6	-	43	-

* A blank means no quotation is available

1. List out the options which are out-of-the-money.
2. What are the relative pros and cons (i.e. risk and reward) of selling a call against the 5000 shares held, using (i) Feb/380 calls versus (ii) March 320/ calls ?
3. Show how to calculate the maximum profit, maximum loss and break-even associated with the strategy of simultaneously buying say March/340 call while selling March/ 360 call?
4. What are the implications for the firm, if for instance, it simultaneously writes March 360 call and buys March 320/put?
5. What should be value of the March/360 call as per the Black-Scholes Model? Assume that $t=3$ months, risk-free rate is 8 percent and the standard deviation is 0.40
6. What should be the value of the March/360 put if the put-call parity is working?

Solution:

- 1) Calls with strike prices 360 and 380 are out –of –the- money.
- 2) (i) If the firm sells Feb/380 call on 5000 shares, it will earn a call premium of Rs.25,000 now. The risk however is that the firm will forfeit the gains that it would have enjoyed if the share price rises above Rs. 380.
(ii) If the firm sells March 320 calls on 5000 shares, it will earn a call premium of Rs.215,000 now. It should however be prepared to forfeit the gains if the share price remains above Rs.320.
- 3) Let s be the stock price, p_1 and p_2 the call premia for March/ 340 and March/ 360 calls respectively. When s is greater than 360, both the calls will be exercised and the profit will be $\{ s-340-p_1 \} - \{ s-360- p_2 \} = \text{Rs. } 15$
The maximum loss will be the initial investment , i.e. $p_1-p_2 = \text{Rs.}5$
The break even will occur when the gain on purchased call equals the net premium paid
i.e. $s-340 = p_1 - p_2 = 5$ Therefore $s= \text{Rs. } 345$
- 4) If the stock price goes below Rs.320, the firm can execute the put option and ensure that its portfolio value does not go below Rs. 320 per share. However, if stock price goes above Rs. 380, the call will be exercised and the stocks in the portfolio will have to be delivered/ sold to meet the obligation, thus limiting the upper value of the portfolio to Rs. 380 per share. So long as the share price hovers between R. 320 and Rs. 380, the firm will lose Rs. 1 (net premium received) per pair of call and put.

5)

$$S_0 = 350 \quad E = 360 \quad t = 0.25 \quad r = 0.07 \quad \sigma = 0.40$$

$$d_1 = \frac{\ln \left(\frac{350}{360} \right) + \left(0.07 + \frac{(0.40)^2}{2} \right) \times 0.25}{0.40 \times \sqrt{0.25}}$$

$$= (-0.0282 + 0.0375) / 0.2 = 0.0465$$

$$d_2 = 0.0465 - 0.40 \sqrt{0.25} = -0.1535$$

Using normal distribution table

$$N(0.00) = 1 - 0.5000 = 0.5000$$

$$N(0.05) = 1 - 0.4801 = 0.5199$$

$$\text{Therefore } N(0.0465) = 0.5000 + (0.0465/0.0500) \times (0.5199 - 0.5000) = 0.5185$$

$$N(-0.20) = 0.4207$$

$$N(-0.15) = 0.4404$$

$$\text{Therefore } N(-0.1535) = 0.4207 + (0.0465/0.0500) \times (0.4404 - 0.4207) = 0.4390$$

$$E / e^{rt} = 360 / e^{0.07 \times 0.25} = 360 / 1.01765 = 353.75$$

$$C_0 = 350 \times 0.5185 - 353.75 \times 0.4390 = 181.480 - 155.30 = \text{Rs. } 26.18$$

- 6) If put-call parity is working, we have $P_0 = C_0 - S_0 + E/e^{rt}$
 Value of the March/360 put = $26.18 - 350 + 353.75$
 = Rs.29.93

CHAPTER 11

1. Matrix Associates is evaluating a project whose expected cash flows are as follows:

<u>Year</u>	<u>Cash flow (Rs. in million)</u>
0	(23)
1	6
2	8
3	9
4	7

The cost of capital for Matrix Associates is 14 percent.

- (i) What is the NPV of the project?

Solution:

$$\begin{aligned} \text{NPV} &= -23 + \frac{6}{(1.14)} + \frac{8}{(1.14)^2} + \frac{9}{(1.14)^3} + \frac{7}{(1.14)^4} \\ &= -23 + 5.263 + 6.156 + 6.075 + 4.145 \\ &= -1.361 \end{aligned}$$

(ii) What is the IRR of the project?

Solution:

When the discount rate is 14 %, the NPV is -1.361
Trying a lower rate of 12%

$$\begin{aligned} \text{NPV} &= -23 + \frac{6}{(1.12)} + \frac{8}{(1.12)^2} + \frac{9}{(1.12)^3} + \frac{7}{(1.12)^4} \\ &= -23 + 5.357 + 6.378 + 6.406 + 4.449 = -0.41 \end{aligned}$$

Trying a still lower rate of 11%

$$\begin{aligned} \text{NPV} &= -23 + \frac{6}{(1.11)} + \frac{8}{(1.11)^2} + \frac{9}{(1.11)^3} + \frac{7}{(1.11)^4} \\ &= -23 + 5.405 + 6.493 + 6.581 + 4.611 = 0.09 \end{aligned}$$

By linear interpolation we get

$$\text{IRR} = 11 + \frac{0.09}{(0.41 + 0.09)} = 11.18\%$$

(iii) What is the NPV* of the project if the reinvestment rate is 18 percent?

Solution:

$$\begin{aligned} \text{Terminal value} &= 6(1.18)^3 + 8(1.18)^2 + 9(1.18) + 7 = 38.617 \\ \text{NPV}^* &= 38.617 / (1.14)^4 - 23 = -0.136 \end{aligned}$$

(iv) What is the MIRR of the project if the reinvestment rate is 18 percent?

Solution:

$$23 (1+\text{MIRR})^4 = 38.617$$

$$(1+\text{MIRR})^4 = 38.617 / 23 = 1.679$$

$$\text{MIRR} = (1.679)^{1/4} - 1 = 13.83\%$$

2. Sigma Corporation is evaluating a project whose expected cash flows are as follows:

Year	Cash flow (Rs.in million)
0	- 16.0
1	3.2
2	4.5
3	7.0
4	8.4

The cost of capital for Sigma Corporation is 12 percent .

(i) What is the NPV of the project?

Solution:

$$\begin{aligned} \text{NPV} &= -16.0 + \frac{3.2}{(1.12)} + \frac{4.5}{(1.12)^2} + \frac{7.0}{(1.12)^3} + \frac{8.4}{(1.12)^4} \\ &= -16.0 + 2.8576 + 3.5865 + 4.984 + 5.3424 \\ &= 0.7705 \end{aligned}$$

(ii) What is the IRR of the project?

Solution:

At 12% discount rate NPV is 0.7705										
Try 13%										
NPV	=	-16	+	3.2 (0.885)	+	4.5 (0.783)	+	7 (0.693)	+	8.4 (0.613)
	=	-16	+	2.832	+	3.5235	+	4.851	+	5.1492
	=	0.3557								
Try 14%										
NPV	=	-16	+	3.2 (0.877)	+	4.5 (0.769)	+	7 (0.675)	+	8.4 (0.592)
	=	-16	+	2.8064	+	3.4605	+	4.725	+	4.9728
	=	-0.0353								
As this is very nearly zero, the IRR of the project is 14 %										

(iii) What is the NPV* of the project if the reinvestment rate is 16%?

Solution:

Terminal Value	=	3.2 (1.16) ³	+	4.5 (1.16) ²	+	7 (1.16) ¹	+	8.4
	=	3.2 (1.561)	+	4.5 (1.346)	+	7 (1.16)	+	8.4
	=	4.9952	+	6.057	+	8.12	+	8.4
	=	27.5722						
NPV*	=	$\frac{27.5722}{(1.12)^4} - 16 = 1.5359$						

(iv) What is the IRR* if the reinvestment rate is 16%?

Solution:

$16 (1 + \text{IRR}^*)^4$	=	27.5722
$(1 + \text{IRR}^*)^4$	=	$\frac{27.5722}{16} = 1.7233$
IRR*	=	$(1.7233)^{1/4} - 1$
	=	1.1457 - 1 = 14.57 %

3. Dumas Company is evaluating a project whose expected cash flows are as follows:

<i>Year</i>	<i>Cash flow</i>
0	- Rs.700,000
1	Rs.150,000
2	Rs.200,000
3	Rs.300,000
4	Rs.350,000

The cost of capital for Dumas Company is 12 percent

(i) What is the NPV of the project?

Solution:

- 700,000	1.000	-700,000
150,000	0.893	133,950
200,000	0.797	159,400
300,000	0.712	213,600
350,000	0.636	222,600
		29,550

(ii)

Solution:

	13%		14%	
	PVIF	PV	PVIF	PV
150,000	0.885	132,750	0.877	131,550
200,000	0.783	156,600	0.769	153,800
300,000	0.693	207,900	0.675	202,500
350,000	0.613	214,550	0.592	207,200
		<u>711,800</u>		<u>695,050</u>

$$\text{IRR} = 13\% + \frac{711,800 - 700,000}{711,800 - 695,050} \times 1\% = 13.70\%$$

(iii) What is the NPV* of the project if the reinvestment rate is 15% ?

Solution:

Terminal value	=	150,000 (1.15) ³	+	200,000 (1.15) ²	+	300,000 (1.15) ¹	+	350,000
	=	150,000 (1.521)	+	200,000 (1.322)	+	300,000 (1.150)	+	350,000
	=	228,150	+	264,400	+	345,000	+	350,000
	=	1,187,550						
NPV*	=	1,187,550	-	700,000				
		(1.12) ⁴						
	=	54,709						

(iv) What is the IRR* if the reinvestment rate is 15%?

Solution:

$$\begin{aligned}
 700,000 (1 + \text{IRR}^*)^4 &= 1,187,550 \\
 (1 + \text{IRR}^*)^4 &= 1,187,550 / 700,000 = 1.6965 \\
 \text{IRR}^* &= (1.6965)^{1/4} - 1 \\
 &= 1.1413 - 1 = 14.13\%
 \end{aligned}$$

4. You are evaluating a project whose expected cash flows are as follows:

<i>Year</i>	<i>Cash flow</i>
0	-1,000,000
1	200,000
2	300,000
3	400,000
4	500,000

What is the NPV of the project (in '000s) if the discount rate is 10 percent for year 1 and rises thereafter by 2 percent every year?

Solution:

$$\begin{aligned}
 \text{PVB} &= \frac{200}{(1.10)} + \frac{300}{(1.10)(1.12)} + \frac{400}{(1.10)(1.12)(1.14)} \\
 &\quad + \frac{500}{(1.10)(1.12)(1.14)(1.16)} \\
 &= 181.82 + 243.51 + 284.80 + 306.90 \\
 &= 1017.03 ; \\
 \text{NPV} &= 1,017,030 - 1,000,000 = 17,030
 \end{aligned}$$

5. The cash flows associated with an investment are given below:

<i>Year</i>	<i>Cash flow</i>
0	Rs.(850,000)
1	120,000
2	450,000
3	360,000
4	210,000
5	130,000

Calculate the benefit cost ratio of this investment, if the discount rate is 12 percent.

Solution:

$$\begin{aligned} \text{PV of benefits (PVB)} &= 120,000 \times \text{PVIF (12,1)} + 450,000 \times \text{PVIF (12,2)} \\ &+ 360,000 \times \text{PVIF (12,3)} + 210,000 \times \text{PVIF (12,4)} \\ &+ 130,000 \times \text{PVIF (12,5)} \\ &= 107,160 + 358,650 + 256,320 + 133,560 + 73,710 \\ &= \text{Rs. } 929,400 \text{(A)} \end{aligned}$$

$$\text{Investment} = 850,000 \quad \text{(B)}$$

$$\text{Benefit cost ratio (A/B)} = 929,400 / 850,000 = 1.09$$

6. The cash flows associated with an investment are given below:

<i>Year</i>	<i>Cash flow</i>
0	Rs.(260,000)
1	85,420
2	103,240
3	128,430
4	92,480
5	78,350

Calculate the benefit cost ratio of this investment, if the discount rate is 18 percent.

Solution:

$$\begin{aligned} \text{PV of benefits (PVB)} &= 85,420 \times \text{PVIF (18,1)} + 103,240 \times \text{PVIF (18,2)} \\ &+ 128,430 \times \text{PVIF (18,3)} + 92,480 \times \text{PVIF (18,4)} \\ &+ 78,350 \times \text{PVIF (18,5)} \\ &= 72,351 + 74,126 + 78,214 + 47,720 + 34,239 \\ &= \text{Rs. } 306,650 \text{(A)} \end{aligned}$$

$$\text{Investment} = 260,000 \quad \text{(B)}$$

$$\text{Benefit cost ratio(A/B)} = 306,650 / 260,000 = 1.18$$

7. Your company is considering two mutually exclusive projects, *A* and *B*. Project *A* involves an outlay of Rs.250 million which will generate an expected cash inflow of Rs.60 million per year for 8 years. Project *B* calls for an outlay of Rs.100 million which will produce an expected cash inflow of Rs.25 million per year for 8 years. The company's cost of capital is 14 percent.
- Calculate the NPV and IRR of each project
 - What is the NPV and IRR of the differential project (the project that reflects the difference between Project *B* and Project *A*)

Solution:

(a) Project A

$$\begin{aligned} \text{NPV at a cost of capital of 14\%} \\ &= -250 + 60 \times \text{PVIFA}(14,8) \\ &= \text{Rs.}-250 + 60 \times 4.639 = \text{Rs.}28.34 \text{ million} \end{aligned}$$

IRR (r) can be obtained by solving the following equation for r .

$$\begin{aligned} 60 \times \text{PVIFA}(r,8) &= 250 \\ \text{PVIFA}(r,8) &= 4.17 \end{aligned}$$

From tables we see that when:

$$\begin{aligned} r = 17\%, \quad \text{RHS} &= 4.207 \\ r = 18\%, \quad \text{RHS} &= 4.078 \end{aligned}$$

By extrapolation,

$$r = 17 + (4.207 - 4.17) / (4.207 - 4.078) = 17.29\%$$

Project B

$$\begin{aligned} \text{NPV at a cost of capital of 14\%} \\ &= -100 + 25 \times \text{PVIFA}(14,8) \\ &= \text{Rs.}15.98 \text{ million} \end{aligned}$$

IRR (r') can be obtained by solving the equation

$$\begin{aligned} 25 \times \text{PVIFA}(r',8) &= 100 \\ \text{PVIFA}(r',8) &= 4 \end{aligned}$$

From tables we see that when:

$$\begin{aligned} r' = 18\%, \quad \text{RHS} &= 4.078 \\ r' = 19\%, \quad \text{RHS} &= 3.954 \end{aligned}$$

By extrapolation,

$$r' = 18 + (4.078 - 4) / (4.078 - 3.954) = 18.63\%$$

- (b) Difference in capital outlays between projects A and B is Rs.150 million
 Difference in net annual cash flow between projects A and B is Rs.35 million.
 NPV of the differential project at 14%
 $= -150 + 35 \times \text{PVIFA}(14,8)$
 $= \text{Rs.12.37 million}$

IRR (r'') can be obtained by solving the equation

$$35 \times \text{PVIFA}(r'',8) = 150$$

$$\text{PVIFA}(r'',8) = 4.286$$

From tables we see that when:

$$r'' = 16\%, \quad \text{RHS} = 4.344$$

$$r'' = 17\%, \quad \text{RHS} = 4.207$$

By extrapolation,

$$r'' = 16 + (4.344 - 4.286) / (4.344 - 4.207) = 16.42\%$$

8. Your company is considering two projects, *M* and *N*. Each of which requires an initial outlay of Rs.240 million. The expected cash inflows from these projects are:

<i>Year</i>	<i>Project M</i>	<i>Project N</i>
1	85	100
2	120	110
3	180	120
4	100	90

- What is the payback period for each of the projects?
- What is the discounted payback period for each of the projects if the cost of capital is 15 percent?
- If the two projects are independent and the cost of capital is 15 percent, which project(s) should the firm invest in?
- If the two projects are mutually exclusive and the cost of capital is 12 percent, which project should the firm invest in?
- If the two projects are mutually exclusive and the cost of capital is 20 percent, which project should the firm invest in?
- If the cost of capital is 13 percent, what is the modified IRR of each project?

Solution:

Project M

The pay back period of the project lies between 2 and 3 years. Interpolating in this range we get an approximate pay back period of 2.19 years.

Project N

The pay back period lies between 2 and 3 years. Interpolating in this range we get an approximate pay back period of 2.25 years.

(b)

Project M

Cost of capital = 15 % p.a

Year	Cash flow	PV of cash flow	Cumulative PV of cash flow
1	85	73.91	73.91
2	120	90.74	164.65
3	180	118.35	283
4	100		

Discounted pay back period (DPB) lies between 2 and 3 years. Interpolating in this range we get an approximate DPB of 2.64 years.

Project N

Cost of capital = 15 % p.a

Year	Cash flow	PV of cash flow	Cumulative PV of cash flow
1	100	86.96	86.96
2	110	83.18	170.14
3	120	78.90	249.04
4	90		

Discounted pay back period (DPB) lies between 2 and 3 years. Interpolating in this range we get an approximate DPB of 2.89 years.

(c)

Project M

Cost of capital = 15% per annum
NPV = - 240 + 85 x PVIF (15,1)
+ 120 x PVIF (15,2) + 180 x PVIF (15,3)
+ 100 x PVIF (15,4)
= - 240 + 85 x 0.870 + 120 x 0.756 + 180 x 0.658
+ 100 x 0.572
= Rs. 100.31 million

Project N

Cost of capital = 12% per annum
NPV = - 240 + 100 x PVIF (15,1)
+ 110 x PVIF (15,2) + 120 x PVIF (15,3)
+ 90 x PVIF (15,4)
= - 240 + 100 x 0.870 + 110 x 0.756 + 120 x 0.658
+ 90 x 0.572
= Rs. 60.6 million

Since the two projects are independent and the NPV of each project is positive,

both the projects can be accepted. This assumes that there is no capital constraint.

- (d) Project M
Cost of capital = 12% per annum
NPV = Rs.123.23 million

Project N
Cost of capital = 10% per annum
NPV = Rs.79.59 million

Since the two projects are mutually exclusive, we need to choose the project with the higher NPV i.e., choose project M.

NOTE: The MIRR can also be used as a criterion of merit for choosing between the two projects because their initial outlays are equal.

- (e) Project M
Cost of capital = 15% per annum
NPV = 66.56 million

Project N
Cost of capital: 15% per annum
NPV = Rs.32.57 million

Again the two projects are mutually exclusive. So we choose the project with the higher NPV, i.e., choose project M.

- (f) Project M
Terminal value of the cash inflows: 579.27
MIRR of the project is given by the equation
$$240 (1 + \text{MIRR})^4 = 579.27$$

i.e., MIRR = 24.64 %

Project N
Terminal value of the cash inflows: 510.35
MIRR of the project is given by the equation
$$240 (1 + \text{MIRR})^4 = 510.35$$

i.e., MIRR = 20.76 %

9. If an equipment costs Rs.350,000 and lasts 6 years, what should be the minimum annual cash inflow before it is worthwhile to purchase the equipment ? Assume that the cost of capital is 12 percent

Solution:

Let NCF be the minimum constant annual net cash flow that justifies the purchase of the given equipment. The value of NCF can be obtained from the equation

$$\begin{aligned} \text{NCF} \times \text{PVIFA}(12,6) &= 350,000 \\ \text{NCF} &= 350,000 / 4.111 \\ &= 85,137 \end{aligned}$$

10. If an equipment costs Rs.2,000,000 and lasts 8 years, what should be the minimum annual cash inflow before it is worthwhile to purchase the equipment ? Assume that the cost of capital is 14 percent

Solution:

Let NCF be the minimum constant annual net cash flow that justifies the purchase of the given equipment. The value of NCF can be obtained from the equation

$$\begin{aligned} \text{NCF} \times \text{PVIFA}(14,8) &= 2,000,000 \\ \text{NCF} &= 2,000,000 / 4.639 \\ &= 431,127 \end{aligned}$$

11. How much can be paid for a machine which brings in an annual cash inflow of Rs.50,000 for 8 years ? Assume that the discount rate is 15 percent.

Solution:

Define I as the initial investment that is justified in relation to a net annual cash inflow of Rs.50,000 for 8 years at a discount rate of 15% per annum. The value of I can be obtained from the following equation

$$\begin{aligned} 50,000 \times \text{PVIFA}(15,8) &= I \\ \text{i.e., } I &= 50,000 \times 4.487 = \text{Rs. } 224,350 \end{aligned}$$

12. How much can be paid for a machine which brings in an annual cash inflow of Rs.600,000 for 12 years ? Assume that the discount rate is 16 percent.

Solution:

Define I as the initial investment that is justified in relation to a net annual cash inflow of Rs.600,000 for 12 years at a discount rate of 16% per annum. The value of I can be obtained from the following equation

$$\begin{aligned} 600,000 \times \text{PVIFA}(16, 12) &= I \\ \text{i.e., } I &= 600,000 \times 5.197 = \text{Rs. } 3,118,200 \end{aligned}$$

CHAPTER 12**MINICASE 1**

Metaland is a major manufacturer of light commercial vehicles. It has a very strong R&D centre which has developed very successful models in the last fifteen years. However, two models developed by it in the last few years have not done well and were prematurely withdrawn from the market.

The engineers at its R&D centre have recently developed a prototype for a new light commercial vehicle that would have a capacity of 4 tons.

After a lengthy discussion, the board of directors of Metaland decided to carefully evaluate the financial worthwhileness of manufacturing this model which they have labeled Meta 4.

You have been recently hired as the executive assistant to Vijay Mathur, Managing Director of Metaland. Vijay Mathur has entrusted you with the task of evaluating the project.

Meta 4 would be produced in the existing factory which has enough space for one more product. Meta 4 will require plant and machinery that will cost Rs.400 million. You can assume that the outlay on plant and machinery will be incurred over a period of one year. For the sake of simplicity assume that 50 percent will be incurred right in the beginning and the balance 50 percent will be incurred after 1 year. The plant will commence operation after one year.

Meta 4 project will require Rs.200 million toward gross working capital. You can assume that gross working capital investment will occur after 1 year.

The proposed scheme of financing is as follows : Rs.200 million of equity, Rs.200 million of term loan, Rs.100 million of working capital advance, and Rs.100 million of trade credit. Equity will come right in the beginning by way of retained earnings. Term loan and working capital advance will be raised at the end of year 1.

The term loan is repayable in 8 equal semi-annual instalments of Rs.25 million each. The first instalment will be due after 18 months of raising the term loan. The interest rate on the term loan will be 14 percent.

The levels of working capital advance and trade credit will remain at Rs.100 million each, till they are paid back or retired at the end of 5 years, after the project commences, which is the expected life of the project. Working capital advance will carry an interest rate of 12 percent.

Meta 4 project is expected to generate a revenue of Rs.750 million per year. The operating costs (excluding depreciation and taxes) are expected to be Rs.525 million per year.

For tax purposes, the depreciation rate on fixed assets will be 25 percent as per the written down value method. Assume that there is no other tax benefit.

The net salvage value of plant and machinery is expected to be Rs.100 million at the end of the project life. Recovery of working capital will be at book value.

The income tax rate is expected to be 30 percent.

Vijay Mathur wants you to estimate the cash flows from three different points of view:

- a. Cash flows from the point of all investors (which is also called the explicit cost funds point of view).
- b. Cash flows from the point of equity investors.

Solution:

Cash Flows from the Point of all Investors

<i>Item</i>	0	1	2	3	4	5	6
1. Plant and equipment	(200)	(200)					
2. Net working capital		(100)					
3. Revenue			750	750	750	750	750
4. Operating costs			525	525	525	525	525
5. Depreciation			100	75	56.3	42.2	31.6
6. Profit before tax			125	150	168.7	182.8	193.4
7. Profit after tax (0.7 x 6)			87.5	105	118.1	128.0	135.4
8. Net salvage value of plant and equipment							100
9. Recovery of net working capital							100
10. Initial investment	(200)	(300)					
11. Operating cash flow (7 + 5)			187.5	180	174.4	170.2	167
12. Terminal cash inflow							200
13. Net cash flow	(200)	(300)	187.5	180	174.4	170.2	367

Cash Flows from the Point of Equity Investors

<i>Item</i>	0	1	2	3	4	5	6
1. Equity funds	(200)						
2. Revenues			750	750	750	750	750
3. Operating costs			525	525	525	525	525
4. Depreciation			100	75	56.3	42.2	31.6
5. Interest on working capital			12	12	12	12	12
6. Interest on term loan			28	26.3	19.3	12.3	5.3
7. Profit before tax			85	111.7	137.4	158.5	176.1
8. Profit after tax			59.5	78.2	96.2	111	123.3
9. Net salvage value of plant & equipment							100
10. Recovery of working capital							200
11. Repayment of term loans				50	50	50	50
12. Repayment of working capital advance							100
13. Retirement of trade credit							100
14. Initial investment (1)	(200)						
15. Operating cash inflows (8 + 4)			159.5	153.2	152.5	153.2	154.9
16. Liquidation & retirement cash flows (9 + 10 – 13 – 14 – 15)				(50)	(50)	(50)	50
17. Net cash flow	(200)	-	159.5	103.2	102.5	103.2	204.9

MINICASE 2

Max Drugs Limited is a leader in the bulk drug industry. It manufactures a range of bulk drugs, technically called APIs (active pharmaceutical ingredients). Max is considering a new bulk drug called MBD-9.

You have recently joined Max as a finance officer and you report to Prakash Singh, Vice President (Finance), who coordinates the capital budgeting activity. You have been asked to develop the financials for MBD-9.

After discussing with marketing, technical, and other personnel, you have gathered the following information.

The MBD-9 project has an economic life of 5 years. It would generate a revenue of Rs.50 million in year1 which will rise by Rs.10 million per year for the following two years. Thereafter, revenues will decline by Rs.10 million per year for the remaining two years. Operating costs (costs before depreciation, interest, and taxes) will be 60 percent of revenues. MBD-9 is expected to erode the revenues of an existing bulk drug. Due to this erosion there will be a loss of Rs.4 million per year by way of contribution margin for 5 years. While there may be some other impacts as well, they may be ignored in the present analysis.

MBD-9 will require an outlay of Rs.40 million in plant and machinery right in the beginning. The same will be financed by equity and term loan in equal proportions. The term loan will carry an interest of 8 percent per annum and will be repayable in 4 equal annual instalments, the first instalment falling due at the end of year 1.

For tax purposes, the depreciation rate will be 15 percent as per the written down value method. The net salvage value of plant and machinery after 5 years is expected to be Rs.20 million.

The net working capital requirement will be 20 percent of revenues. Assume that the investment in net working capital will be made right in the beginning of each year and the same will be fully financed by working capital advance carrying an interest rate of 10 percent per annum. At the end of 5 years the working capital is expected to be liquidated at par. The effective tax rate is 30%

Required

1. Estimate the net cash flows relating to explicit cost funds (investor claims) over the 5-year period.
2. Estimate the net cash flows relating to equity over the 5-year period.

Solution:*Net Cash Flows Relating to Explicit Cost Funds**(Rs.in million)*

	0	1	2	3	4	5
1. Fixed assets	(40.0)					
2. Net working capital	(10.0)	(2.0)	(2.0)	2.0	2.0	
3. Revenues		50.0	60.0	70.0	60.0	50.0
4. Operating costs		30.0	36.0	42.0	36.0	30.0
5. Loss of contribution margin		4.0	4.0	4.0	4.0	4.0
6. Depreciation		6.0	5.1	4.34	3.68	3.13
7. Profit before tax		10.0	14.9	19.66	16.32	12.87
8. Tax		3.0	4.47	5.90	4.90	3.86
9. Profit after tax		7.0	10.43	13.76	11.42	9.01
10. Net salvage value of fixed assets						20.0
11. Recovery of working capital						10.0
12. Initial outlay & working capital	(50.0)	(2.0)	(2.0)	2.0	2.0	
13. Operating cash flow (9 + 6)		13.0	15.53	18.10	15.1	12.14
14. Terminal cash inflow (10 + 11)						30.00
15. Net cash flow	(50.0)	11.0	13.53	20.10	17.1	42.14

Net Cash Flows Relating to Equity(Rs.in million)

	0	1	2	3	4	5
1. Equity funds	(20.0)	-	-	-	-	-
2. Revenues		50.0	60.0	70.0	60.0	50.0
3. Operating costs		30.0	36.0	42.0	36.0	30.0
4. Loss of contribution margin		4.0	4.0	4.0	4.0	4.0
5. Depreciation		6.0	5.1	4.34	3.68	3.13
6. Interest on working capital advance		1.0	1.2	1.40	1.20	1.00
7. Interest on term loan		1.6	1.2	0.8	0.4	-
8. Profit before tax		7.4	12.5	17.46	14.72	11.87
9. Tax		2.22	3.75	5.24	4.42	3.56
10. Profit after tax		5.18	8.75	12.22	10.30	8.31
11. Net salvage value of fixed assets						20.0
12. Net salvage value of current assets						10.0
13. Repayment of term loan		5.0	5.0	5.0	5.0	-
14. Repayment of working capital advance						10.0
15. Initial investment (1)	(20.0)	-	-	-	-	-
16. Operating cash flows (10 + 5)		11.18	13.85	16.56	13.98	11.44
17. Liquidation & retirement cash flows (11 + 12 - 13 - 14)		(5.0)	(5.0)	(5.0)	(5.0)	20.0
18. Net cash flow (15+16+17)	(20.0)	6.18	8.85	11.56	8.98	31.44

MINICASE 3

Medipharm, a pharmaceutical company, is considering the manufacture of a new antibiotic preparation, M-cin, for which the following information has been gathered.

- M-cin is expected to have a product life cycle of five years and thereafter it would be withdrawn from the market. The sales from this preparation are expected to be as follows:

<i>Year</i>	<i>Sales (Rs in million)</i>
1	50
2	100
3	150
4	100
5	50

- The capital equipment required for manufacturing M-cin will cost Rs.80 million and it will be depreciated at the rate of 25 percent per year as per the WDV method for tax purposes. The expected net salvage value of the capital equipment after 5 years is Rs.20 million.
- The net working capital requirement for the project is expected to be 25 percent of sales. The net working capital will be adjusted at the beginning of the year in relation to the expected sales for the year. For example, the net working capital at the beginning of year 1 (i.e at the end year 0) will be Rs.12.5 million, that is 25 percent of the expected revenue of Rs.50.0 million for year 1.
- The accountant of the firm has provided the following cost estimates for M-cin :
 - Raw material cost : 40 percent of sales
 - Variable labour cost : 10 percent of sales
 - Fixed annual operating: Rs.4 million
and maintenance cost
 - Overhead allocation : 10 percent of sales
(excluding depreciation
maintenance, and interest)
- While the project is charged an overhead allocation , it is not likely to have any effect on overhead expenses as such.
- The manufacture of M-cin would use some of the common facilities of the firm. The use of these facilities will necessitate reducing the production of other pharmaceutical preparations of the firm. This will mean a reduction of Rs.10 million of contribution margin from those preparations.
- The tax rate applicable for this project is 30 percent.

(a) Estimate the post-tax incremental cash flows of the project viewed from the point of all investors(which is also called the explicit cost funds point of view).

(b) To calculate the cash flows from the point of equity investors, what additional information would you need ?

Solution:

Item	<i>Cash Flows from the Point of All Investors</i>					
	0	1	2	3	4	5
1. Fixed assets	(80)					
2. Net working capital level	12.5	25.0	37.5	25.0	12.5	–
3. Investment in net working capital	(12.5)	(12.5)	(12.5)	12.5	12.5	–
4. Sales		50.00	100.00	150.00	100.00	50.00
5. Raw material cost		20.00	40.00	60.00	40.00	20.00
6. Variable labour cost		5.00	10.00	15.00	10.00	5.00
7. Fixed annual operating cost		4.00	4.00	4.00	4.00	4.00
8. Depreciation		20.00	15.00	11.25	8.44	6.33
9. Loss of contribution margin		10.00	10.00	10.00	10.00	10.00
10. Profit before tax		(9.00)	21.00	49.75	27.56	4.67
11. Profit after tax		(6.30)	14.70	34.83	19.29	3.27
12. NSV of fixed assets						20.00
13. Recovery of NWC at the end						12.5
14. Initial investment in fixed assets	(80)					
15. Δ Inv. In NWC	(12.5)	(12.5)	(12.5)	12.5	12.5	
16. Cash flow from operation (11+8)		13.7	29.70	46.08	27.73	9.60
17. Terminal cash flow (12+13)						32.5
Net Cash Flow	(92.5)	1.20	17.20	58.58	40.23	42.10

b. The additional information needed for calculating the cash flow from the point of view of equity investors are:

- Equity funds committed to the project
- Interest cost on all borrowings
- Repayment /retirement schedule of all borrowings and trade creditors
- Net salvage value of all current assets
- Preference dividend and redemption of preference capital

MINICASE 4

Zesna Auto Ltd is considering the manufacture of a new bike, Gale, for which the following information has been gathered.

Gale is expected to have a product life cycle of five years after which it will be withdrawn from the market. The sales from this product is expected to be as follows:

Year	1	2	3	4	5
Sales (Rs. in million)	700	850	1100	1000	800

- The capital equipment required for manufacturing Gale costs Rs.600 million and it will be depreciated at the rate of 25 percent per year as per the WDV method for tax purposes. The expected net salvage value after 5 years is Rs.100 million.
- The working capital requirement for the project is expected to be 10% of sales. Working capital level will be adjusted at the beginning of the year in relation to the sales for the year. At the end of five years, working capital is expected to be liquidated at par, barring an estimated loss of Rs.5 million on account of bad debt, which of course, will be tax-deductible expense.
- The accountant of the firm has provided the following estimates for the cost of Gale.

Raw material cost	:	40 percent of sales
Variable manufacturing cost	:	20 percent of sales
Fixed annual operating and maintenance costs	:	Rs.2.5 million
Variable selling expenses	:	15 percent of sales
- The tax rate for the firm is 30 percent.

Required:

- (a) Estimate the post-tax incremental cash flows for the project to manufacture Gale.
- (b) What is the NPV of the project if the cost of capital is 18 percent?

Solution:Cash flows for the Gale Project

(Rs. in million)

Year	0	1	2	3	4	5
1. Capital equipment	600					
2. Level of working capital	70	85	110	100	80	-
3. Revenues		700	850	1100	1000	800
4. Raw material cost		280	340	440	400	320
5. Variable manufacturing cost		140	170	220	200	160
6. Operating and maintenance cost		2.5	2.5	2.5	2.5	2.5
7. Variable selling expenses		105	127.5	165	150	120
8. Depreciation		150	112.5	84.4	63.3	47.5
9. Bad debt loss						5
10. Profit before tax		22.5	97.5	188.1	184.2	145.0
11. Tax		6.8	29.25	56.4	55.3	43.5
12. Profit after tax		15.7	68.25	131.7	128.9	101.5
13. Net Salvage Value of Capital Equipment						100
14. Recovery of Working Capital						75
15. Initial Investment	(600)					
16. Operating cash flow (12+8+9)		165.70	180.75	216.1	192.2	154.0
17. Terminal cash flow (13 + 14)						175
18. Working Capital investment	(70)	(15)	(25)	10	20	
19. Net cash flow (15 + 16 + 17 + 18)	(670)	150.7	155.75	226.1	212.2	329

$$\begin{aligned}
 \text{(b) NPV} &= -670 + \frac{150.70}{(1.18)} + \frac{155.75}{(1.18)^2} + \frac{226.1}{(1.18)^3} + \frac{212.2}{(1.18)^4} + \frac{329}{(1.18)^5} \\
 &= -670 + 127.71 + 111.86 + 137.61 + 109.45 + 143.81 \\
 &= -39.56
 \end{aligned}$$

MINICASE 5

Phoenix Pharma is considering the manufacture of a new drug, Torrexin, for which the following information has been gathered

- Torrexin is expected to have a product life cycle of five years after which it will be withdrawn from the market. The sales from this drug are expected to be as follows:

Year	1	2	3	4	5
Sales (Rs in million)	100	150	200	150	100

- The capital equipment required for manufacturing Torrexin is 120 million and it will be depreciated at the rate of 25 percent per year as per the WDV method for tax purposes. The expected net salvage value after 5 years is Rs.30 million
- The working capital requirement for the project is expected to be 20 percent of sales. Working capital level will be adjusted at the beginning of the year in relation to the sales for the year. At the end of five years, working capital is expected to be liquidated at par, barring an estimated loss of Rs.5 million on account of bad debt which, of course, will be tax-deductible expense
- The accountant of the firm has provided the following estimates for the cost of Torrexin

Raw material cost	:	40 percent of sales
Variable manufacturing cost	:	10 percent of sales
Fixed annual operating and maintenance costs	:	Rs.8 million
Variable selling expenses	:	10 percent of sales

- The tax rate for the firm is 30 percent

Required :

- (a) Estimate the post-tax incremental cash flows for the project to manufacture Torrexin
- (b) What is the NPV of the project if the cost of capital is 15 percent?

Solution:

(a)	0	1	2	3	4	5
1. Capital equipment	(120)					
2. Level of working capital (ending)	20	30	40	30	20	
3. Revenues		100	150	200	150	100
4. Raw material cost		40	60	80	60	40
5. Variable mfrg cost		10	15	20	15	10
6. Fixed annual operating and maintenance costs		8	8	8	8	8
7. Variable selling expenses		10	15	20	15	10
8. Bad debt loss		-	-	-	-	5
9. Depreciation		30	22.5	16.9	12.7	9.5
10. Profit before tax		2	29.5	55.1	39.3	17.5
11. Tax		0.6	8.9	16.5	11.8	5.3
12. Profit after tax		1.4	20.6	38.6	27.5	12.2
13. Net salvage value of capital equipment						30.0
14. Recovery of working capital						15.0
15. Initial investment	(120)					
16. Operating cash flow (12 + 8 + 9)		31.4	43.1	55.5	40.2	26.7
17. Δ Working capital	20	10	10	(10)	(10)	
18. Terminal cash flow (13+14)						45.0
19. Net cash flow (15 + 16 + 17 + 18)	(140)	21.4	33.1	65.5	50.2	71.7

$$\begin{aligned}
 \text{(b) NPV} &= -140 + \frac{21.4}{(1.15)} + \frac{33.1}{(1.15)^2} + \frac{65.5}{(1.15)^3} + \frac{50.2}{(1.15)^4} + \frac{71.7}{(1.15)^5} \\
 &= -140 + 18.6 + 25.0 + 43.1 + 28.7 + 35.6 \\
 &= \text{Rs } 11.0 \text{ million}
 \end{aligned}$$

MINICASE 6

Malabar Corporation is determining the cash flow for a project involving replacement of an old machine by a new machine. The old machine bought a few years ago has a book value of Rs.1,200,000 and it can be sold to realise a post tax salvage value of Rs.800,000. It has a remaining life of four years after which its net salvage value is expected to be Rs.500,000. It is being depreciated annually at a rate of 20 percent the WDV method. The working capital associated with this machine is Rs.700,000.

The new machine costs Rs.5,000,000. It is expected to fetch a net salvage value of Rs.2,500,000 after four years. The depreciation rate applicable to it is 20 percent under the WDV method. The new machine is expected to bring a saving of Rs.800,000 annually in manufacturing costs (other than depreciation). The incremental working capital associated with the new machine is Rs.200,000. The tax rate applicable to the firm is 34 percent.

- (a) Estimate the cash flow associated with the replacement project.
- (b) What is the NPV of the replacement project if the cost of capital is 15 percent?

Solution:

- (a) A. Initial outlay (Time 0)

i.	Cost of new machine	Rs. 5,000,000
ii.	Salvage value of old machine	800,000
iii	Incremental working capital requirement	200,000
iv.	Total net investment (=i – ii + iii)	4,900,000

- B. Operating cash flow (years 1 through 4)

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
i. Post-tax savings in manufacturing costs	528,000	528,000	528,000	528,000
ii. Incremental depreciation	760,000	608,000	486,400	389,120
iii. Tax shield on incremental dep.	258,400	206,720	165,376	132,301
iv. Operating cash flow (i + iii)	786,400	734,720	693,376	660,301

C. Terminal cash flow (year 4)

i.	Salvage value of new machine	Rs.	2,500,000
ii.	Salvage value of old machine		500,000
iii.	Recovery of incremental working capital		200,000
iv.	Terminal cash flow (i – ii + iii)		2,200,000

D. Net cash flows associated with the replacement project (in Rs)

<i>Year</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
NCF	(4,900,000)	786,400	734,720	693,376	2,860,301

(b) NPV of the replacement project

$$\begin{aligned} &= -4,900,000 + 786,400 \times \text{PVIF}(15,1) \\ &\quad + 734,720 \times \text{PVIF}(15,2) \\ &\quad + 693,376 \times \text{PVIF}(15,3) \\ &\quad + 2,860,301 \times \text{PVIF}(15,4) \\ &= -\text{Rs.}1,568,050 \end{aligned}$$

MINICASE 7

Sangeeta Enterprises is determining the cash flow for a project involving replacement of an old machine by a new machine. The old machine bought a few years ago has a book value of Rs.2,800,000 and it can be sold to realise a post tax salvage value of Rs.2,200,000. It has a remaining life of five years after which its net salvage value is expected to be Rs.900,000. It is being depreciated annually at a rate of 30 percent the WDV method. The working capital associated with this machine is Rs.1,000,000.

The new machine costs Rs.8,000,000. It is expected to fetch a net salvage value of Rs.3,500,000 after five years. The depreciation rate applicable to it is 25 percent under the WDV method. The new machine is expected to bring a saving of Rs.1,000,000 annually in manufacturing costs (other than depreciation). The incremental working capital associated with the new machine is Rs.600,000. The tax rate applicable to the firm is 33 percent.

- (a) Estimate the cash flow associated with the replacement project.
- (b) What is the NPV of the replacement project if the cost of capital is 14 percent?

Solution:

(a)	A.	Initial outlay (Time 0)				
	i.	Cost of new machine	Rs.	8,000,000		
	ii.	Salvage value of old machine		2,200,000		
	iii.	Incremental working capital requirement		600,000		
	iv.	Total net investment (=i – ii + iii)		6,400,000		
	E.	Operating cash flow (years 1 through 4)				
	<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
	i. Post-tax savings in manufacturing costs	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
	ii. Depreciation on new machine	2,000,000	1,500,000	1,125,000	843,750	632,813
	iii. Depreciation on old machine	840,000	588,000	411,600	288,120	201,684
	iv. Incremental derecipation	1,160,000	912,000	713,400	555,630	431,129
	v. Tax shield on incremental dep.	382,800	300,960	235,422	183,358	142,273
	iv. Operating cash flow(i +v)	1,382,800	1,300,960	1,235,422	1,183,358	1,142,273

F. Terminal cash flow (year 5)

i.	Salvage value of new machine	Rs.	3,500,000
ii.	Salvage value of old machine		900,000
iii.	Recovery of incremental working capital		600,000
iv.	Terminal cash flow (i – ii + iii)		3,200,000

G. Net cash flows associated with the replacement project (in Rs)

<i>Year</i>	<i>0</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
NCF	(6,400,000)	1,382,800	1,300,960	1,235,422	1,183,358	4,342,273

(c) NPV of the replacement project

$$(6,400,000) + 1,382,800 \times \text{PVIF}(14,1) + 1,300,960 \times \text{PVIF}(14,2) + 1,235,422 \times \text{PVIF}(14,3) + 1,183,358 \times \text{PVIF}(14,4) + 4,342,273 \times \text{PVIF}(14,5)$$

$$= - \text{Rs.}398,749$$

8. A machine costs Rs.250,000 and is subject to a depreciation rate of 24 percent under the WDV method. What is the present value of the tax savings on account of depreciation for a period of 5 years if the tax rate is 34 percent and the discount rate is 16 percent?

Solution:

Tax shield (savings) on depreciation (in Rs)

<i>Year</i>	<i>Depreciation charge (DC)</i>	<i>Tax shield = 0.34 x DC</i>	<i>PV of tax shield @ 16% p.a.</i>
1	60,000	20,400	17,586
2	45,600	15,504	11,522
3	34,656	11,783	7,549
4	26,339	8,955	4,946
5	20,017	6,806	3,240

			44,843

Present value of the tax savings on account of depreciation = Rs.44,843

9. A machine costs Rs.680,000 and is subject to a depreciation rate of 27 percent under the WDV method. What is the present value of the tax savings on account of depreciation for a period of 4 years if the tax rate is 36 percent and the discount rate is 18 percent?

Solution:

Tax shield (savings) on depreciation (in Rs)

Year	<i>Depreciation charge (DC)</i>	<i>Tax shield = 0.36 x DC</i>	<i>PV of tax shield @ 18% p.a.</i>
1	183,600	66,096	56,014
2	134,028	48,250	34,652
3	97,840	35,222	21,437
4	71,423	25,712	13,262
			----- 125,365 -----
Present value of the tax savings on account of depreciation = Rs.125,365			

CHAPTER 13

1. A project requires an investment of 500,000. The unit selling price is 70 and the unit variable cost is 35. Fixed costs other than depreciation will be 280,000 per year. Depreciation will be 80,000 per year for tax purposes. The life of the project is 5 years. The effective tax rate is 33 percent. The cost of capital is 14 percent. What is the financial break-even point?

Solution:

Variable cost	= 0.5 of sales (S)
Contribution	= 0.5 of sales (S)
Fixed cost	= 280,000
Depreciation	= 80,000
Pre-tax profit	= 0.5 S – 280,000 – 80,000 = 0.5 S – 360,000
Cash flow	= (0.5 S – 360,000) (1-0.33) + 80,000 = 0.335 S - 161,200
PV of cash flow	= (0.335 S -161,200) PVIFA (14%, 5) = (0.335 S -161,200) x 3.433
Equating this with the initial investment, we get	
	(0.335 S -161,200) x 3.433 = 500,000
	(0.335 S -161,200) = 145,645.21
	S = 915,955.85

2. A project requires an investment of 800,000. The unit selling price is 50 and the unit variable cost is 25. Fixed costs other than depreciation will be 250,000 per year. Depreciation will be 85,000 per year for tax purposes. The life of the project is 6 years. The effective tax rate is 20 percent. The cost of capital is 12 percent. What is the financial break-even Point?

Solution:

Variable cost	=	50 percent of sales (S)
Contribution margin	=	50 percent of sales (S)
Fixed costs	=	250,000
Depreciation	=	85,000
Pre-tax profit	=	$(0.5S - 250,000 - 85,000)$
Cash flow	=	$(0.5S - 335,000) 0.8 + 85,000$
	=	$0.4S - 183,000$
Present value of cash flows is		
		$(0.4S - 183,000) \times 4.111$
Equating this with the initial investment of 800,000 we get		
$1.6444 S - 752313$	=	800,000
S	=	943999.6

3. A project requires an investment of 500,000. The unit selling price is 70 and the unit variable cost is 35. Fixed costs other than depreciation will be 280,000 per year. Depreciation will be 80,000 per year for tax purposes. The life of the project is 5 years. The effective tax rate is 33 percent. The cost of capital is 14 percent. What is the financial break-even point?

Solution:

Variable cost	=	0.5 of sales (S)
Contribution	=	0.5 of sales (S)
Fixed cost	=	280,000
Depreciation	=	80,000
Pre-tax profit	=	$0.5 S - 280,000 - 80,000 = 0.5 S - 360,000$
Cash flow	=	$(0.5 S - 360,000) (1-0.33) + 80,000$
	=	$0.335 S - 161,200$
PV of cash flow	=	$(0.335 S - 161,200) \text{ PVIFA } (14\%, 5)$
	=	$(0.335 S - 161,200) \times 3.433$
Equating this with the initial investment, we get		
		$(0.335 S - 161,200) \times 3.433 = 500,000$
		$(0.335 S - 161,200) = 145,645.21$
S	=	915,955.85

4. You are the financial manager of Navneet Limited. Navneet is planning to set up a factory at Aurangabad. Your project staff has developed the following cash flow forecast for the factory.

Cash Flow Forecast for Navneet's factory

	<i>Year 0</i>	<i>Rs. in million Years 1 - 10</i>
Investment	(500)	
Sales		400
Variable costs (60% of sales)		240
Fixed costs		60
Depreciation (assumed at 10% of investment per annum)		50
Pre-tax profit		50
Tax (at a rate assumed at 30 % of pre-tax profit)		15
Profit after tax		35
Cash flow from operations		85
Net cash flow		85

What is the NPV of the project? Assume that the cost of capital is 15 percent. The range of values that the underlying variables can take is shown below:

Underlying Variable	Pessimistic	Expected	Optimistic
Investment (Rs. in million)	400	500	700
Sales (Rs. in million)	250	400	650
Variable cost as a percent of sales	70	60	55
Fixed costs (Rs. in million)	65	60	50
Cost of capital (%)	18	15	12

- Calculate the effect of variations in the values of the underlying variables on NPV.
- Calculate the accounting break-even point.

Solution:

	Expected Scenario	Optimistic Scenario	Pessimistic Scenario
1. Investment	500	400	700
2. Sales	400	650	250
Variable costs as a percentage of sales	60	55	70
3. Variable costs	240	357.5	175
4. Fixed costs	60	50	65
5. Depreciation (assumed at 10% of investment per annum)	50	40	70

6. Pre-tax profit	50	202.5	-60
7. Tax(at a rate assumed at 30 % of pre-tax profit)	15	60.75	-18
8. Profit after tax	35	141.75	-42
9. Annual cash flow from operations	85	181.75	28
10. Net present value	-73.40	626.93	-574.17

- Assumptions: (1) The useful life is assumed to be 10 years under all three scenarios. It is also assumed that the salvage value of the investment after ten years is zero.
- (2) The investment is assumed to be depreciated at 10% per annum; and it is also assumed that this method and rate of depreciation are acceptable to the IT (income tax) authorities.
- (3) It is assumed that only loss on this project can be offset against the taxable profit on other projects of the company; and thus the company can claim a tax shield on the loss in the same year.

(b) *Accounting break even point (under 'expected' scenario)*

Fixed costs + depreciation	= Rs. 110 million
Contribution margin ratio	= $160 / 400 = 0.4$
Break even level of sales	= $110 / 0.4 = \text{Rs.}275 \text{ million}$

5. You are the financial manager of Magnum Corporation. Magnum is planning to set up a Machine Tools plant at Chennai. Your project staff has developed the following cash flow forecast for the project.

Cash Flow Forecast for Navneet's factory

	<i>Year 0</i>	<i>Rs. in million Years 1 - 8</i>
Investment	(1000)	
Sales		800
Variable costs (70% of sales)		560
Fixed costs		90
Depreciation (assumed at 10% of investment per annum)		100
Pre-tax profit		50
Tax (at a rate assumed at 33 % of pre-tax profit)		16.5
Profit after tax		33.5
Cash flow from operations		133.5
Net cash flow		133.5

What is the NPV of the project ? Assume that the cost of capital is 14 percent. The range of values that the underlying variables can take is shown below:

Underlying Variable	Pessimistic	Expected	Optimistic
Investment (Rs. in million)	1300	1000	800
Sales (Rs. in million)	650	800	1000
Variable cost as a percent of sales	75	70	60
Fixed costs (Rs. in million)	95	90	80
Cost of capital (%)	16	14	13

- (a) Calculate the effect of variations in the values of the underlying variables on NPV.
 (b) Calculate the accounting break-even point.

Solution:

	Expected Scenario	Optimistic Scenario	Pessimistic Scenario
1. Investment	1000	800	1300
2. Sales	800	1000	650
Variable costs as a percentage of sales	70	60	75
3. Variable costs	560	600	487.5
4. Fixed costs	90	80	95
5. Depreciation (assumed at 10% of investment per annum)	100	80	130
6. Pre-tax profit	50	240	-62.5
7. Tax (at a rate assumed at 33 % of pre-tax profit)	16.5	79.2	-20.625
8. Profit after tax	33.5	160.8	-41.875
9. Annual cash flow from operations	133.5	240.8	88.125
10. Net present value	-380.71	355.54	-917.22

- Assumptions: (1) The useful life is assumed to be 8 years under all three scenarios. It is also assumed that the salvage value of the investment after eight years is zero.
 (2) The investment is assumed to be depreciated at 10% per annum; and it is also assumed that this method and rate of depreciation are acceptable to the IT (income tax) authorities.

- (3) It is assumed that only loss on this project can be offset against the taxable profit on other projects of the company; and thus the company can claim a tax shield on the loss in the same year.

(b) *Accounting break even point (under 'expected' scenario)*

Fixed costs + depreciation	= Rs. 190 million
Contribution margin ratio	= 0.3
Break even level of sales	= $190 / 0.3 = \text{Rs.}633.33$ million

6. Rakesh Limited is considering the risk characteristics of a certain project. The firm has identified that the following factors, with their respective expected values, have a bearing on the NPV of this project.

Initial investment	Rs.50,000
Cost of capital	12%
Quantity manufactured and sold annually	2,800
Price per unit	Rs.50
Variable cost per unit	Rs.28
Fixed costs	Rs.8,000
Depreciation	Rs.5,000
Tax rate	35%
Life of the project	6 years
Net salvage value	Nil

Assume that the following underlying variables can take the values as shown below:

Underlying variable	Pessimistic	Optimistic
Quantity manufactured and sold	2,000	3,500
Price per unit	Rs.35	Rs.60
Variable cost per unit	Rs.35	Rs.20

- a. Calculate the sensitivity of net present value to variations in (a) quantity manufactured and sold, (b) price per unit, and (c) variable cost per unit.

Solution:Sensitivity of net present value to quantity manufactured and sold

	Expected	Pessimistic	Optimistic
Quantity manufactured and sold annually	2,800	2000	3500
Initial investment	50,000	50,000	50,000
Sales revenue	140,000	100,000	175,000
Variable costs	78,400	56,000	98,000
Fixed costs	8,000	8,000	8,000
Depreciation	5,000	5,000	5,000
Profit before tax	48,600	31,000	64,000
Tax	17,010	10,850	22,400
Profit after tax	31,590	20,150	41,600
Net cash flow	36,590	25,150	46,600
NPV at a cost of capital of 12 % and useful life of 6 years	100,436	53,402	141,592

Sensitivity of net present value to price per unit

	Expected	Pessimistic	Optimistic
Price per unit	50	35	60
Initial investment	50,000	50,000	50,000
Sales revenue	140,000	98,000	168,000
Variable costs	78,400	78,400	78,400
Fixed costs	8,000	8,000	8,000
Depreciation	5,000	5,000	5,000
Profit before tax	48,600	6,600	76,600
Tax	17,010	2,310	26,810
Profit after tax	31,590	4,290	49,790
Net cash flow	36,590	9,290	54,790
NPV at a cost of capital of 12 % and useful life of 6 years	100,436	-11,805	175,264

Sensitivity of net present value to variable cost per unit.

	Expected	Pessimistic	Optimistic
Variable cost per unit	28	35	20
Initial investment	50,000	50,000	50,000
Sales revenue	140,000	140,000	140,000
Variable costs	78,400	98,000	56,000
Fixed costs	8,000	8,000	8,000
Depreciation	5,000	5,000	5,000
Profit before tax	48,600	29,000	71,000
Tax	17,010	10,150	24,850
Profit after tax	31,590	18,850	46,150
Net cash flow	36,590	23,850	51,150
NPV at a cost of capital of 12 % and useful life of 6 years	100,436	48,057	160,298

7. A project involving an outlay of Rs.15 million has the following benefits associated with it.

<u>Year 1</u>		<u>Year 2</u>		<u>Year 3</u>	
<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>
<i>(Rs. in mln)</i>		<i>(Rs. in mln)</i>		<i>(Rs. in mln)</i>	
7	0.3	6	0.5	5	0.4
8	0.5	8	0.2	7	0.3
9	0.2	10	0.3	9	0.3

Assume that the cash flows are independent. Calculate the expected net present value and the standard deviation of net present value assuming that $i = 12$ percent.

Solution:

Define A_t as the random variable denoting net cash flow in year t .	
$\overline{A_1}$	= $7 \times 0.3 + 8 \times 0.5 + 9 \times 0.2$ = 7.9
$\overline{A_2}$	= $6 \times 0.5 + 8 \times 0.2 + 10 \times 0.3$ = 7.6
$\overline{A_3}$	= $5 \times 0.4 + 7 \times 0.3 + 9 \times 0.3$ = 6.8
NPV	= $7.9 / 1.12 + 7.6 / (1.12)^2 + 6.8 / (1.12)^3 - 15$ = Rs.2.95 million

$$\sigma_1^2 = 0.3 \times (7-7.9)^2 + 0.5(8-7.9)^2 + 0.2(9-7.9)^2 = 0.49$$

$$\sigma_2^2 = 0.5(6-7.6)^2 + 0.2(8-7.6)^2 + 0.3(10-7.6)^2 = 3.04$$

$$\sigma_3^2 = 0.4(5-6.8)^2 + 0.3(7-6.8)^2 + 0.3(9-6.8)^2 = 2.76$$

$$\begin{aligned} \sigma^2 \text{ NPV} &= \frac{\sigma_1^2}{(1.12)^2} + \frac{\sigma_2^2}{(1.12)^4} + \frac{\sigma_3^2}{(1.12)^6} \\ &= 0.49/(1.12)^2 + 3.04/(1.12)^4 + 2.76/(1.12)^6 \\ &= 3.72 \\ \sigma \text{ (NPV)} &= \text{Rs.1.93 million} \end{aligned}$$

8. A project involving an outlay of Rs.25 million has the following benefits associated with it.

<u>Year 1</u>		<u>Year 2</u>		<u>Year 3</u>	
<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>
<i>(Rs. in mln)</i>		<i>(Rs. in mln)</i>		<i>(Rs. in mln)</i>	
10	0.2	9	0.6	12	0.5
12	0.5	11	0.2	13	0.4
13	0.3	12	0.2	14	0.1

Assume that the cash flows are independent. Calculate the expected net present value and the standard deviation of net present value assuming that $i = 15$ percent.

Solution:

Define A_t as the random variable denoting net cash flow in year t .

$$\overline{A_1} = 10 \times 0.2 + 12 \times 0.5 + 13 \times 0.3 = 11.9$$

$$\overline{A_2} = 9 \times 0.6 + 11 \times 0.2 + 12 \times 0.2 = 10$$

$$\overline{A_3} = 12 \times 0.5 + 13 \times 0.4 + 14 \times 0.1 = 12.6$$

$$\text{NPV} = 11.9 / 1.15 + 10 / (1.15)^2 + 12.6 / (1.15)^3 - 25 = \text{Rs.1.19 million}$$

$$\sigma_1^2 = 0.2 \times (10-11.9)^2 + 0.5(12-11.9)^2 + 0.3(13-11.9)^2 = 1.09$$

$$\sigma_2^2 = 0.6(9-10)^2 + 0.2(11-10)^2 + 0.2(12-10)^2 = 1.6$$

$$\sigma_3^2 = 0.5(12-12.6)^2 + 0.4(13-12.6)^2 + 0.1(14-12.6)^2 = 0.44$$

$$\begin{aligned} \sigma^2 \text{ NPV} &= \frac{\sigma_1^2}{(1.12)^2} + \frac{\sigma_2^2}{(1.12)^4} + \frac{\sigma_3^2}{(1.12)^6} \end{aligned}$$

$$\begin{aligned}
&= 1.09/(1.15)^2 + 1.6/(1.15)^4 + 0.44/(1.15)^6 \\
&= 1.93 \\
\sigma \text{ (NPV)} &= \text{Rs.1.39million}
\end{aligned}$$

9. Mohan is considering an investment which requires a current outlay of Rs.25,000. The expected value and standard deviation of cash flows are:

<i>Year</i>	<i>Expected Value</i>	<i>Standard Deviation</i>
1	Rs.25,000	Rs.3,000
2	15,000	4,000
3	14,000	4,000
4	10,000	2,000

The cash flows are perfectly correlated. Calculate the expected net present value and standard deviation of net present value of this investment, if the risk-free interest rate is 7 percent.

Solution:

$$\begin{aligned}
&\text{Expected NPV} \\
&= \sum_{t=1}^4 \frac{A_t}{(1.07)^t} - 25,000 \\
&= \frac{25,000}{(1.07)} + \frac{15,000}{(1.07)^2} + \frac{14,000}{(1.07)^3} + \frac{10,000}{(1.07)^4} - 25,000 = 30,523 \\
&\text{Standard deviation of NPV} \\
&= \sum_{t=1}^4 \frac{\sigma_t}{(1.07)^t} \\
&= \frac{3,000}{(1.07)} + \frac{4,000}{(1.07)^2} + \frac{4,000}{(1.07)^3} + \frac{2,000}{(1.07)^4} \\
&= 11,088.48
\end{aligned}$$

10. Boldman is considering an investment which requires a current outlay of Rs.100,000. The expected value and standard deviation of cash flows are:

<i>Year</i>	<i>Expected Value</i>	<i>Standard Deviation</i>
1	Rs.40,000	Rs.8,000
2	55,000	10,000
3	34,000	7,000
4	20,000	9,000

The cash flows are perfectly correlated. Calculate the expected net present value and standard deviation of net present value of this investment, if the risk-free interest rate is 10 percent.

Solution:

$$\begin{aligned}
 & \text{Expected NPV} \\
 & = \sum_{t=1}^4 \frac{\overline{A}_t}{(1.1)^t} - 100,000 \\
 & = \frac{40,000}{(1.1)} + \frac{55,000}{(1.1)^2} + \frac{34,000}{(1.1)^3} \\
 & \quad + \frac{20,000}{(1.1)^4} - 100,000 = 21,023 \\
 & \text{Standard deviation of NPV} \\
 & = \sum_{t=1}^4 \frac{\sigma_t}{(1.1)^t} \\
 & = \frac{8,000}{(1.1)} + \frac{10,000}{(1.1)^2} + \frac{7,000}{(1.1)^3} + \frac{9,000}{(1.1)^4} \\
 & = 26,944
 \end{aligned}$$

11. Dinesh Associates is considering an investment project which has an estimated life of four years. The cost of project is 400,000 and the possible cash flows are given below:

<i>Year 1</i>		<i>Year 2</i>		<i>Year 3</i>		<i>Year 4</i>	
<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>	<i>Cash Flow</i>	<i>Prob.</i>
110,000	0.3	120,000	0.5	130,000	0.2	110,000	0.4
120,000	0.4	130,000	0.3	140,000	0.3	120,000	0.4
130,000	0.3	140,000	0.2	150,000	0.5	130,000	0.2

The cash flows of various years are independent and the risk-free discount rate (post-tax) is 8 percent.

- What is the expected NPV ?
- If the NPV is approximately normally distributed, what is the probability that the NPV will be zero or less ?
- What is the probability that the profitability index will be greater than 1.1 ?

Solution:

$$\begin{aligned}
 (a) \quad & \text{Expected NPV} \\
 & = \sum_{t=1}^4 \frac{\overline{A}_t}{(1.08)^t} - 400,000 \quad \dots (1) \\
 \frac{\overline{A}_1}{\overline{A}_2} & = 110,000 \times 0.3 + 120,000 \times 0.4 + 130,000 \times 0.3 = 120,000 \\
 & = 120,000 \times 0.5 + 130,000 \times 0.3 + 140,000 \times 0.2 = 127,000 \\
 \frac{\overline{A}_3}{\overline{A}_4} & = 130,000 \times 0.2 + 140,000 \times 0.3 + 150,000 \times 0.5 = 143,000 \\
 & = 110,000 \times 0.4 + 120,000 \times 0.4 + 130,000 \times 0.2 = 118,000
 \end{aligned}$$

Substituting these values in (1) we get

$$\text{Expected NPV} = \text{NPV} = 120,000 / (1.08) + 127,000 / (1.08)^2 + 143,000 / (1.08)^3 + 118,000 / (1.08)^4 - 400,000 = 20,245$$

(b)

The variance of NPV is given by the expression

$$\sigma^2(\text{NPV}) = \sum_{t=1}^4 \frac{\sigma_t^2}{(1.08)^{2t}} \quad \dots\dots\dots (2)$$

$$\begin{aligned} \sigma_1^2 &= [(110,000 - 120,000)^2 \times 0.3 + (120,000 - 120,000)^2 \times 0.4 \\ &+ (130,000 - 120,000)^2 \times 0.3] = 60,000,000 \\ \sigma_2^2 &= [(120,000 - 127,000)^2 \times 0.5 + (130,000 - 127,000)^2 \times 0.3 \\ &+ (140,000 - 127,000)^2 \times 0.2] = 61,000,000 \\ \sigma_3^2 &= [(130,000 - 143,000)^2 \times 0.2 + (140,000 - 143,000)^2 \times 0.3 \\ &+ (150,000 - 143,000)^2 \times 0.5] = 61,000,000 \\ \sigma_4^2 &= [(110,000 - 118,000)^2 \times 0.4 + (120,000 - 118,000)^2 \times 0.4 \\ &+ (130,000 - 118,000)^2 \times 0.2] = 56,000,000 \end{aligned}$$

Substituting these values in (2) we get

$$\begin{aligned} \sigma^2(\text{NPV}) &= 60,000,000 / (1.08)^2 + 61,000,000 / (1.08)^4 \\ &+ 61,000,000 / (1.08)^6 + 56,000,000 / (1.08)^8 \\ &= 164,972,555 \end{aligned}$$

$$\sigma \text{ NPV} = \sqrt{164,972,555} = \text{Rs. } 12,844$$

$$\begin{aligned} \text{Prob}(\text{NPV} \leq 0) &= \text{Prob.} \left(\frac{\text{NPV} - \overline{\text{NPV}}}{\sigma \text{ NPV}} \right) \leq \left(\frac{0 - \overline{\text{NPV}}}{\sigma \text{ NPV}} \right) \\ &= \text{Prob} \left(Z \leq \frac{0 - 20,245}{12,844} \right) \\ &= \text{Prob}(Z \leq -1.58) \end{aligned}$$

From the normal distribution tables, we have,

when $Z = -1.60$, the probability = 0.0548

when $Z = -1.55$, the probability = 0.0606

$$\begin{aligned} \text{Extrapolating, we get } \text{Prob}(Z \leq -1.58) &= 0.0548 + (1.60 - 1.58)(0.0606 - 0.0548) / 0.05 \\ &= 0.0548 + 0.00232 \\ &= 0.0571 \end{aligned}$$

So the probability of NPV being negative is 5.71 %

$$\begin{aligned} \text{(c) } \text{Prob}(P_1 \geq 1.1) & \quad \text{Prob}(PV / I \geq 1.1) \\ & \quad \text{Prob}(NPV / I \geq 0.1) \end{aligned}$$

$$\begin{aligned} &\text{Prob. (NPV} \geq 0.1 \times 400,000) \\ &\text{Prob (NPV} \geq 40,000) \end{aligned}$$

$$\begin{aligned} \text{Prob (NPV} \geq 40,000) &= \text{Prob (Z} \geq (40,000 - 20,245) / 12,844) \\ &= \text{Prob (Z} \geq -1.54) \end{aligned}$$

From the normal distribution tables, we have,

$$\begin{aligned} \text{when Z} = 1.55, \text{ the probability} &= 1 - 0.0606 = 0.9394 \\ \text{when Z} = 1.50, \text{ the probability} &= 1 - 0.0668 = 0.9332 \end{aligned}$$

$$\begin{aligned} \text{Extrapolating, we get Prob (Z} \geq -1.54) &= 0.9332 + (1.54 - 1.50)(0.9394 - 0.9332) / 0.05 \\ &= 0.9332 + 0.00496 \\ &= 0.9382 \end{aligned}$$

So the probability of $P_1 \geq 1.1$ is 93.82%

12. The expected cash flows of a project are given below:

<i>Year</i>	<i>Cash Flow</i>
0	Rs. (50,000)
1	10,000
2	30,000
3	20,000
4	20,000
5	10,000

The certainty equivalent factor behaves as per the following equation : $\alpha_t = 1 - 0.08t$

Calculate the net present value of the project if the risk-free rate of return is 8 percent

Solution:

Year	Cash Flow	Certainty Equivalent Factor: $\alpha_t = 1 - 0.08t$	Certainty Equivalent value	Discount Factor at 8%	Present Value
0	-50000	1	-50000	1	-50000
1	10000	0.92	9200	0.925926	8519
2	30000	0.84	25200	0.857339	21605
3	20000	0.76	15200	0.793832	12066
4	20000	0.68	13600	0.73503	9996
5	10000	0.6	6000	0.680583	4083
				NPV =	6270

CHAPTER 14

1 The latest balance sheet of ARN Limited is given below

<i>Liabilities</i>		<i>Assets</i>	
Equity capital	3500	Fixed assets	11000
Preference capital	200	Investments	800
Reserves & Surplus	5200	Current assets, loans & advances	3700
Debentures	2600		
Working capital loan	2500		
Current liabilities & Provisions	1500		
	<u>15500</u>		<u>15500</u>

The target capital structure of ARN has 60 percent equity, 5 percent preference, and 35 percent debt. ARN's preference capital has a post-tax cost of 7 percent. ARN's debentures consist of Rs.100 par, 8 percent coupon payable annually, with a residual maturity of 3 years. The market price of these debentures is Rs.103. Working capital loan carries an interest rate of 11 percent. ARN's equity stock is currently selling for Rs.102 per share. Its last dividend was Rs.3.00 per share and the dividend per share is expected to grow at a rate of 14 percent per year in future.

ARN's equity beta is 1.5, the risk-free rate is 6 percent, and the market risk premium is 8 percent. ARN's tax rate is 33 percent

- (i) What is ARN's average pre-tax cost of debt?
(Use the approximate yield formula)

Solution:

$$\text{Pre-tax cost of debenture} = \frac{8 + (100-103) / 3}{(0.4 \times 100) + (0.6 \times 103)} = \frac{7}{101.8} = 6.88\%$$

Pre-tax cost of working capital loan = 11%

$$\text{Average pre-tax cost of debt} = \frac{2600}{5100} \times 6.88 + \frac{2500}{5100} \times 11 = 8.90\%$$

- (ii) What is ARN's cost of equity using the constant growth dividend discount model?

Solution:

$$r_E = \frac{D_0(1+g)}{P_0} + g = \frac{3.42}{102} + 0.14 = 17.35\%$$

(iii) What is ARN's post tax weighted average cost of capital? Use the CAPM to estimate the cost of equity and employ the weights in the target capital structure.

Solution:

$$r_E = 6 + 1.5 \times 8 = 18\%$$

$$r_A = 0.60 \times 18 + 0.05 \times 7 + 0.35 \times 8.90 (1-0.33) = 13.24\%$$

2. The latest balance sheet of MM Limited is given below

<i>Liabilities</i>		<i>Assets</i>	
Equity capital	3200	Fixed	assets
Preference capital	300	10500	
Reserves & Surplus	6800	Investments	
Debentures	2100	1100	
Working capital loan	2000	Current assets, loans & advances	
Current liabilities & Provisions	1700	4500	
	<u>16100</u>		<u>16100</u>

The target capital structure of MM has 65 percent equity, 5 percent preference, and 30 percent debt. MM's preference capital has a post-tax cost of 8 percent. MM's debentures consist of Rs.100 par, 9 percent coupon payable annually, with a residual maturity of 4 years. The market price of these debentures is Rs.105. Working capital loan carries an interest rate of 10 percent. MM's equity stock is currently selling for Rs.90 per share. Its last dividend was Rs.2.00 per share and the dividend per share is expected to grow at a rate of 12 percent per year in future.

MM's equity beta is 1.05, the risk-free rate is 7 percent, and the market risk premium is 6 percent. MM's tax rate is 30 percent

(i) What is MM's average pre-tax cost of debt?
(Use the approximate yield formula)

Solution:

Pre-tax cost of debenture

$$9 + (100 - 105) / 4 = 7.52\%$$

$$0.6 \times 105 + 0.4 \times 100$$

Pre-tax cost of working capital loan = 10%

Average pre-tax cost of debt

$$\begin{array}{r} 2100 \\ 7.52\% \quad 4100 \end{array} + \begin{array}{r} 2000 \\ 10\% \quad 4100 \end{array}$$
$$= 3.85 + 4.88 = 8.73 \%$$

(ii) What is MM's cost of equity using the constant growth dividend discount model ?

Solution:

$$\begin{aligned} r_E &= \frac{D_0(1+g)}{P_0} + g = \frac{2(1.12)}{90} + 0.12 \\ &= 14.49 \% \end{aligned}$$

(iii) What is MM's post tax weighted average cost of capital? Use the CAPM to estimate the cost of equity and employ the weights in the target capital structure.

Solution:

$$\begin{aligned} r_E &= 7 + 1.05(6) = 13.30\% \\ r_A &= 0.65 \times 13.3 + 0.05 \times 8 + 0.3 \times 8.73 \\ &= 8.645 + 0.4 + 2.619 \\ &= 11.664 \end{aligned}$$

3. The latest balance sheet of Phoenix Limited is given below

<i>Liabilities</i>		<i>Assets</i>	
Equity capital	1500	Fixed assets	4000
Preference capital	200	Investments	1000
Reserves & Surplus	2000	Current assets, loans & advances	1500
Debentures	1800		
Current liabilities & Provisions	1000		
	<u>6500</u>		<u>6500</u>

The target capital structure of Phoenix has 70 percent equity, 5 percent preference, and 25 percent debt. Phoenix's preference capital has a post-tax cost of 9 percent. Phoenix's debentures consist of Rs.100 par, 8 percent coupon payable annually, with a residual maturity of 5 years. The market price of these debentures is Rs.105. Phoenix's equity stock is currently selling at Rs.125 per share. Its last dividend was Rs.3.00 per share and the dividend per share is expected to grow at a rate of 12 percent per year in future. Phoenix's equity beta is 0.9, the risk-free rate is 7 percent, and the market risk premium is 7 percent. Phoenix's tax rate is 30 percent

- (i) What is Phoenix's pre-tax cost of debt?
(Use the approximate yield formula)

Solution:

$$\frac{8 + (100 - 105) / 5}{0.6 \times 105 + 0.4 \times 100} = 6.80\%$$

- (ii) What is Phoenix' cost of equity using the constant growth dividend discount model?

Solution:

$$r_E = \frac{D_0 (1 + g)}{P_0} + g = \frac{3 (1.12)}{125} + 0.12 = 14.69\%$$

- (iii) What is Phoenix's post tax weighted average cost of capital? Use the CAPM to estimate the cost of equity and employ the weights in the target capital structure.

Solution:

$$\begin{aligned}
 r_E &= 7 + 0.9 (7) = 13.3\% \\
 r_A &= 0.70 \times 13.3 + 0.05 \times 9 + 0.25 \times 6.80 (1 - 0.3) \\
 &= 9.31 + 0.45 + 1.19 = 10.95 \%
 \end{aligned}$$

4. Nishant Limited's WACC is 14 percent and its tax rate is 33 percent. Nishant's pre-tax cost of debt is 12 percent and its debt-equity ratio is 2:1. The risk-free rate is 8 percent and the market risk premium is 6 percent. What is the beta of Nishant's equity?

Solution:

Given: $\frac{2}{3} \times 12\% \times (1 - 0.33) + \frac{1}{3} \times r = 14\%$ where r is the cost of equity capital. Therefore $r = (14 - 5.36) \times 3 = 25.92\%$

Using the SML equation we get: $8\% + 6\% \times \beta = 25.92\%$
Solving this equation we get $\beta = 2.99$

5. Astute Corporation's WACC is 11 percent and its tax rate is 36 percent. Astute's pre-tax cost of debt is 10 percent and its debt-equity ratio is 1.5:1. The risk-free rate is 7 percent and the market risk premium is 8 percent. What is the beta of Astute's equity?

Solution:

Given: $(1.5/2.5) \times 10\% \times (1 - 0.36) + (1/2.5) \times r = 11\%$ where r is the cost of equity capital. Therefore $r = (11 - 3.84) \times 2.5 = 17.9\%$

Using the SML equation we get: $7\% + 8\% \times \beta = 17.9\%$
Solving this equation we get $\beta = 1.36$

6. North Star Limited has 30 million equity shares outstanding. The book value per share is Rs.60 and the market price per share is Rs.180. North Star has two debenture issues outstanding. The first issue has a face value of Rs.400 million, 13 percent coupon, and sells for 95 percent of its face value. It will mature in 6 years. The second issue has a face value of Rs.300 million, 12 percent coupon, and sells for 108 percent of its face value. It will mature in 7 years. North Star also has a bank loan of Rs.300 million on which the interest rate is 14 percent.

What are North Star's capital structure weights on a book value basis and on a market value basis?

Solution:

The book value and market values of the different sources of finance are provided in the following table. The book value weights and the market value weights are provided within parenthesis in the table.

<i>(Rs. in million)</i>		
Source	Book value	Market value
Equity	1800 (0.64)	5400 (0.84)
Debentures – first series	400 (0.14)	380 (0.06)
Debentures – second series	300 (0.11)	324 (0.05)
Bank loan	300 (0.11)	300 (0.05)
Total	2800 (1.00)	6404 (1.00)

7. Jaihind Corporation has 100 million equity shares outstanding. The book value per share is Rs.100 and the market price per share is Rs.680. Jaihind has a debenture issue outstanding with a face value of Rs.800 million. The coupon rate for a debenture is 13 percent coupon, and it sells for 85 percent of its face value. It will mature in 4 years. Jaihind also has a bank loan of Rs.600 million on which the interest rate is 11 percent.

What are Jaihind's capital structure weights on a book value basis and on a market value basis?

Solution:

The book value and market values of the different sources of finance are provided in the following table. The book value weights and the market value weights are provided within parenthesis in the table.

<i>(Rs. in million)</i>		
Source	Book value	Market value
Equity	10,000 (0.88)	68,000 (0.98)
Debentures	800 (0.07)	680(0.01)
Bank loan	600 (0.05)	600 (0.01)
Total	11,400 (1.00)	69,280 (1.00)

8. Friends Associates manufactures industrial solvents. Its debt-equity ratio is 5:3 Its WACC is 13 percent and its tax rate is 34 percent.
- If Friends Associate's cost of equity is 22 percent, what is its pre-tax cost of debt?
 - If Friends Associates can issue debt at an interest rate of 10 percent, what is its cost of equity?

Solution:

(a) Given: $r_D \times (1 - 0.34) \times (5/8) + 22\% \times (3/8) = 13\%$
 $r_D = (13 - 8.25)/0.4125 = 11.5\%$
 where r_D represents the pre-tax cost of debt.

9. Pioneer Limited's capital structure in terms of market value is:

Debt	Rs.30 million
Equity	Rs.90 million

The company plans to maintain this market-value capital structure. The company has a plan to invest Rs.16 million next year. This will be financed as follows:

Retained earnings	Rs.6 million
Additional equity	Rs.6 million
Debt	Rs.4 million

The company's equity stock presently sells for Rs.40 per share. The next dividend expected is Rs.6.00. The expected rate of dividend growth is 6 percent. Additional equity can be issued at Rs.35 per share (net). The interest rate applicable to additional debt would be as follows:

First Rs.3 million	12 percent
Next Rs.1 million	14 percent

The tax rate for the firm is 33 percent.

Required:

- At what amounts of new capital will there be breaks in the marginal cost of capital schedule?
- What will be the marginal cost of capital in the interval between each of the breaks?

Solution:

$$\begin{aligned} \text{Cost of equity} &= D_1/P_0 + g \\ &= 6.00 / 40 + 0.06 \\ &= 21 \% \end{aligned}$$

- The first chunk of financing will comprise of Rs.6 million of retained earnings and 3 millions of fresh equity costing 21 percent and Rs.3 million of debt costing $12(1-.33) = 8.04$ per cent

The second chunk of financing will comprise of Rs.3 million of additional equity costing 21 per cent and Rs.1million of debt costing $14(1-.33) = 9.38$ per cent

The marginal cost of capital in the first chunk will be :
 $9/12 \times 21\% + 3/12 \times 8.04 \% = 17.76 \%$

The marginal cost of capital in the second chunk will be:
 $3/4 \times 21\% + 1/4 \times 9.38 \% = 18.1 \%$

Note : We have assumed that

- The net realisation per share will be Rs.35, after floatation costs, and
- The planned investment of Rs.16 million is inclusive of floatation costs

10. Mahaveer Cotspin's capital structure in terms of market value is:

Debt	Rs.50 million
Equity	Rs.75 million

The company plans to maintain this market-value capital structure. The company has a plan to invest Rs.15 million next year. This will be financed as follows:

Retained earnings	Rs.4.5 million
Additional equity	Rs.4.5 million
Debt	Rs.6 million

The company's equity stock presently sells for Rs.20 per share. The next dividend expected is Rs.4.00. The expected rate of dividend growth is 10 percent. Additional equity can be issued at Rs.18 per share (net). The interest rate applicable to additional debt would be as follows:

First Rs.4 million	14 percent
Next Rs.2 million	15 percent

The tax rate for the firm is 34 percent.

Required:

- At what amounts of new capital will there be breaks in the marginal cost of capital schedule?
- What will be the marginal cost of capital in the interval between each of the breaks?

Solution:

$$\begin{aligned} \text{Cost of equity} &= D_1/P_0 + g \\ &= 4.00 / 20 + 0.10 \\ &= 30 \% \end{aligned}$$

- (b) The first chunk of financing will comprise of Rs.4.5 million of retained earnings and 1.5 millions of fresh equity costing 30 percent and Rs.4 million of debt costing 14 (1-.34) = 9.24 per cent

The second chunk of financing will comprise of Rs.3 million of additional equity costing 30 per cent and Rs.2million of debt costing 15(1-.34) = 9.90 per cent

The marginal cost of capital in the first chunk will be :

$$6/10 \times 30\% + 4/10 \times 9.24 \% = 21.7 \%$$

The marginal cost of capital in the second chunk will be:

$$6/10 \times 30\% + 4/10 \times 9.90 \% = 21.96 \%$$

Note : We have assumed that

- The net realisation per share will be Rs.18, after floatation costs, and
- The planned investment of Rs.15 million is inclusive of floatation costs

11. Modern Limited has the following book value capital structure:

Equity capital (25 million shares, Rs.10 par)	Rs.250 million
Preference capital, 10 percent (800,000 shares, Rs.100 par)	Rs. 80 million
Retained earnings	Rs. 50 million
Debentures 14 percent (2,000,000 debentures, Rs.100 par)	Rs.200 million
Term loans, 14 percent	Rs. 220 million
	<u>Rs.800 million</u>

The next expected dividend per share is Rs.3.00. The dividend per share is expected to grow at the rate of 10 percent. The market price per share is Rs.260. Preference stock, redeemable after 8 years, is currently selling for Rs.90 per share. Debentures, redeemable after 5 years, are selling for Rs.105 per debenture. The tax rate for the company is 34 percent.

(a) Calculate the average cost of capital using

- (i) book value proportions, and
- (ii) market value proportions

(b) Define the marginal cost of capital schedule for the firm if it raises Rs.280 million next year, given the following information:

- (i) the amount will be raised from equity and term loans in equal proportions
- (ii) the firm expects to retain Rs.40 million earnings next year;
- (iii) the additional issue of equity stock will fetch a net price per share of Rs.250.
- (iv) the debt capital raised by way of term loans will cost 12 percent for the first Rs.100 million and 13 percent for the next Rs.40 million.

Solution:

(a) (i) The cost of equity and retained earnings

$$r_E = \frac{D_1}{P_0} + g = 3.0 / 260 + 0.10 = 11.15 \%$$

The cost of preference capital, using the approximate formula, is:

$$r_P = \frac{10 + (100-90)/8}{0.6 \times 90 + 0.4 \times 100} = 11.97 \%$$

The pre-tax cost of debentures, using the approximate formula, is :

$$r_D = \frac{14 + (100-105)/5}{0.6 \times 105 + 0.4 \times 100} = 12.62 \%$$

The post-tax cost of debentures is

$$12.62 (1 - \text{tax rate}) = 12.62 (1 - 0.34) \\ = 8.33\%$$

The post-tax cost of term loans is

$$14 (1 - \text{tax rate}) = 14 (1 - 0.34) \\ = 9.24 \%$$

The average cost of capital using book value proportions is calculated below :

<i>Source of capital</i>	<i>Component Cost</i>	<i>Book value Rs. in million</i>	<i>Book value proportion</i>	<i>Product of (1) & (3)</i>
	(1)	(2)	(3)	
Equity capital	11.15%	250	0.31	3.46
Preference capital	11.97%	80	0.10	1.20
Retained earnings	11.15%	50	0.06	0.67
Debentures	8.33 %	200	0.25	2.08
Term loans	9.24 %	220	0.28	2.59
		800	Average cost of capital	10.0 %

(ii) The average cost of capital using market value proportions is calculated below:

<i>Source of capital</i>	<i>Component cost</i>	<i>Market value Rs. in million</i>	<i>Market value proportion</i>	<i>Product of (1) & (3)</i>
	(1)	(2)	(3)	(1) & (3)
Equity capital and retained earnings	11.15%	6,500	0.93	10.37
Preference capital	11.97%	72	0.01	0.12
Debentures	8.33%	210	0.03	0.25
Term loans	9.24%	220	0.03	0.28
		7,002	Average cost of capital	11.02 %

(b) The Rs.280 million to be raised will consist of the following:

Retained earnings Rs.40 million
 Additional equity Rs. 100 million
 Debt Rs. 140 million

The first batch will consist of Rs. 40 million each of retained earnings and debt costing 11.15 percent and $12(1-0.34) = 7.92$ percent respectively. The second batch will consist of Rs. 60 million each of additional equity and debt at 11.15 percent and 7.92 percent respectively. The third chunk will consist of Rs.40 million each of additional equity and debt costing 11.15 percent and $13(1-0.34) = 8.58$ percent respectively.

The marginal cost of capital in the chunks will be as under

First batch : $(0.5 \times 11.15) + (0.5 \times 7.92) = 9.54\%$
 Second batch : $(0.5 \times 11.15) + (0.5 \times 7.92) = 9.54\%$
 Third batch : $(0.5 \times 11.15) + (0.5 \times 8.58) = 9.87\%$

The marginal cost of capital schedule for the firm will be as under.

Range of total financing (Rs. in million)	Weighted marginal cost of capital (%)
0 - 200	9.54
201-280	9.87

Here it is assumed that the Rs.280 million to be raised is inclusive of floatation costs.

12. Madhu Corporation has the following book value capital structure:

Equity capital (30 million shares, Rs.10 par)	Rs.300 million
Preference capital, 15 percent (1,000,000 shares, Rs.100 par)	Rs. 100 million
Retained earnings	Rs. 100 million
Debentures 11 percent (2,500,000 debentures, Rs.100 par)	Rs .250 million
Term loans, 13 percent	Rs. 300 million
	<u>Rs.1050 million</u>

The next expected dividend per share is Rs.4.00. The dividend per share is expected to grow at the rate of 15 percent. The market price per share is Rs.80. Preference stock, redeemable after 6 years, is currently selling for Rs.110 per share. Debentures, redeemable after 6 years, are selling for Rs.102 per debenture. The tax rate for the company is 35 percent.

- (a) Calculate the average cost of capital using
 (i) book value proportions, and
 (ii) market value proportions

- (b) Define the marginal cost of capital schedule for the firm if it raises Rs.450 million next year, given the following information:
- (i) the amount will be raised from equity and term loans in the proportion 2:1.
 - (ii) the firm expects to retain Rs.80 million earnings next year;
 - (iii) the additional issue of equity stock will fetch a net price per share of Rs.75.
 - (iv) the debt capital raised by way of term loans will cost 11percent for the first
 - (v) Rs.100 million and 12 percent for amounts thereafter.

Solution:

- (a) (i) The cost of equity and retained earnings

$$r_E = \frac{D_1/P_0}{g} + g = 4.0 / 80 + 0.15 = 20 \%$$

The cost of preference capital, using the approximate formula, is :

$$r_P = \frac{15 + (100-110)/6}{0.6 \times 110 + 0.4 \times 100} = 12.58 \%$$

The pre-tax cost of debentures, using the approximate formula, is :

$$r_D = \frac{11 + (100-102)/6}{0.6 \times 102 + 0.4 \times 100} = 10.54 \%$$

The post-tax cost of debentures is

$$10.54 (1-\text{tax rate}) = 10.54 (1 - 0.35) = 6.85 \%$$

The post-tax cost of term loans is

$$13 (1-\text{tax rate}) = 13 (1 - 0.35) = 8.45 \%$$

The average cost of capital using book value proportions is calculated below:

<i>Source of capital</i>	<i>Component Cost</i> (1)	<i>Book value Rs. in million</i> (2)	<i>Book value proportion</i> (3)	<i>Product of (1) & (3)</i>
Equity capital	20.00%	300	0.29	5.8
Preference capital	12.58 %	100	0.09	1.13
Retained earnings	20.00%	100	0.09	1.80
Debentures	6.85 %	250	0.24	1.64
Term loans	8.45%	300	0.29	2.45
		1050	Average cost of capital	12.82 %

(ii) The average cost of capital using market value proportions is calculated below :

<i>Source of capital</i>	<i>Component cost</i> (1)	<i>Market value Rs. in million</i> (2)	<i>Market value proportion</i> (3)	<i>Product of (1) & (3)</i>
Equity capital and retained earnings	20.00%	2400	0.78	15.60
Preference capital	12.58%	110	0.04	0.50
Debentures	6.85%	255	0.08	0.55
Term loans	8.45%	300	0.10	0.85
		3065	Average cost of capital	17.50 %

(b) The Rs.450 million to be raised will consist of the following:

Retained earnings Rs.80 million
 Additional equity Rs. 220 million
 Debt Rs. 150 million

The first batch will consist of Rs. 80 million of retained earnings and Rs.40 million of debt costing 20 percent and $11(1-0.35) = 7.15$ percent respectively. The second batch will consist of Rs. 120 million of additional equity and Rs. 60 million of debt at 20 percent 7.15 percent respectively. The third chunk will consist of Rs.100 million of additional equity and Rs.50 million of debt costing 20 percent and $12(1-0.35) = 7.8$ percent respectively.

The marginal cost of capital in the chunks will be as under

$$\text{First batch} : (2/3) \times 20 + (1/3) \times 7.15 = 15.72 \%$$

$$\text{Second batch} : (2/3) \times 20 + (1/3) \times 7.15 = 15.72 \%$$

$$\text{Third batch} : (2/3) \times 20 + (1/3) \times 7.8 = 15.93 \%$$

The marginal cost of capital schedule for the firm will be as under.

Range of total financing (Rs. in million)	Weighted marginal cost of capital (%)
0 - 300	15.72
301-450	15.93

Here it is assumed that the Rs.450 million to be raised is inclusive of floatation costs.

13. Imperial Industries is currently at its target debt-equity ratio of 0.8 : 1. It is considering a proposal to expand capacity which is expected to cost Rs.600 million and generate after-tax cash flows of Rs.150 million per year for the next 10 years. The tax rate for the firm is 35 percent. Ganesh, the CFO of the company, has considered two financing options : (i) Issue of equity stock. The required return on the company's new equity is 25 percent and the issuance cost will be 10 percent. (ii) Issue of debentures at a yield of 14 percent. The issuance cost will be 2 percent.
- What is the WACC for Imperial Industries?
 - What is Imperial Industries's weighted average floatation cost?
 - What is the NPV of the proposal after taking into account the floatation costs?

Solution:

- (a) WACC = $4/9 \times 14\% \times (1 - 0.35) + 5/9 \times 25\%$
= 17.93%
- (b) Weighted average floatation cost
= $4/9 \times 2\% + 5/9 \times 10\%$
= 6.44 %
- (c) NPV of the proposal after taking into account the floatation costs
= $150 \times \text{PVIFA}(17.93\%, 10) - 600 / (1 - 0.0644)$
= 675.79 - 641.30 = Rs. 34.49million

14. Pan India Limited is currently at its target debt-equity ratio of 1.5 : 1. It is considering a proposal to expand capacity which is expected to cost Rs.1000 million and generate after-tax cash flows of Rs.200 million per year for the next 12 years. The tax rate for the firm is 33 percent. Ravikiran, the CFO of the company, has considered two financing options : (i) Issue of equity stock. The required return on the company's new equity is 19 percent and the issuance cost will be 11 percent. (ii) Issue of debentures at a yield of 12 percent. The issuance cost will be 1.5 percent.
- What is the WACC for Pan India?
 - What is Pan India's weighted average floatation cost?
 - What is the NPV of the proposal after taking into account the floatation costs?

Solution:

(a)	WACC	=	$(3/5) \times 12\% \times (1 - 0.33) + (2/5) \times 19\%$
		=	12.42%
(b)	Weighted average floatation cost		
		=	$3/5 \times 1.5\% + 2/5 \times 11\%$
		=	5.3 %
(c)	NPV of the proposal after taking into account the floatation costs		
		=	$200 \times \text{PVIFA}(12.42\%, 12) - 1000 / (1 - 0.0533)$
		=	1215.13 - 1056.30 = Rs. 158.83million

15. Jawahar Associates, an all-equity firm, is evaluating the following projects:

<i>Project</i>	<i>Beta</i>	<i>ExpectedReturn</i> (%)
A	0.4	12
B	0.8	14
C	1.3	18
D	1.8	24

The risk-free rate is 8 percent and the expected market premium is 7 percent. Jawahar's cost of capital is 16 percent. Which projects would be accepted or rejected incorrectly on the basis of the firm's cost of capital as a hurdle rate?

Solution:

<i>Project</i>	<i>Beta</i>	<i>Required return based on SML equation (%)</i>	<i>Expected return (%)</i>
A	0.4	10.8	12
B	0.8	13.6	14
C	1.3	17.1	18
D	1.8	20.6	24

Given a hurdle rate of 16% (the firm's cost of capital), projects A and B would have been rejected because the expected returns on these projects are below 16%. Projects C and D would be accepted because the expected returns on these projects exceed 16%. An appropriate basis for accepting or rejecting the projects would be to compare the expected rate of return and the required rate of return for each project. Based on this comparison, we find that all the four projects need to be rejected.

16. Aryan Limited, an all-equity firm, is evaluating the following projects:

<i>Project No.</i>	<i>Beta</i>	<i>ExpectedReturn (%)</i>
1	0.9	14
2	1.1	16
3	1.2	18
4	1.7	25

The risk-free rate is 7 percent and the expected market premium is 9 percent. Aryan's cost of capital is 15 percent. Which projects would be accepted or rejected incorrectly on the basis of the firm's cost of capital as a hurdle rate?

Solution:

<i>Project</i>	<i>Beta</i>	<i>Required return based on SML equation (%)</i>	<i>Expected return (%)</i>
1	0.9	15.1	14
2	1.1	16.9	16
3	1.2	17.8	18
4	1.7	22.3	25

Given a hurdle rate of 15% (the firm's cost of capital), project 1 would have been rejected because the expected returns on this project is below 15%. Projects 2, 3

and 4 would be accepted because the expected returns on these projects exceed 15%. An appropriate basis for accepting or rejecting the projects would be to compare the expected rate of return and the required rate of return for each project. Based on this comparison, we find that all the four projects need to be rejected.

CHAPTER 15

1. Plastic emulsion for a building costs Rs.600,000 and has a life of 8 years. Distemper painting costs Rs.250,000 and has a life of 4 years. How does the UAE of plastic emulsion painting compare with that of distemper painting if the cost of capital is 15 percent?

Solution:

EAC	
(Plastic Emulsion)	= 600000 / PVIFA (15%,8)
	= 600000 / 4.487
	= Rs.133,720
EAC	
(Distemper Painting)	= 250000 / PVIFA (15%,4)
	= 250000 / 2.855
	= Rs.87,566

Since EAC of distemper painting is less than that of plastic emulsion, it is the preferred alternative.

2. The initial outlay on a security system would be Rs.2,000,000. The operating costs are expected to be as follows:

<i>Year</i>	<i>Operating Costs (in Rs.)</i>
1	500,000
2	720,000
3	860,000
4	530,000
5	400,000

The estimated salvage value at the end of five years is Rs.600,000. What is the UAE if the cost of capital is 12 percent?

Solution:

$$\begin{aligned}
& \text{PV of the net costs associated with the security system} \\
& = 2\,000\,000 + 500\,000 \times \text{PVIF}(12\%,1) + 720\,000 \times \text{PVIF}(12\%,2) \\
& \quad + 860\,000 \times \text{PVIF}(12\%,3) + 530\,000 \times \text{PVIF}(12\%,4) \\
& \quad + 400\,000 \times \text{PVIF}(12\%,5) - 600\,000 \times \text{PVIF}(12\%,5) \\
& = 2\,000\,000 + 500\,000 \times 0.893 + 720\,000 \times 0.797 \\
& \quad + 860\,000 \times 0.712 + 530\,000 \times 0.636 \\
& \quad + 400\,000 \times 0.567 - 600\,000 \times 0.567 = 3,856,340 \\
& \\
& \text{EAC of the security system} \\
& = 3856340 / \text{PVIFA}(12\%, 5) \\
& = 3856340 / 3.605 = 1,069,720
\end{aligned}$$

3. The initial outlay for an internal transportation system would be Rs.900,000. The operating costs are expected to be as follows:

<i>Year</i>	<i>Operating Costs (in Rs.)</i>
1	100,000
2	182,000
3	290,000
4	240,000
5	140,000

The estimated salvage value at the end of five years is Rs.100,000. What is the UAE if the cost of capital is 16 percent?

Solution:

$$\begin{aligned}
& \text{PV of the net costs associated with the internal transportation system} \\
& = 900\,000 + 100\,000 \times \text{PVIF}(16\%,1) + 182\,000 \times \text{PVIF}(16\%,2) \\
& \quad + 290\,000 \times \text{PVIF}(16\%,3) + 240\,000 \times \text{PVIF}(16\%,4) \\
& \quad + 140\,000 \times \text{PVIF}(16\%,5) - 100\,000 \times \text{PVIF}(16\%,5) \\
& = 900\,000 + 100\,000 \times 0.862 + 182\,000 \times 0.743 \\
& \quad + 290\,000 \times 0.641 + 240\,000 \times 0.552 \\
& \quad + 140\,000 \times 0.476 - 100\,000 \times 0.476 = 1,458,836 \\
& \\
& \text{EAC of the internal transportation system} \\
& = 1,458,836 / \text{PVIFA}(16\%,5) \\
& = 1,458,836 / 3.274 = 445,582
\end{aligned}$$

4. Hansen Electricals is evaluating a capital project requiring an outlay of Rs.1900 million. It is expected to generate a net cash inflow of Rs.600 million per year for 5 years. The opportunity cost of capital is 18 percent. Hansen Electricals can raise a term loan of Rs.800 million for the project, carrying an interest rate of 8 percent per year payable annually. The principal amount will be repayable in 4 equal annual instalments, the first instalment falling due at the end of the second year. The balance amount required for the project can be raised by issuing external equity. The issue cost is expected to be 10 percent. The effective tax rate for the company is 30 percent

- (i) What is the *base case* NPV?

Solution:

The base case NAV

$$\begin{aligned}
 &= -1900 + 600 \times \text{PVIFA} (18\%, 5 \text{ yrs}) \\
 &= -1900 + 600 \times 3.127 \\
 &= -23.8
 \end{aligned}$$

- (ii) What is the *adjusted* NPV if the adjustment is made only for the issue cost of external equity?

Solution:

$$\frac{1100}{1 - 0.10} = 1222.2$$

Issue cost = Rs. 122.2 million

Adjusted NPV considering only the issue cost

$$= -23.8 - 122.2 = -146.0 \text{ million}$$

- (iii) What is the present value of the tax shield?

Solution:

Year	Debt outstanding at beginning	Interest	Tax shield	PV @ 8% discount rate	PV
1	800	64	19.2	0.926	17.78
2	800	64	19.2	0.857	16.45
3	600	48	14.4	0.794	11.43
4	400	32	9.6	0.735	7.06
5	200	16	4.8	0.681	3.27
					55.99

5. Alok Appliances is evaluating a capital project requiring an outlay of Rs.1500 million. It is expected to generate a net cash inflow of Rs.400 million per year for 6 years. The opportunity cost of capital is 16 percent. Alok Appliances can raise a term loan of Rs.900 million for the project, carrying an interest rate of 10 percent per year payable annually. The principal amount will be repayable in 5 equal annual instalments, the first instalment falling due at the end of the first year. The balance amount required for the project can be raised by issuing external equity. The issue cost is expected to be 9 percent. The effective tax rate for Alok Appliances is 33 percent.

- (i) What is the *base case* NPV?

Solution:

$$\text{Base case NPV} = -1500 + 400 \text{ PVIFA} (16\%, 6) = -1500 + 400 \times 3.685 = -26$$

- (ii) What is the *adjusted* NPV if the adjustment is made only for the issue cost of external equity?

Solution:

$$\begin{aligned} 600 / (1-0.09) &= 659.34 \\ \text{Additional equity to be raised} &= 59.34 \\ \text{Adjusted NPV for issue cost} &= -26 - 59.34 = -85.34 \end{aligned}$$

- (iii) What is the present value of the tax shield?

Solution:

Year	Debt outstanding at the beginning	Interest	Tax shield	PVIF@ 10%	PV of tax shield
1	900	90	29.70	0.909	27.00
2	720	72	23.76	0.826	19.63
3	540	54	17.82	0.751	13.38
4	360	36	11.88	0.683	8.11
5	180	18	5.94	0.621	3.69
					71.81

6. Mitra Chemicals is evaluating a capital project requiring an outlay of Rs.1800 million. It is expected to generate a net cash inflow of Rs.500 million per year for 6 years. The opportunity cost of capital is 15 percent. Mitra Chemicals can raise a term loan of Rs.800 million for the project. The term loan will carry an interest of 9 percent per year payable annually. The principal amount will be repayable in 4 equal annual instalments, the first instalment falling due at the end of the second year. The balance amount required for the project can be raised by issuing external equity. The issue cost is expected to be 7 percent. The effective tax rate for the company is 30 percent

- (i) What is the *base case* NPV?

Solution:

$$\begin{aligned} & -1800 + 500 \times \text{PVIFA} (15\%, 6 \text{ yrs}) \\ & = -1800 + 500 \times 3.784 \\ & = -92 \end{aligned}$$

- (ii) What is the *adjusted* NPV if the adjustment is made only for the issue cost of external equity?

Solution:

$$\frac{1,000}{1 - 0.07} = 1075.3$$

Issue cost = Rs.75.3 million

$$\begin{aligned} \text{Adjusted NPV considering only the issue cost} \\ & = -92 - 75.3 = -167.3 \text{ million} \end{aligned}$$

- (iii) What is the present value of the tax shield?

Solution:

Year	Debt outstanding at beginning	Interest	Tax shield	PV @ 9 % discount rate	PV
1	800	72	21.6	0.917	19.81
2	800	72	21.6	0.842	18.19
3	600	54	16.2	0.772	12.51
4	400	36	10.8	0.708	7.65
5	200	18	5.4	0.650	3.51
					61.67

CHAPTER 18

1. Bearings Limited received a subscription for 390,000 shares as against 500,000 shares that were offered and fully underwritten. The underwritten commitments of 5 underwriters P, Q, R, S, and T are as under:

	<i>Underwriting commitment</i>	<i>Shares procured</i>
P	90,000	70,000
Q	80,000	70,000
R	100,000	85,000
S	130,000	115,000
T	100,000	120,000

Determine the liability of each underwriter.

Solution:

	<i>Underwriting commitment</i>	<i>Shares procured</i>	<i>Excess/shortfall</i>	<i>Credit</i>	<i>Net shortfall</i>
P	90,000	70,000	(20,000)	4500	(15,500)
Q	80,000	70,000	(10,000)	4000	(6,000)
R	100,000	85,000	(15,000)	5000	(10,000)
S	130,000	115,000	(15,000)	6500	(8,500)
T	100,000	120,000	20,000		

2. Welcome Industries received a subscription for 850,000 shares as against 1,000,000 shares that were offered and fully underwritten. The underwritten commitments of 4 underwriters M, N, O and P are as under:

	<i>Underwriting commitment</i>	<i>Shares procured</i>
M	200,000	160,000
N	300,000	220,000
O	400,000	345,000
P	100,000	125,000

Determine the liability of each underwriter.

Solution:

	<i>Underwriting commitment</i>	<i>Shares procured</i>	<i>Excess/ shortfall</i>	<i>Credit</i>	<i>Net shortfall</i>
<i>M</i>	200,000	160,000	(40,000)	5556	(34,444)
<i>N</i>	300,000	220,000	(80,000)	8333	(71,667)
<i>O</i>	400,000	345,000	(55,000)	11111	(43,889)
<i>P</i>	100,000	125,000	25,000		

3. The equity stock of Paramount Corporation is selling for Rs.240 per share. The firm is planning to issue rights shares in the ratio of one right share for every existing four shares:
- What is the theoretical value of a right if the subscription price is Rs.220?
 - What is the ex-rights value per share if the subscription price is Rs.210?
 - What is the theoretical value per share when the stock goes ex-rights, if the subscription price is Rs.240? Rs.200?

Solution:

	$P_o = \text{Rs.}240$	$N = 4$
a.	The theoretical value of a right if the subscription price is Rs.220	
	$\frac{P_o - S}{N+1} = \frac{4(240 - 220)}{5} = \text{Rs.}16$	
b.	The ex-rights value per share if the subscription price is Rs.210	
	$\frac{NP_o + S}{N+1} = \frac{4 \times 240 + 210}{4+1} = \text{Rs.}234$	
c.	The theoretical value per share, ex-rights, if the subscription price is Rs.240? 100?	
	$\frac{4 \times 240 + 240}{4+1} = \text{Rs.}240$	
	$\frac{4 \times 240 + 100}{4+1} = \text{Rs.}212$	

4. The equity stock of Parakram Limited is selling for Rs.860 per share. The firm is planning to issue rights shares in the ratio of one right share for every existing three shares:
- What is the theoretical value of a right if the subscription price is Rs.800 ?
 - What is the ex-rights value per share if the subscription price is Rs.820 ?
 - What is the theoretical value per share when the stock goes ex-rights, if the subscription price is Rs.860? Rs.700?

Solution:

$P_o = \text{Rs.}860 \quad N = 3$

a. The theoretical value of a right if the subscription price is Rs.800

$$\frac{P_o - S}{N+1} = \frac{3(860 - 800)}{4} = \text{Rs.} 45$$

b. The ex-rights value per share if the subscription price is Rs.820

$$\frac{NP_o + S}{N+1} = \frac{3 \times 860 + 820}{3+1} = \text{Rs.}850$$

c. The theoretical value per share, ex-rights, if the subscription price is Rs.860? 700?

$$\frac{3 \times 860 + 860}{3+1} = \text{Rs.}860$$

$$\frac{3 \times 860 + 700}{3+1} = \text{Rs.}820$$

CHAPTER 19

1. Advaith Corporation has a net operating income of Rs.50 million. Advaith employs Rs.200 million of debt capital carrying 12 percent interest charge. The equity capitalisation rate applicable to Advaith is 14 percent. What is the market value of Advaith under the net income method? Assume there is no tax.

Solution:

Net operating income (O)	:	Rs.50 million
Interest on debt (I)	:	Rs.24 million
Equity earnings (P)	:	Rs.26 million
Cost of equity (r_E)	:	14 %
Cost of debt (r_D)	:	12 %
Market value of equity (E)	:	Rs.26 million/0.14 =Rs.185.7 million
Market value of debt (D)	:	Rs.24 million/0.12 =Rs.200 million
Market value of the firm (V)	:	Rs.385.7 million

2. Kanishk Limited has a net operating income of Rs.100 million. Kanishk employs Rs.800 million of debt capital carrying 10 percent interest charge. The equity capitalisation rate applicable to Kanishk is 13 percent. What is the market value of Kanishk under the net income method? Assume there is no tax.

Solution:

Net operating income (O)	:	Rs.100 million
Interest on debt (I)	:	Rs.80 million
Equity earnings (P)	:	Rs.20 million
Cost of equity (r_E)	:	13 %
Cost of debt (r_D)	:	10 %
Market value of equity (E)	:	Rs.20 million/0.13 =Rs.153.8 million
Market value of debt (D)	:	Rs.80 million/0.10 =Rs.800 million
Market value of the firm (V)	:	Rs.953.8 million

3. The following information is available for two firms, Anil Corporation and Sunil Corporation.

	<u>Anil</u>	<u>Sunil</u>
Net operating income	Rs.3,200,000	Rs.3,200,000
Interest on debt	Nil	480,000
Cost of equity	16 %	16%
Cost of debt	12 %	12 %

Calculate the market value of equity, market value of debt, and market value of the firm for Anil Corporation and Sunil Corporation.

- What is the average cost of capital for each of the firms?
- What happens to the average cost of capital of Anil Corporation if it employs Rs.50 million of debt to finance a project that yields an operating income of Rs.5 million?
- What happens to the average cost of capital of Sunil Corporation if it sells Rs.4 million of additional equity (at par) to retire Rs.4 million of outstanding debt?

In answering the above questions assume that the net income approach applies and there are no taxes.

Solution:

	<u>Anil</u>	<u>Sunil</u>
Market value of equity	3,200,000/0.16 = Rs.20 million	3,200,000/0.16 = Rs.20 million
Market value of debt	0	480,000/0.12 =Rs.4 million
Market value of the firm	Rs.20million	24 million

(a) Average cost of capital for Anil Corporation

$$\frac{20}{20} \times 16\% + \frac{0}{20} \times 12\% = 16\%$$

Average cost of capital for Sunil Corporation

$$\frac{20}{24} \times 16\% + \frac{4}{24} \times 12\% = 15.33\%$$

(b) If Anil Corporation employs Rs.50 million of debt to finance a project that yields Rs.5 million net operating income, its financials will be as follows.

Net operating income	Rs.8,200,000
Interest on debt	Rs.6,000,000
Equity earnings	Rs.2,200,000
Cost of equity	16%
Cost of debt	12%
Market value of equity	Rs.13.75million
Market value of debt	Rs.50 million
Market value of the firm	Rs.63.75 million

Average cost of capital

$$16\% \frac{13.75}{63.75} \times \frac{50}{63.75} + 12\% \times = 12.86\%$$

(c) If Sunil Corporation sells Rs.4 million of additional equity to retire Rs.4 million of debt, it will become an all-equity company. So its average cost of capital will simply be equal to its cost of equity, which is 16%.

4. The management of Janata Company, subscribing to the net operating income approach, believes that its cost of debt and overall cost of capital will remain at 7 percent and 14 percent, respectively. If the equity shareholders of the firm demand a return of 25 percent, what should be the proportion of debt and equity in the firm's capital structure? Assume that there are no taxes.

Solution:

$$r_E = r_A + (r_A - r_D)D/E$$

$$25 = 14 + (14 - 7) D/E$$

So, $D/E = 1.57$

5. The management of Lavanya Corporation, subscribing to the net operating income approach, believes that its cost of debt and overall cost of capital will remain at 10 percent and 16 percent, respectively. If the equity shareholders of the firm demand a return of 22 percent, what should be the proportion of debt and equity in the firm's capital structure? Assume that there are no taxes.

Solution:

$$\begin{aligned}
 r_E &= r_A + (r_A - r_D)D/E \\
 22 &= 16 + (16 - 10) D/E \\
 \text{So } D/E &= 1.0
 \end{aligned}$$

6. The management of a firm believes that the cost of equity and debt for different proportions of equity and debt in the capital structure are as follows

<i>Proportion of Equity</i>	<i>Proportion of Debt</i>	<i>Cost of Equity, $r_E\%$</i>	<i>Cost of Debt, $r_D\%$</i>
1.00	0.00	15.0	7.0
0.90	0.10	16.0	7.5
0.80	0.20	16.5	8.0
0.70	0.30	17.0	8.5
0.60	0.40	17.5	9.0
0.50	0.50	18.0	9.5
0.40	0.60	18.5	10.0
0.30	0.70	19.0	11.0
0.20	0.80	19.5	12.0
0.10	0.90	20.0	14.0

What is the optimal capital structure of the firm?

Solution:

$$\frac{E}{D+E} r_E + \frac{D}{D+E} r_D = r_A$$

1.00	0.00	15.0	7.0	15.0
0.90	0.10	16.0	7.5	15.15
0.80	0.20	16.5	8.0	14.8
0.70	0.30	17.0	8.5	14.45
0.60	0.40	17.5	9.0	14.10
0.50	0.50	18.0	9.5	13.75
0.40	0.60	18.5	10.0	13.40
0.30	0.70	19.0	11.0	13.40
0.20	0.80	19.5	12.0	13.50
0.10	0.90	20.0	14.0	14.60

The debt ratios 0.60 or 0.70 minimises the WACC . The optimal ratio is 0.60 as the firm's financial flexibility in that case is more.

7. The following information is available on Vidyut Corporation.
- Net operating income = Rs.100 million
 - Tax rate = 35 percent
 - Debt capital = Rs.250 million
 - Interest rate on debt capital = Rs.12 percent
 - Capitalisation rate applicable to debt-free Firm in the risk class to which Vidyut Corporation belongs = 14 percent
- What should be the value of Vidyut Corporation .according to Modigliani and Miller?

Solution:

The value of Vidyut Corporation.according to Modigliani and Miller hypothesis is			
Expected operating income	=	$\frac{100}{0.14}$	= Rs.714 million
Discount rate applicable to the risk class to which Vidyut Corporation.belongs			

8. The following information is available on Magnificent Corporation.

Net operating income = Rs.80 million

Tax rate = 33 percent

Debt capital = Rs.150 million

Interest rate on debt capital = Rs.14 percent

Capitalisation rate applicable to debt-free

Firm in the risk class to which

Magnificent Corporation. belongs = 15 percent

What should be the value of Magnificent Corporation, according to Modigliani and Miller?

Solution:

The value of Magnificent Corporation, according to Modigliani and Miller hypothesis is		
Expected operating income	=	$\frac{80}{0.15}$ = Rs.533 million
Discount rate applicable to the risk class to which Magnificent Corporation..belongs		

9. If $t_c = 30\%$, $t_{pe} = 10\%$, and $t_{pd} = 20\%$, what is the tax advantage of a rupee of debt?

Solution:

	$(1-t_c) (1 - t_{pc})$		$(1-0.3) (1-0.10)$
1 -	$\frac{\quad}{(1 - t_{pd})}$	=	1 - $\frac{\quad}{(1 - 0.20)}$
			= 0.21 or 21 paise

10. If $t_c = 35\%$, $t_{pe} = 10\%$, and $t_{pd} = 25\%$, what is the tax advantage of a rupee of debt?

Solution:

$$1 - \frac{(1-t_c)(1-t_{pc})}{(1-t_{pd})} = 1 - \frac{(1-0.35)(1-0.10)}{(1-0.25)}$$

$$= 0.22 \text{ or } 22 \text{ paise}$$

CHAPTER 20

1. The profit and loss account for the year 1 (the year that has just ended) and the balance sheet at the end of year 1 for Red Rock Limited are as follows.

<i>Profit and Loss Account</i>		<i>Balance Sheet</i>	
	<u>Rs.in crore</u>	<u>Sources of Funds</u>	<u>Rs. in crore</u>
Sales	520	Shareholders' Funds	300
PBIT	86	Paid up capital : 60 (Equity shares of par value Rs.10)	
Interest	16	Reserves and Surplus: 240	
PBT	70	Loan Funds	<u>200</u>
Tax ($t_c = 30\%$)	21		<u>500</u>
PAT	49	<u>Application of Funds</u>	
Dividends (Rs. 3 per share)	18	Net fixed assets	350
Retained Earnings	31	Net current assets	150

- (i) What should have been the ROI of Red Rock Limited for it to meet its target ROE of 20 percent? Note that the pre-tax cost of debt is 8 percent.

Solution:

$$\begin{aligned} [ROI + (ROI - r) D/E] (1 - t_c) &= 20\% \\ [ROI + (ROI - 8) 2/3] (1 - 0.3) &= 20\% \\ ROI &= 20.34\% \end{aligned}$$

- (ii) Red Rock Limited requires Rs. 200 crore of external financing for which it is considering two alternatives:

Alternative A : Issue of 1.6 crore equity shares of Rs 10 par at Rs. 125 each.

Alternative B : Issue of Rs.200 crore of debentures carrying 8 percent interest rate.

What is the EPS-PBIT indifference point?

Solution:

$$EPS_A = \frac{(PBIT - 16)(1 - 0.3)}{7.6}$$

$$EPS_B = \frac{(PBIT - 32)(1 - 0.3)}{6}$$

Equating EPS_A and EPS_B gives $PBIT = Rs. 92$ crore.

2. The profit and loss account for year 1 (the year which has just ended) and the balance sheet at the end of year 1 for Glendale are as follows:

<i>Balance Sheet</i>		<i>Profit and Loss Account</i>	
<i>Sources of Funds</i>	<i>Rs. in crore</i>		<i>Rs in crore</i>
• Shareholders' Funds	260	Sales	500
Paid up capital : 60 (Equity shares of Rs.10 par)		PBIT	80
Reserves & surplus : 200		Interest	10
• Loan Funds	100	PBT	70
	<u>360</u>	Tax ($t_c=30\%$)	21
<i>Application of Funds</i>		PAT	49
• Net Fixed Assets	250	Dividends	18
• Net Current Assets	110	(Rs.3 per share)	
	<u>360</u>	Retained earnings	31

- (i) What should have been the ROI of Glendale Company to meet a target ROE of 25 percent? Note that the pre-tax cost of debt is 10 percent

Solution:

$$\begin{aligned} [\text{ROI} + (\text{ROI} - r) D/E] (1 - t_c) &= 25\% \\ [\text{ROI} + (\text{ROI} - .10) 0.385] (1 - 0.3) &= 25\% \\ \Rightarrow \text{ROI} &= 28.57\% \end{aligned}$$

(ii) Glendale Company requires Rs.50 crore of external financing for which it is considering two alternatives:

Alternative A : Issue of 0.4 crore shares at Rs.125 each.

Alternative B : Issue of Rs.50 crore of debentures carrying 10 percent interest rate.

What is the EPS-PBIT indifference point?

Solution:

$$\text{EPS}_A = \frac{(\text{PBIT} - 10) (1 - 0.3)}{6.4}$$

$$\text{EPS}_B = \frac{(\text{PBIT} - 15) (1 - 0.3)}{6}$$

Equating EPS_A and EPS_B gives

$$\frac{0.7 \text{PBIT} - 7}{6.4} = \frac{0.7 \text{PBIT} - 10.5}{6.0}$$

$$\Rightarrow \text{PBIT} = \text{Rs.90 crore}$$

3. A company's present capital structure contains 4,000,000 equity shares and 100,000 preference shares. The firm's current PBIT is Rs.25 million. Preference shares carry a dividend of Rs.3 per share. The earnings per share is Rs.4. The firm is planning to raise Rs.40 million of external financing. Two financing alternatives are being considered: (i) issuing 4,000,000 equity shares for Rs.10 each, (ii) issuing debentures for Rs.40 million carrying 12 percent interest.

Required (a) Compute the EPS-PBIT indifference point.

(b) Define the alternative which maximises EPS for various levels of PBIT.

Solution:

(a) Currently
No. of shares = 4,000,000
PBIT = Rs 25 million
Interest = 0
Preference dividend = Rs.3 x 100,000 = Rs.0.3 million
EPS = Rs.4

$$EPS = \frac{(PBIT - \text{Interest}) (1-t) - \text{Preference dividend}}{\text{No. of shares}}$$
$$4 = \frac{(25,000,000 - 0) (1-t) - 300,000}{4,000,000}$$

Hence $t = 0.348$ or 34.8 per cent

The *EPS* under the two financing plans is :

Financing Plan A : Issue of 4,000,000 shares

$$EPS_A = \frac{(PBIT - 0) (1 - 0.348) - 300,000}{8,000,000}$$

Financing Plan B : Issue of Rs.10 million debentures carrying 15 per cent interest

$$EPS_B = \frac{(PBIT - 4,800,000) (1-0.348) - 300,000}{4,000,000}$$

The *EPS – PBIT* indifference point can be obtained by equating EPS_A and EPS_B

$$\frac{(PBIT - 0) (1 - 0.348) - 300,000}{8,000,000} = \frac{(PBIT - 4,800,000) (1 - 0.348) - 300,000}{4,000,000}$$

$$0.652 PBIT - 300,000 = 2(0.652 PBIT - 3,129,600 - 300,000)$$
$$0.652 PBIT = 6,559,200 \text{ or } PBIT = 10,060,123$$

(b) As long as *PBIT* is less than Rs.10,060,123 equity financing maximises *EPS*.
When *PBIT* exceeds Rs. 10,060,123 debt financing maximises *EPS*.

4. BGM Limited's present capital structure consists of 20 million equity shares of Rs.10 each. It requires Rs.60 million of external financing. It is considering two alternatives:

Alternative 1 : Issue of 3 million equity shares of Rs.10 par at Rs.15 each and 1.5 million preference shares of Rs.10 par, carrying a dividend rate of 10 percent.

Alternative 2 : Issue of 2 million equity shares of Rs.10 par at Rs.15 each and debentures for Rs.30 million carrying an interest rate of 11 percent

The company's tax rate is 35 percent? What is the EPS-PBIT indifference point?

Solution:

Alternative 1	
EPS	$= \frac{(\text{PBIT} - 0)(1 - 0.35) - 1.5}{23}$
Alternative 2	
EPS	$= \frac{(\text{PBIT} - 3.3)(1 - 0.35)}{22}$
$\frac{0.65 \text{ PBIT} - 1.5}{23}$	$= \frac{0.65 \text{ PBIT} - 2.145}{22}$
$14.3 \text{ PBIT} - 33$	$= 14.95 \text{ PBIT} - 49.335$
0.65 PBIT	$= 16.335$
PBIT	$= 25.13$

5. Keerthinath Corporation presently has two million outstanding equity shares (Rs.10 par) selling at Rs.11 per share and no outstanding debt . It needs Rs.8 million of additional funds which can be raised in two ways:

- (a) issue of 0.8 million equity shares at Rs.10 per share,
- (b) issue of debt capital carrying 14 percent interest.

The expected earnings before interest and taxes after the new funds are raised will be Rs.6 million per year with a standard deviation of Rs.2 million. Keerthinath Corporation's tax rate is 35 percent. What is the probability that the debt alternative is better than the equity alternative with respect to earnings per share

Solution:

Plan A : Issue 0.8 million equity shares at Rs. 10 per share.

Plan B : Issue Rs.8 million of debt carrying interest rate of 14 per cent.

$$EPS_A = \frac{(PBIT - 0)(1 - 0.35)}{2,800,000}$$
$$EPS_B = \frac{(PBIT - 1,120,000)(1 - 0.35)}{2,000,000}$$

Equating EPS_A and EPS_B , we get

$$\frac{(PBIT - 0)(1 - 0.35)}{2,800,000} = \frac{(PBIT - 1,120,000)(1 - 0.35)}{2,000,000}$$

$$1.82 PBIT - 2.0384 = 1.3 PBIT \text{ or } PBIT = 3.92 \text{ million}$$

Thus the debt alternative is better than the equity alternative when $PBIT > 3.92$ million

$$\text{Prob}(PBIT > 3,920,000) = \text{Prob} \left[\frac{PBIT - \overline{PBIT}}{\sigma PBIT} > \frac{3.92 - 6.000}{2.000} \right]$$
$$= \text{Prob} [z > -1.04]$$

From the tables we have

when $z = -1.00$, the probability is $= 1 - 0.1587 = 0.8413$

when $z = -1.05$, the probability is $= 1 - 0.1469 = 0.8531$

By extrapolation we have

$$\text{Prob} [z > -2.08] = 0.8413 + (1.04 - 1)(0.8531 - 0.8413)/0.05$$
$$= 0.8507 \text{ or } 85.07 \text{ percent.}$$

6. Innovation Limited presently has 10 million outstanding equity shares (Rs.10 par) selling at Rs.11 per share and no outstanding debt. It needs Rs.60 million of additional funds which can be raised in two ways:
- (a) issue of 6 million equity shares at Rs.10 per share,
 - (b) issue of debt capital carrying 11 percent interest.

The expected earnings before interest and taxes after the new funds are raised will be Rs.16 million per year with a standard deviation of Rs.8 million. Innovation Limited tax rate is 33 percent. What is the probability that the debt alternative is better than the equity alternative with respect to earnings per share.

Solution:

Plan A : Issue 6 million equity shares at Rs. 10 per share.

Plan B : Issue Rs.60 million of debt carrying interest rate of 11 per cent.

$$EPS_A = \frac{(PBIT - 0)(1 - 0.33)}{16,000,000}$$

$$EPS_B = \frac{(PBIT - 6,600,000)(1 - 0.33)}{10,000,000}$$

Equating EPS_A and EPS_B , we get

$$\frac{(PBIT - 0)(1 - 0.33)}{16,000,000} = \frac{(PBIT - 6,600,000)(1 - 0.33)}{10,000,000}$$

$$10.72 PBIT - 70.752 = 6.7 PBIT \text{ or } PBIT = 17.6 \text{ million}$$

Thus the debt alternative is better than the equity alternative when $PBIT > 17.6$ million

$$\begin{aligned} \text{Prob}(PBIT > 17,600,000) &= \text{Prob} \left[\frac{\overline{PBIT} - PBIT}{\sigma PBIT} > \frac{17.6 - 16.0}{8} \right] \\ &= \text{Prob} [z > 0.2] \\ &= 0.4207 \text{ or } 42.07 \% \end{aligned}$$

7. Hurricane Transport has an average cost of 10 percent for debt financing. The financial leverage ratio is 0.8 and the ROI is 15 percent. What is the ROE for the company, if its tax rate is 40 percent?

Solution:

$$ROE = [15 + (15 - 10) 0.8] (1 - 0.4) = 11.4 \%$$

8. Nanda Enterprises has a target ROE of 20 percent. The financial leverage ratio for the firm is 0.6 and its tax rate is 33 percent. What ROI should the company plan to earn? The cost of debt is 14 percent.

Solution:

$$20 = [ROI + (ROI - 14) 0.6] (1 - 0.33) = 0.67 ROI + 0.402 ROI - 5.628$$

$$1.072 ROI = 25.628$$

$$ROI = 23.91 \%$$

9. The following information is available about Excalibur Limited.

Depreciation	Rs.5 million
EBIT	Rs.35 million
Interest on debt	Rs.7 million
Tax rate	35 percent
Loan repayment instalment	Rs.4.0 million

- Required: (a) Calculate the interest coverage ratio.
(b) Calculate the cash flow coverage ratio.

Solution:

a.	Interest coverage ratio	=	$\frac{EBIT}{Interest\ on\ debt}$
		=	$\frac{35}{7}$
		=	5.0
b.	Cash flow coverage ratio	=	$\frac{EBIT + Depreciation}{Int.on\ debt + \left[\frac{Loan\ repayment\ instalment}{(1 - Tax\ rate)} \right]}$
		=	$\frac{35 + 5}{7 + 4/0.65} = 3.04$

10. The following information is available about Notting Hill Corporation.

Depreciation	Rs.30 million
EBIT	Rs.125 million
Interest on debt	Rs.52 million

Tax rate 33 percent
 Loan repayment instalment Rs.20.0 million

Required: (a) Calculate the interest coverage ratio.
 (b) Calculate the cash flow coverage ratio.

Solution:

	$EBIT$
a. Interest coverage ratio	$= \frac{\text{Interest on debt}}$
	$= \frac{125}{52}$
	$= 2.40$
b. Cash flow coverage ratio	$= \frac{EBIT + Depreciation}{\text{Int.on debt} + \left[\frac{\text{Loan repayment instalment}}{(1 - \text{Tax rate})} \right]}$
	$= \frac{125 + 30}{52 + 20/0.67} = 1.89$

11. The following projections are available for Aristocrats Limited:

	<i>Rs. in million</i>				
	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>
Profit after tax	-3.0	13.0	24.00	28.00	25.00
Depreciation	15.0	11.25	8.43	6.33	4.75
Interest on term loan	14.00	14.00	14.0	11.20	8.4
Term loan repayment instalment	-	-	20.00	20.00	20.00

Required: Calculate the debt service coverage ratio.

Solution:

The debt service coverage ratio for Aristocrats Limited is given by:	
	$\sum_{i=1}^5 (PAT_i + Dep_i + Int_i)$
$DSCR$	$= \frac{\sum_{i=1}^5 (Int_i + LRI_i)}{\sum_{i=1}^5 (PAT_i + Dep_i + Int_i)}$

$$\begin{aligned}
&= \frac{87.00 + 45.76 + 61.6}{61.6 + 60} \\
&= \frac{194.36}{121.6} \\
&= 1.60
\end{aligned}$$

12. The following projections are available for Oscar Corporation.

	<i>Rs. in million</i>				
	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>
Profit after tax	-4.0	-1.0	35.00	80.00	100.00
Depreciation	200	160	128	102.4	81.92
Interest on term loan	91.00	91.00	78.0	65.0	52.0
Term loan repayment instalment	-	100.00	100.00	100.00	100.00

Required: Calculate the debt service coverage ratio.

Solution:

The debt service coverage ratio for Oscar Corporation is given by :	
	$\frac{\sum_{i=1}^5 (PAT_i + Dep_i + Int_i)}{\sum_{i=1}^5 (Int_i + LRI_i)}$
<i>DSCR</i>	$= \frac{210 + 672.32 + 377}{377 + 400}$
	$= \frac{1259.32}{777}$
	$= 1.62$

13. Jaisurya Associates is embarking on an expansion plan requiring an outlay of Rs.800 million. The management of the firm is convinced that debt is a cheaper source of finance and is confident that it can raise the entire amount by debt finance (perpetual) at a rate of 12 percent. However, there is some apprehension about the firm's ability to meet interest burden during a recessionary year. The management feels that in a recessionary year, the net cash flows of the company, not taking into account the interest burden on the new debt, would have an expected value of Rs.200 million with a standard deviation of Rs.80 million. Required: (a) What is the probability of cash inadequacy during a recessionary year, if the entire Rs.800 million are raised as debt finance?

- (b) If the management is prepared to accept only a 4 percent chance of cash inadequacy, what proportion of Rs.800 million requirement should be raised as debt finance?

Solution:

- (a) If the entire outlay of Rs. 800 million is raised by way of debt carrying 12 per cent interest, the interest burden will be Rs. 96 million.

Considering the interest burden the net cash flows of the firm during a recessionary year will have an expected value of Rs. 104 million (Rs.200 million - Rs. 96 million) and a standard deviation of Rs. 80 million .

Since the net cash flow (X) is distributed normally

$$\frac{X - 104}{80}$$

has a standard normal deviation

Cash flow inadequacy means that X is less than 0.

$$\text{Prob}(X < 0) = \text{Prob}(z < -1.3)$$

$$= 0.0968$$

- (b) Since $\mu = \text{Rs.}200$ million, $\sigma = \text{Rs.}80$ million , and the Z value corresponding to the risk tolerance limit of 4 per cent is -1.75 , the cash available from the operations to service the debt is equal to X which is defined as :

$$\frac{X - 200}{80} = -1.75$$

$$X = \text{Rs.}60 \text{ million}$$

Given 15 per cent interest rate, the debt that be serviced is

$$\frac{60}{0.12} = \text{Rs.} 500 \text{ million}$$

14. Medicon Limited is embarking on an expansion plan requiring an outlay of Rs.600 million. The management of the firm is convinced that debt is a cheaper source of finance and is confident that it can raise the entire amount by debt finance (perpetual) at a rate of 10 percent. However, there is some apprehension about the firm's ability to meet interest burden during a recessionary year. The management feels that in a recessionary year, the net cash flows of the company, not taking into account the interest burden on the new debt, would have an expected value of Rs.150 million with a standard deviation of Rs.45 million.

- Required: (a) What is the probability of cash inadequacy during a recessionary year, if the entire Rs.600 million are raised as debt finance?
 (b) If the management is prepared to accept only a 1 percent chance of cash inadequacy, what proportion of Rs.600 million requirement should be raised as debt finance ?

Solution:

- (a) If the entire outlay of Rs. 600 million is raised by way of debt carrying 10 per cent interest, the interest burden will be Rs. 60 million.

Considering the interest burden, the net cash flows of the firm during a recessionary year will have an expected value of Rs. 90 million (Rs.150 million - Rs. 60 million) and a standard deviation of Rs. 45 million .

Since the net cash flow (X) is distributed normally

$$\frac{X - 90}{45}$$

45

has a standard normal deviation

Cash flow inadequacy means that X is less than 0.

$$\text{Prob}(X < 0) = \text{Prob}(z < -2.0)$$

$$= 0.0228$$

- (c) Since $\mu = \text{Rs.}150$ million, $\sigma = \text{Rs.}45$ million , and the Z value corresponding to the risk tolerance limit of 1 per cent is -2.30 (approximately) , the cash available from the operations to service the debt is equal to X which is defined as :

$$\frac{X - 150}{45} = -2.30$$

$$X = \text{Rs.}46.5 \text{ million}$$

Given 10 per cent interest rate, the debt than be serviced is

$$\frac{46.5}{0.10} = \text{Rs.} 465 \text{ million}$$

CHAPTER 21

1. The following data is available for Newton Limited:
 Earnings per share = Rs.6.00
 Rate of return = 18 percent

Cost of capital = 15 percent

- (a) If Walter's valuation formula holds, what will be the price per share when the dividend payout ratio is 30 percent? 40 percent?
 (b) If Gordon's basic valuation formula holds, what will be the price per share when the dividend payout is 30 percent, 40 percent?

Solution:

(a)	<i>Payout ratio</i>	<i>Price per share</i>	
	0.3	$\frac{6(0.3)+6(0.7) \times \frac{0.18}{0.15}}{0.15}$	= Rs. 45.60
	0.40	$\frac{6(0.40)+6(0.6) \left(\frac{0.18}{0.15} \right)}{0.15}$	= Rs. 44.80
(b)	<u>Dividend payout ratio</u>	<u>Price as per Gordon model</u> $P_0 = E_1(1-b)/(k-br)$	
	30 %	= 6 x 0.70/(0.15 - 0.70x 0.18)	=Rs. 175
	40%	= 6 x 0.60/(0.15 - 0.60x 0.18)	=Rs.85.7

2. The stocks of firms A and B are considered to be equally risky. Investors expect the share of firm A – the firm which does not plan to pay dividend -- to be worth Rs 100 next year. From the share of firm B, too, investors expect a pay off of Rs 100 – Rs 10 by way of dividend and Rs 90 by way of share price a year from now. Dividends are taxed at 25 percent and capital gains at 12 percent. What will be the current price of the shares of A and B, if each of them offers an expected post-tax rate of 18 percent? Assume that the radical position applies

Solution:

	A	B
• Next year's price	100	90
• Dividend	0	10
• Current price	A	B
• Capital appreciation	(100-A)	(90-B)
• Post-tax capital appreciation	0.88(100-A)	0.88 (90-B)
• Post-tax dividend income	0	0.75 x 10
• Total return	$\frac{0.88 (100-A)}{A}$	$\frac{0.88 (90-B) + 7.5}{B}$
	= 18%	=18%
• Current price (obtained by solving the preceding equation)	A = Rs.83.02	B = Rs.81.79

3. The stocks of firms *M* and *N* are considered to be equally risky. Investors expect the share of firm *M* – the firm which does not plan to pay dividend -- to be worth Rs 180 next year. From the share of firm *N*, too, investors expect a pay off of Rs 180 – Rs 20 by way of dividend and Rs 160 by way of share price a year from now. Dividends are taxed at 20 percent and capital gains at 10 percent. What will be the current price of the shares of *M* and *N*, if each of them offers an expected post-tax rate of 20 percent? Assume that the radical position applies

Solution:

	M	N
• Next year's price	180	160
• Dividend	0	20
• Current price	M	N
• Capital appreciation	(180-M)	(160-N)
• Post-tax capital appreciation	0.9(180-M)	0.9 (160-N)
• Post-tax dividend income	0	0.8 x 20
• Total return	$\frac{0.9 (180-M)}{M}$	$\frac{0.9 (160-N) + 16}{N}$
	= 20 %	=20 %
• Current price (obtained by solving the preceding equation)	M = Rs.147.27	N= Rs.145.45

4. Assume that investors expect a payoff of Rs.305.2 a year from now from one share of Suman Company: Rs. 5.2 by way of dividend and Rs. 300 by way of share price. If dividend is taxed at 10 percent and capital appreciation is taxed at 20 percent, what will be the current price of Suman Company's share if investors expect a post-tax return of 14 percent?

Solution:

Let the current price of the share be	=	P	
Price one year hence	=	300	
Capital appreciation	=	(300 – P)	
Dividend	=	5.2	
Post tax capital appreciation	=	0.9 (300 – P)	
Post tax dividend income	=	0.8 (5.2)	
Total return = $\frac{0.9 (300 - P) + 4.16}{P} = 0.14$			
$270 - 0.9P + 4.16 = 0.14P$			
$1.04P = 274.16$			
$P = \text{Rs. } 263.62$			

CHAPTER 22

1. Handsome Apparels expects that its net income and capital expenditures over the next four years will be as follows:

<i>Year</i>	<i>Net Income (Rs.)</i>	<i>Capital Expenditures (Rs.)</i>
1	40,000	12,000
2	60,000	10,000
3	25,000	6,000
4	34,000	7,000

The company has 10,000 outstanding shares currently on which it pays a dividend of two rupees per share. The debt- equity target of the firm is 1:1

Required:

- (a) What will be the dividend per share if the company follows a pure residual policy?
- (b) What external financing is required if the company plans to raise dividends by 15 percent every 2 years?
- (c) What will be the dividend per share and external financing requirement if the company follows a policy of a constant 50 percent payout ratio?

Solution:

- a. Under a pure residual dividend policy, the dividend per share over the 4 year period will be as follows:

DPS Under Pure Residual Dividend Policy

(in Rs.)

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Earnings	40,000	60,000	25,000	34,000
Capital expenditure	12,000	10,000	6,000	7,000
Equity investment	6,000	5,000	3,000	3,500
Pure residual dividends	34,000	55,000	22,000	30,500
Dividends per share	3.4	5.5	2.2	3.05

- b. The external financing required over the 4 year period (under the assumption that the company plans to raise dividends by 15 percents every two years) is given below :

Required Level of External Financing

(in Rs.)

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
A . Net income	40,000	60,000	25,000	34,000
B . Targeted <i>DPS</i>	2.00	2.30	2.30	2.65
C . Total dividends	20,000	23,000	23,000	26,500
D . Retained earnings(A-C)	20,000	37,000	2,000	7,500
E . Capital expenditure	12,000	10,000	6,000	7,000
F . External financing requirement (<i>E-D</i>)if $E > D$ or 0 otherwise	0	0	4,000	0

- c. Given that the company follows a constant 50 per cent payout ratio, the dividend per share and external financing requirement over the 4 year period are given below

Dividend Per Share and External Financing Requirement

(in Rs.)

<i>Year</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
A. Net income	40,000	60,000	25,000	34,000
B. Dividends	20,000	30,000	12,500	17,000
C. Retained earnings	20,000	30,000	12,500	17,000
D. Capital expenditure	12,000	10,000	6,000	7,000
E. External financing ($D-C$) if $D > C$, or 0 otherwise	0	0	0	0
F. Dividends per share	2.00	3.00	1.25	1.70

2. Young Turk Associates expects that its net income and capital expenditures over the next five years will be as follows:

<i>Year</i>	<i>Net Income (Rs.)</i>	<i>Capital Expenditures (Rs.)</i>
1	70,000	25,000
2	40,000	50,000
3	85,000	4,000
4	38,000	57,000
5	105,000	14,000

The company has 20,000 outstanding shares currently on which it pays a dividend of two rupees per share. The debt-equity target of the firm is 3:2

Required:

- a. What will be the dividend per share if the company follows a pure residual policy?
- b. What external financing is required if the company plans to raise dividends by 20 percent every 3 years?
- c. What will be the dividend per share and external financing requirement if the company follows a policy of a constant 60 percent payout ratio?

Solution:

- a. Under a pure residual dividend policy, the dividend per share over the 4 year period will be as follows:

DPS Under Pure Residual Dividend Policy*(in Rs.)*

<i>Year</i>	1	2	3	4	5
Earnings	70,000	40,000	85,000	38,000	105,000
Capital expenditure	25,000	50,000	4,000	57,000	14,000
Equity investment	10,000	20,000	1,600	22,800	5,600
Pure residual dividends	60,000	20,000	83,400	15,200	99,400
Dividends per share	3.0	1.0	4.17	0.76	4.97

- b. The external financing required over the 5 year period (under the assumption that the company plans to raise dividends by 20 percents every three years) is given below:

Required Level of External Financing*(in Rs.)*

<i>Year</i>	1	2	3	4	5
A . Net income	70,000	40,000	85,000	38,000	105,000
B . Targeted <i>DPS</i>	2.00	2.00	2.40	2.40	2.40
C . Total dividends	40,000	40,000	48,000	48,000	48,000
D . Retained earnings(A-C)	30,000	0	37,000	-10,000	57,000
E . Capital expenditure	25,000	50,000	4,000	57,000	14,000
F . External financing requirement (<i>E-D</i>)if <i>E</i> > <i>D</i> or 0 otherwise	0	50,000	0	67,000	0

- c. Given that the company follows a constant 60 per cent payout ratio, the dividend per share and external financing requirement over the 5 year period are given below

Dividend Per Share and External Financing Requirement

(in Rs.)

Year	1	2	3	4	5
A. Net income	70,000	40,000	85,000	38,000	105,000
B. Dividends	42,000	24,000	51,000	22,800	63,000
C. Retained earnings	28,000	16,000	34,000	15,200	42,000
D. Capital expenditure	25,000	50,000	4,000	57,000	14,000
F. External financing (D-C)if D>C, or 0 otherwise	0	34,000	0	41,800	0
F. Dividends per share	2.1	1.2	2.55	1.14	3.15

3. The dividend per share of a firm for the current year is Rs.4. What will be the expected dividend per share of a firm for next year, if the expected EPS for that year is Rs.20 and the target payout ratio is 30% and adjustment rate is 0.6? Assume that the Lintner model applies.

Solution:

$$\begin{aligned}
 D_t &= c. r. EPS_1 + (1 - c) D_{t-1} \\
 &= (0.6 \times 0.3 \times 20) + (0.4) \times 4 \\
 &= \text{Rs.}5.2
 \end{aligned}$$

$$\begin{aligned}
 D_t &= c.r.EPS_1 + (1 - c) D_{t-1} \\
 &= (0.8 \times 0.35 \times 8) + (1 - 0.8) \times 2.5 \\
 &= 2.24 + 0.50 = 2.74
 \end{aligned}$$

CHAPTER 23

1. The following information is available for NCEP Limited.

Profit and Loss Account Data

Balance Sheet Data

		Beginning of 20X6		End of 20X6
Sales	6000	Inventory	800	820
Cost of goods sold	4000	Accounts receivable	500	490
		Accounts payable	290	205

What is the duration of the cash cycle?

Solution:

Inventory Period	=	$\frac{(800 + 820) / 2}{4000 / 365}$	=	73.91
Accounts receivable period	=	$\frac{(500 + 490) / 2}{6000 / 365}$	=	30.11
Accounts payable	=	$\frac{(290 + 205) / 2}{4000 / 365}$	=	22.58
Cash cycle	=		=	81.44 days

2. The following information is available for ABC Limited.

Profit and Loss Account Data

Balance Sheet Data

		<i>Beginning of 20X5</i>		<i>End of 20X5</i>
Sales	3000	Inventory	300	310
Cost of goods sold	1800	Accounts receivable	180	170
		Accounts payable	85	95

What is the duration of the cash cycle?

Solution:

Inventory Period	=	$\frac{(300+310)}{2}$	=	61.87
		$\frac{1800}{365}$		
Accounts receivable period	=	$\frac{(180 + 170)}{2}$	=	21.30
		$\frac{3000}{365}$		
Accounts payable	=	$\frac{(85 + 95)}{2}$	=	18.25
		$\frac{1800}{365}$		
Cash Cycle	=	64.9 days		

3. The following annual figures relate to Sugarcolt Limited.

	Rs.
Sales (at two months' credit)	6,000,000
Materials consumed (suppliers extend two months credit)	1,600,000
Wages paid (monthly in arrear)	1,300,000
Manufacturing expenses outstanding at the end of the year (Cash expenses are paid one month in arrear)	140,000
Total administrative expenses, paid as incurred	440,000
Sales promotion expenses, paid quarterly in advance	200,000

The company sells its products on gross profit of 20 percent counting depreciation as part of the cost of production. It keeps one month's stock each of raw materials and finished goods, and a cash balance of Rs.200,000.

Assuming a 25 % safety margin, work out the working capital requirements of the company on cash cost basis. Ignore work-in-process.

Solution:

	Rs.
1. Sales	6,000,000
Less : Gross profit (20 per cent)	1,200,000
Total manufacturing cost	4,800,000
Less : Materials	1,600,000
Wages	<u>1,300,000</u>
Manufacturing expenses	1,900,000
2. Cash manufacturing expenses	1,680,000
(140,000 x 12)	
3. Depreciation : (1) – (2)	220,000
4. Total cash cost	
Total manufacturing cost	4,800,000
Less: Depreciation	220,000
Cash manufacturing cost	4,580,000
Add: Administration and sales promotion expenses	640,000
	<hr/>
	5,220,000
	<hr/>

<i>A : Current Assets</i>		<i>Rs.</i>
	Total cash cost	5,220,000
Debtors	$\frac{\quad}{12} \times 2 =$	$\frac{5,220,000}{12} \times 2 = 870,000$
	Material cost	1,600,000
Raw material stock	$\frac{\quad}{12} \times 1 =$	$\frac{1,600,000}{12} \times 1 = 133,333$
	Cash manufacturing cost	4,580,000
Finished goods stock	$\frac{\quad}{12} \times 1 =$	$\frac{4,580,000}{12} \times 1 = 381,667$
	Sales promotion expenses	200,000
Prepaid sales promotion expenses	$\frac{\quad}{12} \times 3 =$	$\frac{200,000}{12} \times 3 = 50,000$
Cash balance	A predetermined amount	= 200,000
A : Current Assets		= 1,635,000

<i>B : Current Liabilities</i>		<i>Rs.</i>
	Material cost	1,600,000
Sundry creditors	$\frac{\quad}{12} \times 2 =$	$\frac{1,600,000}{12} \times 2 = 266,667$
Manufacturing expenses outstanding	One month's cash manufacturing expenses	= 140,000
Wages outstanding	One month's wages	= 108,333
B : Current liabilities		515,000

Working capital (A – B)	1,120,000
Add 25 % safety margin	280,000
Working capital required	1,400,000

4. The following annual figures relate to Universal Limited.

	<i>Rs.</i>
Sales (at three months' credit)	8,000,000
Materials consumed (suppliers extend one months credit)	2,000,000
Wages paid (monthly in arrear)	1,600,000
Manufacturing expenses outstanding at the end of the year	100,000

(Cash expenses are paid one month in arrear)	
Total administrative expenses, paid as incurred	500,000
Sales promotion expenses, paid quarterly in arrears	400,000

The company sells its products on gross profit of 30 percent counting depreciation as part of the cost of production. It keeps two months' stock each of raw materials and finished goods, and a cash balance of Rs.300,000.

Assuming a 20 % safety margin, work out the working capital requirements of the company on cash cost basis. Ignore work-in-process.

Solution:

	Rs.
1. Sales	8,000,000
Less : Gross profit (30 per cent)	2,400,000
Total manufacturing cost	5,600,000
Less : Materials 2,000,000	
Wages <u>1,600,000</u>	3,600,000
Manufacturing expenses	2,000,000
2. Cash manufacturing expenses	1,200,000
(100,000 x 12)	
3. Depreciation : (1) – (2)	800,000
5. Total cash cost	
Total manufacturing cost	5,600,000
Less: Depreciation	800,000
Cash manufacturing cost	4,800,000
Add: Administration expenses	500,000
	5,300,000

<i>A : Current Assets</i>		<i>Rs.</i>
Debtors	$\frac{\text{Total cash cost}}{12} \times 3 = \frac{5,300,000}{12} \times 3 =$	1,325,000
Raw material stock	$\frac{\text{Material cost}}{12} \times 2 = \frac{2,000,000}{12} \times 2 =$	333,333
Finished goods stock	$\frac{\text{Cash manufacturing cost}}{12} \times 2 = \frac{4,800,000}{12} \times 2 =$	800,000

Cash balance	A predetermined amount	=	300,000
	A : Current Assets	=	2,758,333

<i>B : Current Liabilities</i>		<i>Rs.</i>
Sundry creditors	$\frac{\text{Material cost}}{12} \times 1 = \frac{2,000,000}{12} \times 1 = 166,667$	
Manufacturing expenses outstanding	One month's cash manufacturing expenses	= 100,000
Wages outstanding	One month's wages	= 133,333
Sales Promotion expenses	Three months' expenses	= 100,000
	B : Current liabilities	500,000

Working capital (A – B)	2,258,333
Add 20 % safety margin	451,667
Working capital required	2,710,000

CHAPTER 24

1. You have been asked to prepare a cash budget for the next quarter, January through March, for Sharmilee Exports. They have provided you with the following information:
 - a. Sales are expected to be: Rs.300,000 in January, Rs.260,000 in February, and Rs.350,000 in March. All sales will be in cash.
 - b. The estimated purchases are: Rs.240,000 in January, Rs.220,000 in February, and Rs.250,000 in March. Payments for purchases will be made after a lag of one month. Outstanding on account of purchases in December last are Rs.210,000.
 - c. The rent per month is Rs.8,000 and the partners' personal withdrawal per month is Rs.12,000.
 - d. Salaries and other expenses, payable in cash, are expected to be: Rs.15,000 in January, Rs.15,000 in February, and Rs.16,000 in March.
 - e. They plan to buy two computers worth Rs.50,000 on cash payment in March.
 - f. The cash balance at present is Rs.12,000. Their target cash balance, however, is Rs.20,000. What will be surplus/ deficit of cash in relation to their target cash balance?

Solution:

The projected cash inflows and outflows for the quarter, January through March, is shown below .

<i>Month</i>	<i>December</i> <i>(Rs.)</i>	<i>January</i> <i>(Rs.)</i>	<i>February</i> <i>(Rs.)</i>	<i>March</i> <i>(Rs.)</i>
Inflows :				
Sales collection		300,000	260,000	350,000
Outflows :				
Purchases	210,000	240,000	220,000	250,000
Payment to sundry creditors		210,000	240,000	220,000
Rent		8,000	8,000	8,000
Drawings		12,000	12,000	12,000
Salaries & other expenses		15,000	15,000	16,000
Purchase of computers				50,000
Total outflows(2to6)		245,000	275,000	306,000

Given an opening cash balance of Rs.12,000 and a target cash balance of Rs.20,000, the surplus/deficit in relation to the target cash balance is worked out below :

	<i>January</i> <i>(Rs.)</i>	<i>February</i> <i>(Rs.)</i>	<i>March</i> <i>(Rs.)</i>
1. Opening balance	12,000		
2. Inflows	300,000	260,000	350,000
3. Outflows	245,000	275,000	306,000
4. Net cash flow (2 - 3)	55,000	(15,000)	44,000
5. Cumulative net cash flow	55,000	40,000	84,000
6. Opening balance + Cumulative net cash flow	67,000	52,000	96,000
7. Minimum cash balance required	20,000	20,000	20,000
8. Surplus/(Deficit)	47,000	32,000	76,000

2. You have been asked to prepare a cash budget for the next quarter, January through March, for Jahanara Fashions. They have provided you with the following information:
 - a. Sales are expected to be: Rs.400,000 in January, Rs.400,000 in February, and Rs.600,000 in March. All sales will be in cash.
 - b. The estimated purchases are: Rs.380,000 in January, Rs360,000 in February, and Rs.450,000 in March. Payments for purchases will be made after a lag of one month. Outstanding on account of purchases in December last are Rs.350,000.

- c. The rent per month is Rs.10,000 and the partners' personal withdrawal per month is Rs.25,000.
- d. Salaries and other expenses, payable in cash, are expected to be: Rs.25,000 in January, Rs.20,000 in February, and Rs.30,000 in March.
- e. They plan to buy furniture worth Rs.40,000 on cash payment in January..
- f. The cash balance at present is Rs.6,000. Their target cash balance, however, is Rs.15,000. What will be surplus/ deficit of cash in relation to their target cash balance?

Solution:

The projected cash inflows and outflows for the quarter, January through March, is shown below .

<i>Month</i>	<i>December (Rs.)</i>	<i>January (Rs.)</i>	<i>February (Rs.)</i>	<i>March (Rs.)</i>
Inflows :				
Sales collection		400,000	400,000	600,000
Outflows :				
Purchases	350,000	380,000	360,000	450,000
Payment to sundry creditors		350,000	380,000	360,000
Rent		10,000	10,000	10,000
Drawings		25,000	25,000	25,000
Salaries & other expenses		25,000	20,000	30,000
Purchase of furniture		40,000		
Total outflows (2to6)		450,000	435,000	425,000

Given an opening cash balance of Rs.6,000 and a target cash balance of Rs.15,000, the surplus/deficit in relation to the target cash balance is worked out below :

	<i>January (Rs.)</i>	<i>February (Rs.)</i>	<i>March (Rs.)</i>
1. Opening balance	6,000		
2. Inflows	400,000	400,000	600,000
3. Outflows	450,000	435,000	425,000
4. Net cash flow (2 - 3)	(50,000)	(35,000)	175,000
5. Cumulative net cash flow	(50,000)	(85,000)	90,000
6. Opening balance + Cumulative net cash flow	(44,000)	(79,000)	96,000
7. Minimum cash balance required	15,000	15,000	15,000
8. Surplus/(Deficit)	(59,000)	(94,000)	81,000

3. Smartlink Corporation issues cheques of Rs.10,000 daily and it takes 6 days for its cheques to be cleared. Smartlink Corporation receives cheques of Rs.30,000 daily and it takes 4 days for these cheques to be realised. Assume that there is a balance of Rs.80,000 to begin with; show the balance in the book of the firm and the books of the bank. What will be the balance in the steady state situation?

Solution:

The balances in the books of Smartlink Corporation and the books of the bank are shown below:

	(Rs)							
	1	2	3	4	5	6	7	8
Books of Smartlink Corporation:								
Opening Balance	80,000	100,000	120,000	140,000	160,000	180,000	200,000	220,000
Add: Cheque received	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Less: Cheque issued	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Closing Balance	100,000	120,000	140,000	160,000	180,000	200,000	220,000	240,000
Books of the Bank:								
Opening Balance	80,000	80,000	80,000	80,000	80,000	110,000	140,000	160,000
Add: Cheques realised					30,000	30,000	30,000	30,000
Less: Cheques debited							10,000	10,000
Closing Balance	80,000	80,000	80,000	80,000	110,000	140,000	160,000	180,000

From day 7 we find that the balance as per the bank's books is less than the balance as per Smartlink Corporation's books by a constant sum of Rs.60,000. Hence in the steady situation Smartlink Corporation has a negative net float of Rs.60,000.

4. Shahanshah Limited issues cheques of Rs.50,000 daily and it takes 5 days for its cheques to be cleared. Shahanshah Limited receives cheques of Rs.80,000 daily and it takes 3 days for these cheques to be realised. Assume that there is a balance of Rs.100,000 to begin with; show the balance in the book of the firm and the books of the bank. What will be the balance in the steady state situation?

Solution:

The balances in the books of Shahanshah Limited and the books of the bank are shown below:

(Rs)

Books of Shahanshah Limited							
Opening Balance	100,000	130,000	160,000	190,000	220,000	250,000	280,000
Add: Cheque received	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Less: Cheque issued	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Closing Balance	130,000	160,000	190,000	220,000	250,000	280,000	310,000
Books of the Bank:							
Opening Balance	100,000	100,000	100,000	100,000	180,000	260,000	290,000
Add: Cheques realised				80,000	80,000	80,000	80,000
Less: Cheques debited						50,000	50,000
Closing Balance	100,000	100,000	100,000	180,000	260,000	290,000	320,000

From day 6 we find that the balance as per the bank's books is more than the balance as per Shahanshah Limited's books by a constant sum of Rs.10,000. Hence in the steady situation Shahanshah Limited has a positive net float of Rs.10,000.

- Sourav International requires Rs. 150 million in cash for meeting its transaction needs over the next two months, its planning horizon for liquidity decisions. It currently has the amount in the form of marketable securities that earn 9 percent annual yield. The cash payments will be made evenly over the two months planning period. The conversion of marketable securities into cash entails a fixed cost of Rs. 6,000 per transaction. What is the optimal conversion size as per Baumol model?

Solution:

$$T = 150,000,000 \quad I = 0.09/6 = 0.015 \quad b = 6,000$$

According to the Baumol model:

$$C = \sqrt{\frac{2bt}{I}} = \sqrt{\frac{2 \times 6,000 \times 150,000,000}{0.015}} = \text{Rs. } 10,954,451$$

- Vishal Exports requires Rs.90 million in cash for meeting its transaction needs over the next three months, its planning horizon for liquidity decisions. Vishal Exports currently has the amount in the form of marketable securities. The cash payments will be made evenly over the three months planning period. Vishal Exports earns 8 percent annual yield on its marketable securities. The conversion of marketable securities into cash entails a fixed cost of Rs.4,500 per transaction. What is the optimal conversion size as per the Baumol model ?

Solution:

$$T = 90,000,000 \quad I = 0.08/4 = 0.02 \quad b = 4,500$$

According to the Baumol model:

$$c = \frac{2bT}{I} = \frac{2 \times 4500 \times 90,000,000}{0.02} = \text{Rs. } 6363961.03$$

7. Topnotch Corporation requires Rs.45 million in cash for meeting its transaction needs over the next six months, its planning horizon for liquidity decisions. Topnotch currently has the amount in the form of marketable securities. The cash payments will be made evenly over the six month planning period. Topnotch earns 6 percent annual yield on its marketable securities. The conversion of marketable securities into cash entails a fixed cost of Rs.1,500 per transaction. What is the optimal conversion size as per the Baumol model ?

Solution:

$$T = 45,000,000 \quad I = \frac{0.06}{2} = 0.03 \quad b = 1,500$$

According to the Baumol model:

$$C = \sqrt{\frac{2bT}{I}} = \sqrt{\frac{2 \times 1500 \times 45,000,000}{0.03}} \\ = \text{Rs. } 2,121,320$$

8. Ajit Associates expects its cash flows to behave in a random manner, as assumed by the Miller and Orr model .The following information has been gathered.
- Annual yield on marketable securities = 9 percent
 - The fixed cost of effecting a marketable securities transaction = Rs.2,800
 - The standard deviation of the change in daily cash balance = Rs.19,000
 - Minimum cash balance required to be maintained as per management policy = Rs.2,500,000
- What are the 'return point' and 'upper control point'?

Solution:

$$I = 0.09/360 = 0.00025$$

$$RP = 3 \sqrt{\frac{3b\sigma^2}{4I}} + LL = 3 \sqrt{\frac{3 \times 2,800 \times 19,000 \times 19,000}{4 \times 0.00025}} + 2,500,000$$

$$= \text{Rs. } 2,644,742$$

$$UL = 3RP - 2LL = 3 \times 2,644,742 - 2 \times 2,500,000 = \text{Rs. } 2,934,226$$

9. Hanson Corporation expects its cash flows to behave in a random manner, as assumed by the Miller and Orr model. The following information has been gathered.

- Annual yield on marketable securities = 8 percent
- The fixed cost of effecting a marketable securities transaction = Rs. 1700
 - The standard deviation of the change in daily cash balance = Rs.27,000
 - The management wants to maintain a minimum cash balance of Rs.3,500,000

What are the 'return point' and 'upper control point'?

Solution:

$$I = 0.08 / 360 = 0.000222$$

$$RP = 3 \sqrt{\frac{3b\sigma^2}{4I}} + LL = 3 \sqrt{\frac{3 \times 1700 \times 27,000 \times 27,000}{4 \times 0.000222}} + 3,500,000$$

$$= 3,661,174$$

$$UL = 3RP - 2LL = 3 \times 3,661,174 - 2 \times 3,500,000 = \text{Rs. } 3,983,522$$

10. Premier Limited expects its cash flows to behave in a random manner, as assumed by the Miller and Orr model. The following information has been gathered.

- Annual yield on marketable securities = 5 percent
- The fixed cost of effecting a marketable securities transaction = Rs. 800
- The standard deviation of the change in daily cash balance = Rs.12,000
- The management wants to maintain a minimum cash balance of Rs.1,500,000

What are the 'return point' and 'upper control point'?

Solution:

$$I = 0.05/360 = 0.000139$$

$$RP = 3 \sqrt{\frac{3b\sigma^2}{4I}} + LL$$

$$= 3 \sqrt{\frac{3 \times 800 \times 12,000 \times 12,000}{4 \times 0.000139}} + 1,500,000 = 1,585,343$$

$$UL = 3 RP - 2LL = 1,756,029$$

CHAPTER 25

1. Rakesh Enterprises currently provides 30 days credit to its customers. Its present sales are Rs. 200 million .Its cost of capital is 12 percent and the ratio of variable costs to sales is 0.80 Rakesh Enterprises are considering extending the credit period to 45 days which is likely to push sales up by Rs.60 million. The bad debt proportion on additional sales would be 15 percent. The tax rate is 33 percent. What will be the effect of lengthening the credit period on the residual income of the firm?

Solution:

$$\Delta RI = [\Delta S(1-V) - \Delta S b_n](1-t) - k \Delta I$$

$$\Delta I = (ACP_N - ACP_0) \{ S_0/360 \} + V(ACP_N) \Delta S/360$$

$$= (45-30) \times (200,000,000/360) + 0.80 \times 45 \times (60,000,000/360)$$

$$= 14,333,333$$

$$\Delta RI = (60,000,000 \times 0.20 - 60,000,000 \times 0.15)(0.67) - 0.12 \times 14,333,333$$

$$= 290,000$$

2. Phoenix Limited currently provides 30 days of credit to its customers. Its present level of sales is Rs.150 million. The firm's cost of capital is 14 percent and the ratio of variable costs to sales is 0.70. Phoenix is considering extending its credit period to 60 days. Such an extension is likely to push sales up by Rs.12 million. The bad debt proportion on the additional sales would be 6 percent. The tax rate for Phoenix is 30 percent. What will be the effect of lengthening the credit period on the residual income of Phoenix Limited? Assume 360 days to a year.

Solution:

$$\begin{aligned}
& [12,000,000 \times 0.30 - 12,000,000 \times 0.06] (1 - 0.3) \\
& - 0.14 (60 - 30) \times \frac{150,000,000}{360} + 0.70 \times 60 \times \frac{12,000,000}{360} \\
& = 2,016,000 - 1,946,000 \\
& = 70,000
\end{aligned}$$

3. Acme Limited provides 30 days of credit to its customers. Its present level of sales is Rs.300 million. The firm's cost of capital is 12 percent and the ratio of variable costs to sales is 0.75. Acme is considering extending its credit period to 45 days. Such an extension is likely to push sales up by Rs.25 million. The bad debt proportion on the additional sales would be 8 percent. The tax rate for Acme is 30 percent. What will be the effect of lengthening the credit period on the residual income of Acme? Assume 360 days to a year.

Solution:

$$\begin{aligned}
\Delta RI &= [\Delta S (1-V) - \Delta S b_n] (1-t) - k (ACP_n - ACP_0) + \frac{\Delta S}{360} \times ACP_n \times V \\
&= [25,000,000 \times 0.25 - 25,000,000 \times .08] (1 - 0.3) \\
&\quad - 0.12 \frac{300,000,000}{360} (45-30) + \frac{25,000,000}{360} \times 45 \times 0.75 \\
&= 2,975,000 - 1,781,250 \\
&= 1,193,750
\end{aligned}$$

4. The present credit terms of Indus Industries are 3/15, net 30. Its sales are Rs.470 million, its average collection period is 45 days, its variable costs to sales ratio, V, is 0.85, and its cost of capital is 12 percent. The proportion of sales on which customers currently take discount, is 0.4. Indus is considering relaxing its credit terms to 5/15, net 30. Such a relaxation is expected to increase sales by Rs.20 million, increase the proportion of discount sales to 0.6, and reduce the ACP to 40 days. Indus's tax rate is 30 percent.

What will be the effect of liberalising the cash discount on residual income?

Solution:

$$\begin{aligned}
RI &= [S (I - V) - DIS] (1 - t) + R I \\
DIS &= p_n (S_0 + \Delta S) d_n - p_0 S_0 d_0 \\
&= 0.6 [470,000,000 + 20,000,000] \times 0.05 - 0.4 \times 470,000,000 \times 0.03 \\
&= 9,060,000 \\
I &= 470,000,000 \frac{45 - 40}{360} - 0.85 \times 20,000,000 \frac{40}{360} \\
&= 4,638,889 \\
RI &= [20,000,000 \times 0.15 - 9,060,000] 0.70 + 0.12 \times 4,638,889 \\
&= - 3,685,333
\end{aligned}$$

5. The present credit terms of Globus Corporation are 2/10, net 40. Its sales are Rs.650 million, its average collection period is 30 days, its variable costs to sales ratio, V, is 0.75, and its cost of capital is 10 percent. The proportion of sales on which customers currently take discount, is 0.3. Globus is considering relaxing its credit terms to 3/10, net 40. Such a relaxation is expected to increase sales by Rs.30 million, increase the proportion of discount sales to 0.5, and reduce the ACP to 20 days. Globus's tax rate is 35 percent.

What will be the effect of liberalising the cash discount on residual income?

Solution:

$$\begin{aligned}
\Delta RI &= [\Delta S (1 - V) - \Delta DIS] (1 - t) + R \Delta I \\
\Delta DIS &= p_n (S_0 + \Delta S) d_n - p_0 S_0 d_0 \\
&= 0.5 [650,000,000 + 30,000,000] .03 - 0.30 [650,000,000] .02 \\
&= 10,200,000 - 3,900,000 = 6,300,000 \\
\Delta I &= \frac{650,000,000}{360} (30 - 20) - 0.75 \times \frac{30,000,000}{360} \times 20 \\
&= 18,055,556 - 1,250,000 = 16,805,556 \\
\Delta R I &= [30,000,000 (0.25) - 6,300,000] (0.65) + 0.10 \times 16,805,556 \\
&= 780,000 + 1,680,556 \\
&= 2,460,556
\end{aligned}$$

6. The present credit terms of Hitesh Limited are 1/10, net 30. Its sales are Rs.800 million, its average collection period, ACP, is 22 days, its variable costs to sales ratio, V, is 0.80, and its cost of capital, k, is 15 percent. The proportion of sales on

which customers currently take discount, p_o , is 0.4. Hitesh is considering relaxing its credit terms to 2/10, net 30. Such a relaxation is expected to increase sales by Rs.50 million, increase the proportion of discount sales to 0.6, and reduce the ACP to 18 days. Hitesh's tax rate is 30 percent.

What will be the effect of liberalising the cash discount on residual income?

Solution:

$$\begin{aligned} \Delta RI &= [\Delta S (1 - V) - \Delta DIS] (1 - t) + R \Delta I \\ \Delta DIS &= p_n (S_o + \Delta S) d_n - p_o s_o d_o \\ &= 0.6 [800,000,000 + 50,000,000] .02 - 0.40 [800,000,000] .01 \\ &= 10,200,000 - 3,200,000 = 7,000,000 \\ \Delta I &= \frac{800,000,000}{360} (22 - 18) - 0.8 \times \frac{50,000,000}{360} \times 18 \\ &= 8,888,889 - 2,000,000 = 6,888,889 \\ \Delta RI &= [50,000,000 (0.2) - 7,000,000] (0.7) + 0.15 \times 6,888,889 \\ &= 2,100,000 + 1,033,333 \\ &= 3,133,333 \end{aligned}$$

7. The present sales of Nachiket Industries are Rs.100 million. The firm classifies its customers into 3 credit categories: A, B, and C. The firm extends unlimited credit to customers in category A, limited credit to customers in category B, and no credit to customers in category C. As a result of this credit policy, the firm is foregoing sales to the extent of Rs.10 million to customers in category B and Rs.20 million to customers in category C. The firm is considering the adoption of a more liberal credit policy under which customers in category B would be extended unlimited credit policy and customers in category C would be provided limited credit. Such relaxation would increase the sales by Rs.30 million on which bad debt losses would be 10 percent. The contribution margin ratio for the firm is 20 percent, the average collection period is 45 days, and the cost of capital is 16 percent. The tax rate for the firm is 35 percent.

What will be the effect of relaxing the credit policy on the residual income of the firm?

Solution:

$$\begin{aligned} \Delta RI &= [\Delta S(1-V) - \Delta S b_n](1-t) - k \Delta I \\ \Delta I &= \frac{\Delta S}{360} \times ACP \times V \\ \Delta S &= \text{Rs.30 million, } V=0.80, b_n=0.10, ACP=45 \text{ days, } k=0.16, t=0.35 \\ \text{Hence, } \Delta RI &= [30,000,000(1-0.80) - 30,000,000 \times 0.10] (1-0.35) \\ &\quad - 0.16 \times \frac{30,000,000}{360} \times 45 \times 0.80 \\ &= \text{Rs. 1,470,000} \end{aligned}$$

8. The present sales of Purvanchal Limited are Rs.80 million. The firm is considering the adoption of a more liberal credit policy under which customers with annual income in excess of Rs.1million would be extended unlimited credit and other customers limited credit. Such relaxation would increase the sales by Rs.20 million on which bad debt losses would be 8 percent. The contribution margin ratio for the firm is 25 percent, the average collection period is 30 days, and the cost of capital is 18 percent. The tax rate for the firm is 34 percent.

What will be the effect of relaxing the credit policy on the residual income of the firm?

Solution:

$$\Delta RI = [\Delta S(1-V) - \Delta S b_n](1-t) - k \frac{\Delta I}{\Delta S}$$

$$\Delta I = \frac{\Delta S}{360} \times ACP \times V$$

$\Delta S = \text{Rs.}20 \text{ million}, V=0.75, b_n=0.08, ACP=30 \text{ days}, k=0.18, t=0.34$

Hence, $\Delta RI = [20,000,000(1-0.75) - 20,000,000 \times 0.08] (1-0.34)$

$$- \frac{0.18 \times 20,000,000 \times 30 \times 0.75}{360}$$

$$= \text{Rs. } 2,019,000$$

9. Garibdas Limited is considering relaxing its collection efforts. Presently its sales are Rs.70 million, its average collection period 20 days, its variable costs to sales ratio 0.60, its cost of capital 16 percent, and its bad debt ratio 0.05. The relaxation in collection efforts is expected to push sales up by Rs.10 million, increase the average collection period to 30 days, and raise the bad debts ratio to 0.08. The tax rate of the firm is 35 percent.

What will be the effect of relaxing the collection effort on the residual income of the firm?

Solution:

$$\Delta RI = [\Delta S(1-V) - \Delta BD](1-t) - k \Delta I$$

$$\Delta BD = b_n(S_o + \Delta S) - b_o S_o$$

$$\Delta I = \frac{S_o}{360} (ACP_N - ACP_o) + \frac{\Delta S}{360} \times ACP_N \times V$$

$S_o = \text{Rs.}70 \text{ million}, ACP_o = 20, V = 0.60, k = 0.16, b_o = 0.05, \Delta S = \text{Rs.}10 \text{ million},$

$$ACP_N=30, b_n=0.08, t=0.35$$

$$\Delta RI = [Rs.10,000,000(1-.60) - \{.08(Rs.80,000,000) - .05(Rs.70,000,000)\}](1-0.35)$$

$$- 0.16 \left[\frac{Rs.70,000,000}{360} \times (30-20) + \frac{Rs.10,000,000}{360} \times 30 \times 0.6 \right]$$

$$= Rs.323,889$$

10. Sonar Corporation is considering relaxing its collection efforts. Presently its sales are Rs.200 million, its average collection period 30 days, its variable costs to sales ratio 0.70, its cost of capital 18 percent, and its bad debt ratio 0.05. The relaxation in collection efforts is expected to push sales up by Rs.20 million, increase the average collection period to 40 days, and raise the bad debts ratio to 0.06. The tax rate of the firm is 33 percent.

What will be the effect of relaxing the collection effort on the residual income of the firm?

Solution:

$$\Delta RI = [\Delta S(1-V) - \Delta BD](1-t) - k\Delta I$$

$$\Delta BD = b_n(S_0 + \Delta S) - b_o S_0$$

$$\Delta I = \frac{S_0}{360} (ACP_N - ACP_o) + \frac{\Delta S}{360} \times ACP_N \times V$$

$S_0 = Rs.200$ million, $ACP_o = 30$, $V = 0.70$, $k = 0.18$, $b_o = 0.05$, $\Delta S = Rs.20$ million,
 $ACP_N = 40$, $b_n = 0.06$, $t = 0.33$

$$\Delta RI = [Rs.20,000,000(1-.70) - \{.06(Rs.220,000,000) - .05(Rs.200,000,000)\}](1-0.33)$$

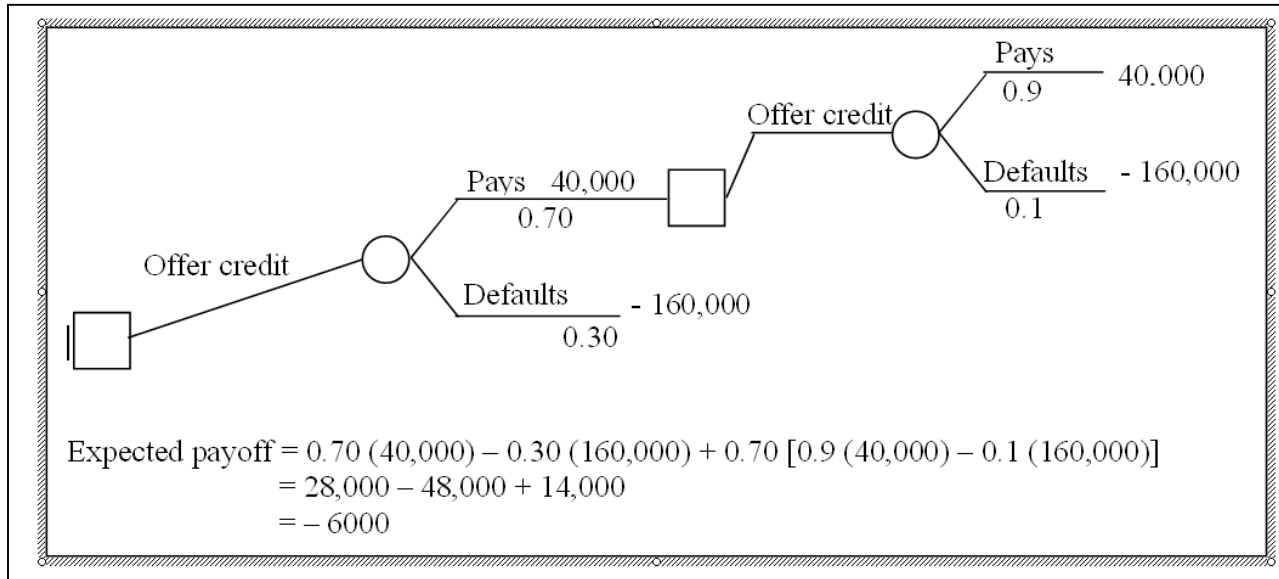
$$- 0.18 \left[\frac{Rs.200,000,000}{360} \times (40-30) + \frac{Rs.20,000,000}{360} \times 40 \times 0.70 \right]$$

$$= Rs.596,000$$

11. The financial manager of a firm is wondering whether credit should be granted to a new customer who is expected to make a repeat purchase. On the basis of credit evaluation, the financial manager feels that the probability that the customer will pay is 0.70 and the probability that the customer will default is 0.30. Once the customer pays for the first purchase, the probability that he will pay for the repeat purchase will be 0.90. The revenue from the sale will be Rs.200,000 and the cost of the sale will be Rs.160,000 – these figures apply to both the initial and the repeat purchases.

What is the expected payoff if the credit is granted?

Solution:



12. The financial manager of a firm is wondering whether credit should be granted to a new customer who is expected to make a repeat purchase. On the basis of credit evaluation, the financial manager feels that the probability that the customer will pay is 0.80 and the probability that the customer will default is 0.20. Once the customer pays for the first purchase, the probability that he will pay for the repeat purchase increases to 0.95. The revenue from the sale will be Rs.250,000 and the cost of the sale would be Rs.180,000 – these figures apply to both the initial and the repeat purchase.

What is the expected payoff if the credit is granted?

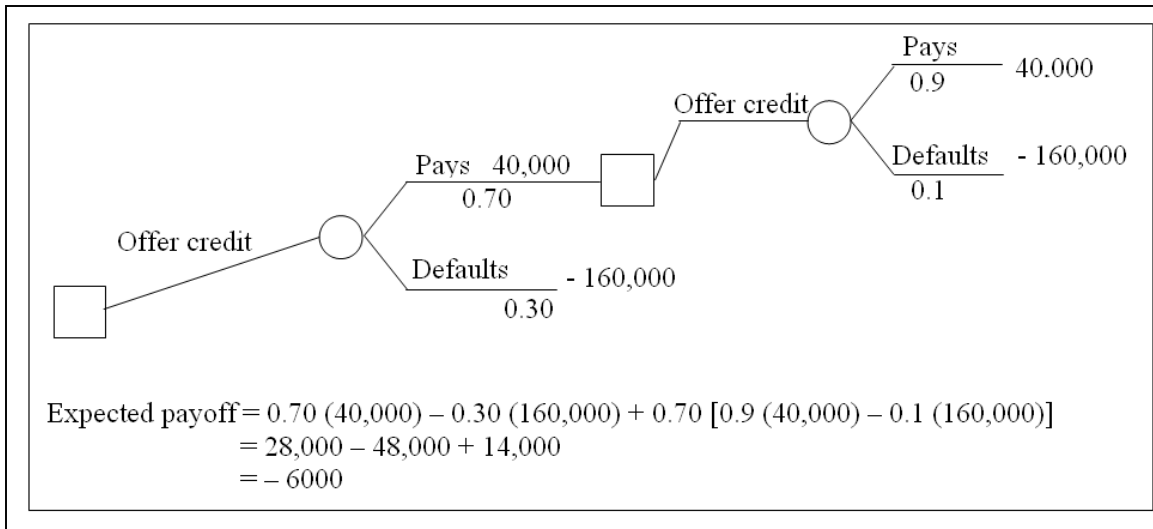
Solution:

$$\begin{aligned} \text{Expected pay off} &= (0.80 \times 70,000) - (0.2 \times 180,000) \\ &\quad + 0.80 [0.95 (70,000) - 0.05 \times 180,000] \\ &= 66,000 \end{aligned}$$

13. The financial manager of a firm is wondering whether credit should be granted to a new customer who is expected to make a repeat purchase. On the basis of credit evaluation, the financial manager feels that the probability that the customer will pay is 0.70 and the probability that the customer will default is 0.30. Once the customer pays for the first purchase, the probability that he will pay for the repeat purchase will be 0.90. The revenue from the sale will be Rs.200,000 and the cost of the sale will be Rs.160,000 – these figures apply to both the initial and the repeat purchases.

What is the expected payoff if the credit is granted?

Solution:



14. Zenith Enterprises sells on terms, 2/10, net 30. Annual sales are Rs.200 million. 40 percent of its customers pay on the 10th day and take the discount. If accounts receivable average is Rs.15 million, what is the average collection period (ACP) on non-discount sales?

Solution:

$$\begin{aligned} \text{Accounts receivable} &= [\text{ACP on discount sales}] \frac{\text{Discount sales}}{360} \\ &+ [\text{ACP on non-discount sales}] \frac{\text{Non - discount sales}}{360} \\ 15,000,000 &= [10] \frac{80,000,000}{360} + \text{ACP} \frac{120,000,000}{360} \\ \text{So ACP} &= 38.3 \text{ days} \end{aligned}$$

15. ATP Ltd. sells on terms 4/45, net 60. Annual sales are Rs.200 million, 40 percent of its customers pay on the 45th day and take the discount. If the accounts receivable average Rs.25 million, what is the average collection period (ACP) on non discount sales?

Solution:

$$\begin{aligned}
 &\text{Accounts receivable} \\
 &= [\text{ACP on discount sales}] \left[\frac{\text{Discount sales}}{360} \right] \\
 &\quad + [\text{ACP on non-discount sales}] \left[\frac{\text{Non-discount sales}}{360} \right] \\
 25 &= 45 \times \frac{0.4 \times 200}{360} + \text{ACP}_{\text{ND}} \times \frac{0.6 \times 200}{360} \\
 \text{i.e. } 25 \times 360 &= 3600 + \text{ACP}_{\text{ND}} \times 120 \\
 \text{ACP}_{\text{ND}} &= 45
 \end{aligned}$$

16. Zenith Enterprises sells on terms, 2/10, net 30. Annual sales are Rs.200 million. 40 percent of its customers pay on the 10th day and take the discount. If accounts receivable average is Rs.15 million, what is the average collection period (ACP) on non-discount sales ?

Solution:

$$\begin{aligned}
 &\text{Accounts receivable} = [\text{ACP on discount sales}] \frac{\text{Discount sales}}{360} \\
 &\quad + [\text{ACP on non-discount sales}] \frac{\text{Non - discount sales}}{360} \\
 15,000,000 &= [10] \frac{80,000,000}{360} + \text{ACP} \frac{120,000,000}{360} \\
 \text{Solving the above we get } &\text{ACP} = 38.3 \text{ days}
 \end{aligned}$$

17. Malwa Industries sells on terms 3/10, net 30. Total sales for the year are Rs.60 million. Forty percent of the sales amount is paid on the tenth day (availing the discount) and the remaining 60 percent pay, on average, 40 days after their purchases.

Calculate the average collection period and the average investment in receivables.

Solution:

40% of sales will be collected on the 10th day

60% of sales will be collected on the 40th day

$$ACP = 0.4 \times 10 + 0.6 \times 40 = 28 \text{ days}$$

$$\text{Value of receivables} = \frac{\text{Rs.60,000,000}}{360} \times 28$$

$$= \text{Rs.4,666,667}$$

Assuming that V is the proportion of variable costs to sales, the investment in receivables is :

$$\text{Rs. 4,666,667} \times V$$

18. Bheema Enterprises sells on terms 4/15, net 40. Total sales for the year are Rs.100 million. Twenty percent of the sales amount is paid on the fifteenth day (getting the benefit of discount) and the remaining 80 percent pay, on average, 60 days after their purchases.

Calculate the average collection period and the average investment in receivables.

Solution:

20% of sales will be collected on the 15th day

80% of sales will be collected on the 60th day

$$ACP = 0.2 \times 15 + 0.8 \times 60 = 51 \text{ days}$$

$$\text{Value of receivables} = \frac{\text{Rs.100,000,000}}{360} \times 51$$

$$= \text{Rs.14,166,667}$$

Assuming that V is the proportion of variable costs to sales, the investment in receivables is :

$$\text{Rs. 14,166,667} \times V$$

19. A firm is wondering whether to sell goods to a customer on credit or not. The revenues from sale will be Rs.50,000 and the cost of sale will be Rs.36,000. What should be the minimum probability that the customer will pay, in order to sell profitably?

Solution:

$$\text{Profit when the customer pays} = \text{Rs.50,000} - \text{Rs.36,000} = \text{Rs.14,000}$$

$$\text{Loss when the customer does not pay} = \text{Rs.36,000}$$

$$\text{Expected profit} = p_1 \times 14,000 - (1-p_1)36,000$$

Setting expected profit equal to zero and solving for p_1 gives:
 $p_1 \times 14,000 - (1 - p_1)36,000 = 0 \longrightarrow p_1 = 0.72$

Hence the minimum probability that the customer must pay is 0.72

20. A firm is wondering whether to sell goods to a customer on credit or not. The revenues from sale will be Rs.100,000 and the cost of sale will be Rs.80,000. What should be the minimum probability that the customer will pay, in order to sell profitably?

Solution:

Profit when the customer pays = Rs.100,000 - Rs.80,000 = Rs.20,000
 Loss when the customer does not pay = Rs.80,000
 Expected profit = $p_1 \times 20,000 - (1 - p_1)80,000$
 Setting expected profit equal to zero and solving for p_1 gives :
 $p_1 \times 20,000 - (1 - p_1)80,000 = 0 \longrightarrow p_1 = 0.8$
 Hence the minimum probability that the customer must pay is 0.8

CHAPTER 26

1. Pioneer Stores is trying to determine the economic order quantity for a certain type of machine tool. The firm sells 60,000 numbers of this machine tool annually at a price of Rs.80 per piece. The purchase price per machine tool to the firm is, however, Rs.65. The cost of carrying a machine tool is Rs.10 per year and the cost of placing an order is Rs.80.
- (a) What is the total cost associated with placing one, two, five, and ten orders per year?
- (b) What is the economic order quantity?

Solution:

a.	<i>No. of Orders Per Year (U/Q)</i>	<i>Order Quantity (Q) Units</i>	<i>Ordering Cost (U/Q x F) Rs.</i>	<i>Carrying Cost Q/2xPxC (where PxC=Rs.10) Rs.</i>	<i>Total Cost of Ordering and Carrying Rs.</i>
		1	60,000	80	300,000	300,080
	2	30,000	160	150,000	150,160
	5	12,000	400	60,000	60,400
	10	6,000	800	30,000	30,800

b. Economic Order Quantity (EOQ) = $\sqrt{\frac{2 UF}{PC}} = \sqrt{\frac{2 \times 60,000 \times 80}{10}}$
 = 980 units (approx)

2. National Stores is trying to determine the economic order quantity for certain type of transformers. The firm sells 400 numbers of this transformers annually at a price of Rs.300 per piece. The purchase price per machine tool to the firm is, however, Rs.230. The cost of carrying a transformer is Rs.40 per year and the cost of placing an order is Rs.180.
- (a) What is the total cost associated with placing one, four, eight , and ten orders per year?
- (b) What is the economic order quantity?

Solution:

a.

<i>No. of Orders Per Year (U/Q)</i>	<i>Order Quantity (Q)</i> <i>Units</i>	<i>Ordering Cost (U/Q x F)</i> <i>Rs.</i>	<i>Carrying Cost Q/2xPxC (where PxC=Rs.40)</i> <i>Rs.</i>	<i>Total Cost of Ordering and Carrying</i> <i>Rs.</i>
1	400	180	8,000	8,180
4	100	720	2,000	2,720
8	50	1440	1,000	2,440
10	40	1800	800	2,600

b. Economic Order Quantity (EOQ) = $\sqrt{\frac{2UF}{PC}} = \sqrt{\frac{2 \times 400 \times 180}{40}}$
= 60 units

3. Harilal Company requires 25,000 units of a certain item per year. The purchase price per unit is Rs.60; the carrying cost per year is 30 percent of the inventory value; and the fixed cost per order is Rs.400.
- (a) Determine the economic order quantity.
- (b) How many times per year will inventory be ordered, if the size is equal to the EOQ?
- (c) What will be the total cost of carrying and ordering inventories when 10 orders are placed per year?

Solution:

a. $EOQ = \sqrt{\frac{2UF}{PC}}$
 $U=25,000, F=Rs.400, PC= Rs.60 \times 0.30 =Rs.18$

$$EOQ = \sqrt{\frac{2 \times 25,000 \times 400}{18}} = 1054 \text{ units.}$$

b. Number of orders that will be placed is $\frac{25,000}{1,054} = 23.72$

Note that though fractional orders cannot be placed, the number of orders relevant for the year will be 23.72 . In practice 24 orders will be placed during the year. However, the 24th order will serve partly(to the extent of 72 percent) the present year and partly(to the extent of 28 per cent) the following year. So only 72 per cent of the ordering cost of the 24th order relates to the present year. Hence the ordering cost for the present year will be 23.72 x Rs.400 = Rs.9,488

c. Total cost of carrying and ordering inventories

$$= [23.72 \times 400 + \frac{1054}{2} \times 18] = \text{Rs.18,974}$$

4. Kamal and Company requires 50,000 units of a certain item per year. The purchase price per unit is Rs.20; the carrying cost per year is 15 percent of the inventory value; and the fixed cost per order is Rs.100.
- Determine the economic order quantity.
 - How many times per year will inventory be ordered, if the size is equal to the EOQ?
 - What will be the total cost of carrying and ordering inventories when 10 orders are placed per year?

Solution:

a $EOQ = \sqrt{\frac{2UF}{PC}}$
 $U=50,000, F=Rs.100, PC= Rs.20 \times 0.15 =Rs.3$

$$EOQ = \sqrt{\frac{2 \times 50,000 \times 100}{3}} = 1826 \text{ units. (approximately)}$$

b. Number of orders that will be placed is $\frac{50,000}{1,826} = 27.38$

Note that though fractional orders cannot be placed, the number of orders relevant for the year will be 27.38 . In practice 28 orders will be placed during the year. However, the 28th order will serve partly(to the extent of 38 percent) the present year and partly(to the extent of 62 per cent) the following year. So only 38 per cent of the ordering cost of the 28th order relates to the present year. Hence the ordering cost for the present year will be 27.38 x Rs.100 = Rs.2,738

c. Total cost of carrying and ordering inventories

$$= [27.38 \times 100 + \frac{1826}{2} \times 3] = \text{Rs.}5477$$

5. Consider the following data for a certain item purchased by Jaibharat Stores..

Annual usage	= 10,000 units
Fixed cost per order	= Rs.200
Purchase price per unit	= Rs.160
Carrying cost	= 25 percent of inventory value

What is the economic order quantity?

Now, assume that a discount of Rs.6 per unit is offered if the order size is 2,000 units. Should Jaibharat seek the quantity discount?

Solution:

$$\begin{aligned}
 U &= 10,000, F = \text{Rs.}200, PC = \text{Rs.}160 \times 0.25 = \text{Rs.}40 \\
 EOQ &= \sqrt{\frac{2 \times 10,000 \times 200}{40}} = 316 \text{ units (approximately)} \\
 \Delta\pi &= UD + \left[\frac{U}{Q^*} - \frac{U}{Q'} \right] F - \left[\frac{Q'(P-D)C}{2} - \frac{Q^*PC}{2} \right] \\
 &= 10,000 \times 6 + \left[\frac{10,000}{316} - \frac{10,000}{2,000} \right] \times 200 \\
 &\quad - \left[\frac{2,000(160)0.25}{2} - \frac{316 \times 160 \times 0.25}{2} \right] \\
 &= 60,000 + 5329 - 32,180 = \text{Rs.}33,149
 \end{aligned}$$

6. Consider the following data for a certain item purchased by Liberty Stores.

Annual usage	= 25,000 units
Fixed cost per order	= Rs.400
Purchase price per unit	= Rs.360
Carrying cost	= 35 percent of inventory value

What is the economic order quantity?

Now, assume that a discount of Rs.10 per unit is offered if the order size is 3,000 units. Should Liberty seek the quantity discount?

Solution:

$$U=25,000, F=Rs.400, PC =Rs.360 \times 0.35 =Rs.126$$

$$EOQ = \sqrt{\frac{2 \times 25,000 \times 400}{126}} = 399 \text{ units (approximately)}$$

$$\Delta \pi = UD + \left[\frac{U}{Q^*} - \frac{U}{Q'} \right] F - \left[\frac{Q'(P-D)C}{2} - \frac{Q^*PC}{2} \right]$$

$$= 25,000 \times 10 + \left[\frac{25,000}{399} - \frac{25,000}{3,000} \right] \times 400$$

$$- \left[\frac{3,000(350)0.35}{2} - \frac{399 \times 360 \times 0.35}{2} \right]$$

$$= 250,000 + 21,729 - 158,613 = Rs.113,116$$

7. Shaheed Corporation requires 10,000 units of a certain item annually. The cost per unit is Rs.50, the fixed cost per order is Rs.200, and the inventory carrying cost is Rs.8 per unit per year.

The supplier offers quantity discount as follows:

<i>Order Quantity</i>	<i>Discount Percentage</i>
2,000	6
3,000	8

What should Shaheed Corporation do?

Solution:

$$U=10,000, F= Rs.200, PC= Rs.50 \times 0.16 = Rs.8$$

$$EOQ = \sqrt{\frac{2 \times 10,000 \times 200}{8}} = 707 \text{ units}$$

If 2000 units are ordered the discount is : $.06 \times Rs.50 = Rs.3$ Change in profit when 2,000 units are ordered is :

$$\Delta\pi = 10,000 \times 3 + \left[\frac{10,000}{707} - \frac{10,000}{2,000} \right] \times 200$$

$$- \left[\frac{2000 \times 47 \times 0.16}{2} - \frac{707 \times 50 \times 0.16}{2} \right] = 30,000 + 1829 - 4692 = \text{Rs.} 27,137$$

If 3000 units are ordered the discount is : $.08 \times \text{Rs.} 50 = \text{Rs.} 4$ Change in profit when 3,000 units are ordered is :

$$\Delta\pi = 10,000 \times 4.0 + \left[\frac{10,000}{707} - \frac{10,000}{3000} \right] \times 200 - \left[\frac{3000 \times 46 \times 0.16}{2} - \frac{707 \times 50 \times 0.16}{2} \right]$$

$$= 40,000 + 2162 - 8,212 = \text{Rs.} 33,950$$

As the change in profit is more when the discount on 3000 units is availed of, that option is the preferred one.

8. Merit International requires 15,000 units of a certain item annually. The cost per unit is Rs.80, the fixed cost per order is Rs.350, and the inventory carrying cost is Rs.10 per unit per year.

The supplier offers quantity discount as follows:

<i>Order Quantity</i>	<i>Discount Percentage</i>
3,000	4
5,000	7

What should Merit International do?

Solution:

$$U=15,000, F= \text{Rs.} 350, PC= \text{Rs.} 80 \times 0.125 = \text{Rs.} 10$$

$$EOQ = \sqrt{\frac{2 \times 15,000 \times 350}{10}} = 1025 \text{ units}$$

If 3000 units are ordered the discount is : $.04 \times \text{Rs.} 80 = \text{Rs.} 3.20$ Change in profit when 3,000 units are ordered is :

$$\Delta\pi = 15,000 \times 3.2 + \left[\frac{15,000}{1025} - \frac{15,000}{3,000} \right] \times 350$$

$$- \left[\frac{3000 \times 76.8 \times 0.125}{2} - \frac{1025 \times 80 \times 0.125}{2} \right] = 48,000 + 3372 - 9,275 = \text{Rs.}42,097$$

If 5000 units are ordered the discount is : $.07 \times \text{Rs.}80 = \text{Rs.}5.6$ Change in profit when 5,000 units are ordered is :

$$\Delta \pi = 15,000 \times 5.6 + \left[\frac{15,000}{1025} - \frac{15,000}{5000} \right] \times 350 - \left[\frac{5000 \times 74.4 \times 0.125}{2} - \frac{1025 \times 80 \times 0.125}{2} \right]$$

$$= 84,000 + 4072 - 18,125 = \text{Rs.} 69,947$$

As the change in profit is more when the discount on 5000 units is availed of, that option is the preferred one.

9. Gulfstar Corporation requires steel for its fabrication work. The probability distributions of the daily usage rate and the lead time for procurement are given below. These distributions are independent.

Daily usage rate in tonnes	Probability	Lead time in days	Probability
5	.2	4	.5
7	.5	6	.3
9	.3	10	.2

The stockout cost is estimated to be Rs.5,000 per ton. The carrying cost is Rs.2,000 per ton per year.

- Required: (a) What is the optimal level of safety stock?
(b) What is the probability of stockout?

Solution:

The quantities required for different combinations of daily usage rate(DUR) and lead times(LT) along with their probabilities are given in the following table

DUR \ LT (Units) \ (Days)	4(0.5)	6(0.3)	10(0.2)
5(0.2)	20*(0.10)	30(0.06)	50(0.04)
7(0.5)	28 (0.25)	42(0.15)	70(0.10)
9(0.3)	36 (0.15)	54(0.09)	90(0.06)

The normal (expected) consumption during the lead time is :

$$20 \times 0.10 + 30 \times 0.06 + 50 \times 0.04 + 28 \times 0.25 + 42 \times 0.15 + 70 \times 0.10 + 36 \times 0.15 + 54 \times 0.09 + 90 \times 0.06 = 41.76 \text{ tonnes}$$

a. Costs associated with various levels of safety stock are given below :

Safety Stock*	Stock outs(in tonnes)	Stock out Cost	Probability	Expected Stock out	Carrying Cost	Total Cost
1	2	3	4	5 [3x4]	6 [(1)x2,000]	7 [5+6]
Tonnes				Rs.	Rs.	Rs.
48.24	0	0	0	0	96,480	96,480
28.24	20	100,000	0.06	6,000	56,480	62,480
12.24	16	80,000	0.10	8,000		
	36	180,000	0.06	10,800	24,480	43,280
				18,800		
8.24	4	20,000	0.09	1,800		
	20	100,000	0.10	10,000		
	40	200,000	0.06	12,000	16,480	40,280
				23,800		
0.24	8	40,000	0.04	1,600		
	12	60,000	0.09	5,400		
	28	140,000	0.10	14,000		
	48	240,000	0.06	14,400	480	
				35,400		
0	0.24	1,200	0.15	180		
	8.24	41,200	0.04	1,648		
	12.24	61,200	0.09	5,508		
	28.24	141,200	0.10	14,120		
	48.24	241,200	0.06	14,472	0	35,928
				35,928		

So the optimal safety stock= 0.24 tonnes

Reorder level = Normal consumption during lead time + safety stock

$$K = 41.76 + 0.24 = 42 \text{ tonnes}$$

- b. Probability of stock out at the optimal level of safety stock = Probability (consumption being 50, 54, 70 or 90 tonnes)

$$\begin{aligned} & \text{Probability (consumption = 50 tonnes)} + \text{Probability (consumption = 54 tonnes)} + \\ & \text{Probability (consumption = 70 tonnes)} + \text{Probability (consumption = 90 tonnes)} \\ & = 0.04 + 0.09 + 0.10 + 0.06 = 0.29 \end{aligned}$$

10. Five Star Limited requires steel for its fabrication work. The probability distributions of the daily usage rate and the lead time for procurement are given below. These distributions are independent.

<i>Daily usage rate in tonnes</i>	<i>Probability</i>	<i>Lead time in days</i>	<i>Probability</i>
2	.4	5	.1
3	.4	8	.6
4	.2	10	.3

The stockout cost is estimated to be Rs.7,000 per ton. The carrying cost is Rs.1,500 per ton per year.

- Required: (a) What is the optimal level of safety stock?
(b) What is the probability of stockout?

Solution:

The quantities required for different combinations of daily usage rate(DUR) and lead times(LT) along with their probabilities are given in the following table

DUR (Units)	LT (Days)			
		5(0.1)	8(0.6)	10(0.3)
2(0.4)		10(0.04)	16(0.24)	20(0.12)
3(0.4)		15 (0.04)	24(0.24)	30(0.12)
4(0.2)		20(0.02)	32(0.12)	40(0.06)

The normal (expected) consumption during the lead time is :

$$\begin{aligned} & 10 \times 0.04 + 16 \times 0.24 + 20 \times 0.012 + 15 \times 0.04 + 24 \times 0.24 + 30 \times 0.12 + 20 \times 0.02 \\ & + 32 \times 0.12 + 40 \times 0.06 = 23.24 \text{ tonnes} \end{aligned}$$

c. Costs associated with various levels of safety stock are given below :

<i>Safety Stock*</i>	<i>Stock outs(in tonnes)</i>	<i>Stock out Cost</i>	<i>Probability</i>	<i>Expected Stock out</i>	<i>Carrying Cost</i>	<i>Total Cost</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i> [3x4]	<i>6</i> [(1)x1,500]	<i>7</i> [5+6]
				Rs.	Rs.	Rs.
16.76	0	0	0	0	25,140	25,140
8.76	8	56,000	0.06	3,360	13,140	16,500
6.76	2	14,000	0.12	1,680		
	8	56,000	0.06	3,360	10,140	15,180
				<u>5,040</u>		
0.76	6	42,000	0.12	5,040		
	8	56,000	0.12	6,720		
	16	1,12,000	0.06	6,720	1,140	19,620
				<u>18,480</u>		
0	0.76	5,320	0.24	1,277		
	6.76	47,320	0.12	5,678		
	8.76	61,320	0.12	7,358		
	16.76	117,320	0.06	7,039		
				<u>21,352</u>	0	21,352

So the optimal safety stock= 6.76 tonnes

Reorder level = Normal consumption during lead time + safety stock

$$K = 23.24 + 6.76 = 30 \text{ tonnes}$$

d. Probability of stock out at the optimal level of safety stock = Probability (consumption being 30, 32, or 40 tonnes)

$$\begin{aligned} & \text{Probability (consumption = 30 tonnes) + Probability (consumption = 32 tonnes) +} \\ & \text{Probability (consumption = 40 tonnes)} \\ & = 0.12 + 0.12 + 0.06 = 0.30 \end{aligned}$$

11. The information about annual usage and price for 12 items used by a firm is as given here.

<i>Item</i>	<i>Annual Usage (Number of Units)</i>	<i>Price per Unit (Rs)</i>	<i>Item</i>	<i>Annual Usage (Number of Units)</i>	<i>Price per Unit (Rs)</i>
1	600	30.00	9	16,500	3.00
2	30	200.00	10	700	40.00
3	4,000	5.00	11	3,800	200.00
4	2,000	12.00	12	1,000	67.00
5	400	100.00	13	12,000	16.00
6	6,000	75.00	14	400	120.00
7	3,200	48.00	15	200	800.00
8	1,600	10.00			

- Required: (a) rank the items of inventory on the basis of annual usage value;
 (b) record the cumulative usage in value;
 (c) show the cumulative percentages of usage of items;
 (d) classify the items into three classes, *A, B and C*

Solution:

<i>Item</i>	<i>Annual Usage(in Units)</i>	<i>Price per Unit Rs.</i>	<i>Annual Usage (in Units) Rs.</i>	<i>Ranking</i>
1	600	30.00	18,000	13
2	30	200.00	6,000	15
3	4,000	5.00	20,000	12
4	2,000	12.00	24,000	11
5	400	100.00	40,000	9
6	6,000	75.00	450,000	2
7	3,200	48.00	153,600	5
8	1,600	10.00	16,000	14
9	16,500	3.00	49,500	7
10	700	40.00	28,000	10
11	3,800	200.00	760,000	1
12	1,000	67.00	67,000	6
13	12,000	16.00	192,000	3
14	400	120.00	48,000	8
15	200	800.00	160,000	4

Cumulative Value of Items & Usage

<i>Item no.</i>	<i>Rank</i>	<i>Annual Usage Value (Rs.)</i>	<i>Cumulative Annual Usage Value(Rs.)</i>	<i>Cumulative % of Usage Value</i>	<i>Cumulative % of Items</i>
11	1	760,000	760,000	37.40	6.67
6	2	450,000	1,210,000	59.54	13.33
13	3	192,000	1,402,000	68.99	20.00
15	4	160,000	1,562,000	76.87	26.67
7	5	153,600	1,715,600	84.42	33.33
12	6	67,000	1,782,600	87.72	40.00
9	7	49,500	1,832,100	90.16	46.67
14	8	48,000	1,880,100	92.52	53.33
5	9	40,000	1,920,100	94.49	60.00
10	10	28,000	1,948,100	95.87	66.67
4	11	24,000	1,972,100	97.05	73.33
3	12	20,000	1,992,100	98.03	80.00
1	13	18,000	2,010,100	98.92	86.67
8	14	16,000	2,026,100	99.70	93.33
2	15	6,000	2,032,100	100.00	100

CHAPTER 27

1. What is the annual percentage interest cost associated with the following credit terms?

- (a) 2/15 net 30 (b) 3/10 net 30 (c) 2/10 net 45 (d) 1/5 net 15

Assume that the firm does not avail of the cash discount but pays on the last day of the net period.

Solution:

Annual interest cost is given by ,

$$\frac{\text{Discount \%}}{1 - \text{Discount \%}} \times \frac{360}{\text{Credit period} - \text{Discount period}}$$

Therefore, the annual per cent interest cost for the given credit terms will be as follows:

a.
$$\frac{0.02}{0.98} \times \frac{360}{15} = 0.4898 = 48.98 \%$$

$$\text{b. } \frac{0.03}{0.97} \times \frac{360}{20} = 0.5567 = 55.67 \%$$

$$\text{c. } \frac{0.02}{0.98} \times \frac{360}{35} = 0.2099 = 20.99 \%$$

$$\text{d. } \frac{0.01}{0.99} \times \frac{360}{10} = 0.3636 = 36.36 \%$$

2. Calculate the annual percentage interest cost of various terms in problem 1 above, assuming that it is possible to stretch payment 20 days beyond the net period.

Solution:

$$\text{a. } \frac{0.02}{0.98} \times \frac{360}{35} = 0.2099 = 20.99 \%$$

$$\text{b. } \frac{0.03}{0.97} \times \frac{360}{40} = 0.2784 = 27.84 \%$$

$$\text{c. } \frac{0.02}{0.98} \times \frac{360}{55} = 0.1336 = 13.36 \%$$

$$\text{d. } \frac{0.01}{0.99} \times \frac{360}{30} = 0.1212 = 12.12 \%$$

3. Consider the data for Kanishka Limited.

	Rs (in million)
Current assets	
Raw material	40
Work-in-process	8
Finished goods	25
Other current assets	3
	76
Current liabilities	
Trade creditors	30
Bank borrowing (including Bills	
Discounted)	10

Other current liabilities	4
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	44
	<hr style="width: 50px; margin-left: auto; margin-right: 0;"/>

What is the maximum permissible bank finance for Kanishka Limited under the three methods suggested by the Tandon Committee? Assume that the core current assets for Kanishka Limited are Rs.15 million.

Solution:

The maximum permissible bank finance under the three methods suggested by The Tandon Committee are :

Method 1 : $0.75(CA-CL) = 0.75(76-44) = \text{Rs.}24 \text{ million}$
 Method 2 : $0.75(CA)-CL = 0.75(76)-44 = \text{Rs.} 13 \text{ million}$
 Method 3 : $0.75(CA-CCA)-CL = 0.75(76-15)-44 = \text{Rs.}1.75 \text{ million}$

4. Consider the data for Smartlink Corporation.

Current assets	Rs (in million)
Raw material	280
Work-in-process	58
Finished goods	240
Other current assets	68
	<hr style="width: 50px; margin-left: auto; margin-right: 0;"/>
	646
Current liabilities	
Trade creditors	160
Bank borrowing (including Bills	
Discounted)	200
Other current liabilities	42
	<hr style="width: 50px; margin-left: auto; margin-right: 0;"/>
	402
	<hr style="width: 50px; margin-left: auto; margin-right: 0;"/>

What is the maximum permissible bank finance for Smartlink Corporation under the three methods suggested by the Tandon Committee? Assume that the core current assets for Smartlink Corporation are Rs.100 million.

Solution:

The maximum permissible bank finance under the three methods suggested by The Tandon Committee are:

Method 1 : $0.75(CA-CL) = 0.75(646 - 402) = \text{Rs.183 million}$

Method 2 : $0.75(CA)-CL = 0.75(646) - 402 = \text{Rs.82.5 million.}$

Method 3 : $0.75(CA-CCA)-CL = 0.75(646 - 100) - 402 = \text{Rs.7.5 million}$

CHAPTER 28**MINICASE 1**

Vikram Thapar, CFO of Aman corporation, recently attended a seminar conducted by an internationally renowned expert on credit analysis. Among various ideas and techniques presented in that seminar, the technique of discriminant analysis impressed him. He felt that it could be applied for classifying the credit applicants of Aman Corporation into 'good' and 'bad' categories.

He asked Sudarshan, a finance executive in his department who recently graduated from a leading business school, to explore the possibility to using discriminant analysis for credit evaluation in Aman Corporation.

Sudarshan suggested that the two ratios that are likely to be most helpful in discriminating between the 'good' and 'bad' accounts are :

- (i) current ratio (Current assets / Current liabilities), and
- (ii) the earning power (PBIT/Capital employed)

Vikram Thapar concurred with Sudarshan's suggestion.

Sudarshan gathered information on 18 accounts, 10 'good' and 8 'bad', which is given below. A 'good' account is an account which pays within the stipulated credit period and a 'bad' account is an account which does not pay within the stipulated credit period.

<i>Good Accounts</i>			<i>Bad Accounts</i>		
<i>Account number</i>	X_i <i>Current ratio</i>	Y_i <i>Earning power (%)</i>	<i>Account number</i>	X_i <i>Current ratio</i>	Y_i <i>Earning power (%)</i>
1	1.20	16	11	1.10	9
2	1.30	17	12	1.00	- 6
3	1.40	14	13	1.20	6
4	1.00	20	14	0.90	8
5	1.50	13	15	1.10	4
6	1.60	12	16	1.20	10
7	1.80	15	17	0.90	7
8	1.60	10	18	1.10	2
9	1.20	15	19	0.80	6
10	1.40	8	20	0.70	4

Required: Estimate the discriminant function which best discriminates between the 'good' and 'bad' applicants.

Solution:

Account Number	X _i	Y _i	X _i - X	Y _i - Y	(X _i - X) ²	(Y _i - Y) ²	Σ(X _i - X) (Y _i - Y)
1	1.2	16	0	6.5	0	42.25	0
2	1.3	17	0.1	7.5	.01	56.25	0.75
3	1.4	14	0.2	4.5	0.04	20.25	0.90
4	1.0	20	-0.2	10.5	0.04	110.25	-2.10
5	1.5	13	0.3	3.5	0.09	12.25	1.05
6	1.6	12	0.4	2.5	0.16	6.25	1.00
7	1.8	15	0.6	5.5	0.36	30.25	3.3
8	1.6	10	0.4	0.5	0.16	0.25	0.2
9	1.2	15	0.0	5.5	0.0	30.25	0
10	1.4	8	0.2	-1.5	0.04	2.25	-0.3
11	1.1	9	-0.1	-0.5	0.01	0.25	.05
12	1.0	-6	-0.2	-15.5	0.04	240.25	3.1
13	1.2	6	0.0	-3.5	0	12.25	0
14	0.9	8	-0.3	-1.5	0.09	2.25	0.45
15	1.1	4	-0.1	-5.5	0.01	30.25	0.55
16	1.2	10	0	+0.5	0	0.25	0
17	0.9	7	-0.3	-2.5	0.09	6.25	0.75
18	1.1	2	-0.1	-7.5	0.01	56.25	0.75
19	0.8	6	-0.4	-3.5	0.16	12.25	1.4
20	0.7	4	-0.5	-5.5	0.25	30.25	2.75
$\frac{\sum X_i}{20} = 24.0$ $\frac{\sum Y_i}{20} = 190$ $\sum (X_i - \bar{X})^2 = 1.56$ $\sum (Y_i - \bar{Y})^2 = 701$ $\sum (X_i - \bar{X})(Y_i - \bar{Y}) = 14.6$							
$\bar{X} = 1.2$ $\bar{Y} = 9.5$							

$$X_1 = \frac{14.0}{10} = 1.4 \quad Y_1 = \frac{140}{10} = 14\% \quad \sigma_x^2 = \frac{1.56}{19} = .082 \quad \sigma_y^2 = \frac{701}{19} = 36.89$$

$$X_2 = \frac{100}{10} = 1.0 \quad Y_2 = \frac{50}{10} = 5\% \quad \sigma_{xy} = \frac{14.6}{19} = 0.768$$

$$dx = 0.4$$

$$dy = 9\%$$

$$a = \frac{\sigma_y^2 \cdot dx - \sigma_{xy} \cdot dy}{\sigma_x^2 \cdot \sigma_y^2 - \sigma_{xy} \cdot \sigma_{xy}} = \frac{36.89 \times 0.4 - 0.768 \times 9}{0.082 \times 36.89 - 0.768 \times 0.768} = \frac{14.756 - 6.912}{3.025 - 0.590}$$

$$= \frac{7.844}{2.435} = 3.221$$

$$b = \frac{\sigma_x^2 \cdot dy - \sigma_{xy} \cdot dx}{\sigma_x^2 \cdot \sigma_y^2 - \sigma_{xy} \cdot \sigma_{xy}} = \frac{0.082 \times 9.0 - 0.768 \times 0.4}{0.082 \times 36.89 - 0.768 \times 0.768}$$

$$= \frac{0.431}{2.435} = 0.177$$

The discriminant function is:

$$Z_i = 3.221X_i + 0.177 Y_i$$

MINICASE 2

Somnath, Finance Director of Apex Electronics, was looking at ways and means of improving credit evaluation of the potential customers of Apex.

He called Ravi, a product of a premier business school from Australia, who joined the finance department of Apex recently, for a discussion.

Ravi showed Somnath a project on discriminant analysis that he had done as part of his graduate studies in business. In that project Ravi had considered four independent variables.

Somnath thought that Apex could also use discriminant analysis. However, to begin with he felt that a discriminant model with two independent variables may be used. Ravi concurred with this view.

Somnath and Ravi discussed this issue with the finance team of Apex. The consensus view that emerged during the discussion was that the most appropriate ratios would be

- (i) ROE (PAT/Net worth) and
- (ii) Current Ratio (Current Assets / Current Liabilities). The group felt that a linear discriminant function of these two ratios would be helpful in discriminating between the 'good' and 'bad' accounts.

Ravi gathered information on 20 accounts, 10 'good' and 10 'bad' which is given below. A 'good' account is an account which pays within the stipulated credit period and a 'bad' account is an account which does not pay within the stipulated period.

Account Number	Good Accounts		Account Number	Bad Accounts	
	X_i ROE	Y_i Current ratio		X_i ROE	Y_i Current ratio
1	18%	1.50	11	-5%	1.10
2	15%	1.80	12	8%	1.20
3	13%	1.20	13	9%	0.90
4	20%	1.30	14	6%	1.10
5	12%	1.40	15	11%	1.00
6	9%	1.10	16	5%	1.40
7	16%	1.60	17	10%	1.10
8	14%	1.20	18	7%	1.20
9	6%	1.50	19	-6%	1.10
10	25%	1.10	20	4%	1.20

Required: Estimate the discriminant function that best discriminates between the ‘good’ and ‘bad’ accounts.

Solution:

Account Number	X_i	Y_i	$X_i - X$	$Y_i - Y$	$(X_i - X)^2$	$(Y_i - Y)^2$	$(X_i - X)(Y_i - Y)$
1	18	1.5	8.15	0.25	66.4225	0.0625	2.0375
2	15	1.8	5.15	0.55	26.5225	0.3025	2.8325
3	13	1.2	3.15	-0.05	9.9225	0.0025	-0.1575
4	20	1.3	10.15	0.05	103.0225	0.0025	0.5075
5	12	1.4	2.15	0.15	4.6225	0.0025	0.3225
6	9	1.1	-0.85	-0.15	0.7225	0.0225	0.3225
7	16	1.6	6.15	0.35	37.8225	0.1225	2.1525
8	14	1.2	4.15	-0.05	17.2225	0.0025	-0.2075
9	6	1.5	-3.85	0.25	14.8225	0.0625	-0.9625
10	25	1.1	15.15	-0.15	229.5225	0.0225	-2.2725
11	-5	1.1	-14.85	-0.15	220.5225	0.0225	2.2275
12	8	1.2	-1.85	-0.05	3.4225	0.0025	0.0925
13	9	0.9	-0.85	-0.35	0.7225	0.1225	0.2975
14	6	1.1	-3.85	-0.15	14.8225	0.0225	0.5775
15	11	1.0	1.15	-0.25	1.3225	0.0625	-0.2875
16	5	1.4	-4.85	0.15	23.5225	0.0225	-0.7275
17	10	1.1	0.15	-0.15	0.0225	0.0225	-0.0225
18	7	1.2	-2.85	-0.05	8.12	0.0025	0.1425
19	-6	1.1	-15.85	-0.15	251.2225	0.0225	2.3775
20	4	1.2	-5.85	-0.05	34.2225	0.0025	0.2925
197	$\bar{Y} = 25$				$\sum(X_i - \bar{X})^2 = 1068.55$	0.93	9.35

$$\begin{array}{l}
\sum X = 197 \\
\frac{197}{20} = 9.85 \\
\sum X_1 = 148 \\
\frac{148}{10} = 14.8 \\
\sum X_2 = 49 \\
\frac{49}{10} = 4.9
\end{array}
\qquad
\begin{array}{l}
\sum Y = 25 \\
\frac{25}{20} = 1.25 \\
\sum Y_1 = 13.7 \\
\frac{13.7}{10} = 1.37 \\
\sum Y_2 = 11.3 \\
\frac{11.3}{10} = 1.13
\end{array}
\qquad
\begin{array}{l}
\sum (X_1 - X) = 1,068.55 \\
\sigma_x^2 = \frac{\sum (X_1 - X)}{1 - n} \\
= \frac{1068.55}{19} \\
= 56.2395 \\
\sum (Y_1 - Y) = 0.93 \\
\sigma_y^2 = \frac{0.93}{19} \\
= 0.0489
\end{array}$$

$$\begin{array}{l}
d_x = X_1 - X_2 \\
= 14.8 - 4.9 \\
= 9.9 \\
dy = Y_1 - Y_2 \\
= 1.37 - 1.13 \\
= 0.24
\end{array}$$

$$\begin{array}{l}
\sum (X_1 - X) (Y_1 - Y) = 9.35 \\
\sigma_{xy} = \frac{9.35}{19} = 0.4921
\end{array}$$

$$\begin{array}{l}
a = \frac{\sigma_y^2 dx - \sigma_{xy} dy}{\sigma_x^2 \sigma_y^2 - \sigma_{xy}^2} = \frac{0.0489 \times 9.9 - 0.4921 \times 0.24}{56.2395 \times 0.0489 - 0.4921 \times 0.4921} \\
= \frac{0.3660}{2.5079} = 0.1459
\end{array}$$

$$\begin{array}{l}
b = \frac{\sigma_x^2 dy - \sigma_{xy} dx}{\sigma_x^2 \sigma_y^2 - \sigma_{xy}^2} = \frac{56.2395 \times 0.24 - 0.4921 \times 9.9}{56.2395 \times 0.0489 - 0.4921 \times 0.4921} \\
= \frac{8.62569}{2.5079} = 3.4394
\end{array}$$

Discriminant function

$$Z = 0.1459X_i + 3.4394Y_i$$

MINICASE 3

Ram Kumar, the CFO of Impex Limited, was discussing with Sreedhar, a senior financial analyst in the company, the problem of judging the creditworthiness of the various customers of Impex Limited.

Sreedhar suggested that discriminant analysis may be used for credit evaluation purposes. Ram Kumar concurred with this suggestion.

Ram Kumar and Sreedhar felt that the two ratios that are likely to be most helpful in discriminating between the 'good' and 'bad' accounts are (i) earning power (PBIT/Capital employed) and (ii) quick ratio (Quick assets / Current liabilities).

Sreedhar gathered information on 18 accounts, 10 'good' and 8 'bad' which is given below. A 'good' account is an account which pays within the stipulated credit period and a 'bad' account is an account which does not pay within the stipulated credit period.

<i>Account Number</i>	<i>Good Accounts</i>		<i>Account Number</i>	<i>Bad Accounts</i>	
	<i>Earning power</i> X_i	<i>Quick ratio</i> Y_i		<i>Earning power</i>	<i>Quick ratio</i>
1	16%	0.70	11	6%	0.70
2	20	0.80	12	9	0.80
3	17	1.00	13	4	0.60
4	12	0.90	14	-5	0.80
5	14	0.70	15	2	0.60
6	13	1.00	16	10	0.70
7	7	0.90	17	8	0.50
8	15	1.10	18	7	0.90
9	10	0.90			
10	15	0.80			

Required: Estimate the discriminant function which best discriminates between the 'good' and the 'bad' applicants.

Solution:

Number	X_i	Y_i	$X_i - \bar{X}$	$Y_i - \bar{Y}$	$(X_i - \bar{X})^2$	$(Y_i - \bar{Y})^2$	$\Sigma(X_i - \bar{X})(Y_i - \bar{Y})$
1	16%	0.70	6	-0.10	36	0.01	-0.6
2	20	0.80	10	0	100	0	0
3	17	1.00	7	0.20	49	0.04	1.4
4	12	0.90	2	0.1	4	0.01	0.2
5	14	0.70	4	-0.1	16	0.01	-0.4
6	13	1.00	3	0.2	9	0.04	0.6
7	7	0.90	-3	0.1	9	0.01	-0.3
8	15	1.10	5	0.3	25	0.09	1.5
9	10	0.90	0	0.1	0	0.01	0
10	15	0.80	5	0	25	0	0
11	6	0.70	-4	-0.1	16	0.01	0.4
12	9	0.80	-1	0	1	0	0
13	4	0.60	-6	-0.2	36	0.04	1.2
14	-5	0.80	-15	0	225	0	0
15	2	0.60	-8	-0.2	64	0.04	1.6
16	10	0.70	0	-0.1	0	0.01	0
17	8	0.50	-2	-0.3	4	0.09	0.6
18	7	0.90	-3	0.1	9	0.01	-0.3
	$\Sigma X_i = 180$ $\bar{X}_i = 10$	$\Sigma Y_i = 14.4$ $\bar{Y}_i = 0.8$			$\Sigma(X_i - \bar{X})^2$ $= 628$	$\Sigma(Y_i - \bar{Y})^2$ $= 0.42$	$\Sigma(X_i - \bar{X})(Y_i - \bar{Y})$ $= 5.9$

$$\bar{X}_1 = \frac{139}{10} = 13.9\% \quad \bar{Y}_1 = \frac{8.8}{10} = 0.88$$

$$\sigma_x^2 = \frac{628}{17} = 36.94$$

$$\sigma_{xy} = \frac{1}{17} \times 5.9 = 0.347$$

$$\bar{X}_2 = \frac{41}{8} = 5.1\% \quad \bar{Y}_2 = \frac{5.6}{8} = 0.70$$

$$d_x = 8.8 \quad d_y = 0.18$$

$$\sigma_y^2 = \frac{0.42}{17} = 0.025$$

$$a = \frac{\sigma_y^2 \cdot d_x - \sigma_{xy} \cdot d_y}{\sigma_x^2 \cdot \sigma_y^2 - \sigma_{xy} \cdot \sigma_{xy}}$$

$$= \frac{0.025 \times 8.8 - 0.347 \times 0.18}{36.94 \times 0.025 - 0.347 \times 0.347}$$

$$36.94 \times 0.025 - 0.347 \times 0.347$$

Contd.

$$a = \frac{0.22 - 0.06246}{0.9235 - 0.1204}$$

$$= \frac{0.15754}{0.8031}$$

$$= 0.196$$

$$b = \frac{\sigma_x^2 \cdot d_y - \sigma_{xy} \cdot d_x}{\sigma_x^2 \cdot \sigma_y^2 - \sigma_{xy} \cdot \sigma_{xy}}$$

$$= \frac{36.94 \times 0.18 - 0.347 \times 8.8}{36.94 \times 0.025 - 0.347 \times 0.347}$$

$$= \frac{6.6494 - 3.0536}{0.8031}$$

$$= 4.4774$$

$$Z = aX_i + bY_i \\ = 0.196X_i + 4.4774Y_i$$

CHAPTER 29

1. Primtech Limited has a Rs.2,000 million 11 percent (coupon rate) bond issue outstanding which has 4 years of residual maturity. The bonds were issued four years ago at par for Rs.2,000 million and Primtech incurred flotation costs of Rs.48 million which are being amortised for tax purposes at the rate of Rs.6 million per year. If the bonds are called, the amortised portion of the flotation costs (Rs.24.0 million) can be deducted for tax purposes. Primtech's tax rate is 30 percent. Primtech can call the bonds for Rs.2100 million. Assume that the call premium of Rs.100 million can be treated as a tax-deductible expense. Primtech has been advised by its merchant bankers that the firm can issue Rs.2,000 million of new bonds at an interest rate of 9 percent and use the proceeds for refunding the old bonds. The new issue will have a maturity of 4 years and involve a flotation cost of Rs.40 million, which can be amortised in 4 equal instalments for tax purposes.

- (i) What will be the initial outlay?

Solution:

(a) Cost of calling the old bonds	
Face value	Rs.2000 million
Call premium	<u>100 million</u>
	<u>2100 million</u>
(b) Net proceeds of the new issue	
Gross proceeds	Rs.2000 million
- Issue cost	<u>40 million</u>
	<u>1960 million</u>
(c) Tax savings on tax-deductible expenses	Rs. 37.2 million
Tax rate [Call premium + Unamortised issue costs on old bonds]	
0.30 [100 + 24]	
(d) Initial outlay: (a) – (b) – (c)	Rs.102.8 million

(ii) What will be the annual net cash savings?

Solution:

(a) Annual net cash outflow on old bonds	
Interest expense	220
- Tax savings on interest expense and amortisation of issue expenses 0.3 (220 + 6)	67.8
	152.2
(b) Annual net cash outflow on new bonds	
Interest expense	180
- Tax saving on interest expense and amortisation of issue expenses : 0.3 (180 + 10)	57
	123.0
(c) Annual net cash savings: (a) – (b)	29.2

(iii) What is the NPV of refunding the bond?

Solution:

Present value of annual net cash savings:	$0.09 (1 - 0.3) = 0.063$
$29.2 \times \text{PVIFA}_{(0.063, 4 \text{ yrs})}$	$\text{PVIFA}_{(0.063, 4 \text{ yrs})}$
$= 29.2 \times 3.441 = 100.48$	$\frac{1 - [1/(1.063)]^4}{0.063} = 3.441$
- Initial outlay = <u>102.80</u>	
- 2.32	

2. Sanofi Limited has a Rs.1200 million, 11 percent (coupon rate) bond issue outstanding which has 4 years residual maturity. The bonds were issued 4 years ago at par for Rs.1200 million and Sanofi incurred floatation costs of Rs.30 million which are being amortised for tax purposes at the rate of Rs.3.75 million per year. If the bonds are called, the unamortised portion of the floatation costs (Rs.15.0 million) can be deducted for tax purposes. Sanofi's tax rate is 30 percent. Sanofi can call the bonds for Rs.1266 million. Assume that the call premium of Rs.66 million can be treated as a tax-deductible expense. Sanofi has been advised by its merchant bankers that due to fall in interest rates, the firm can issue Rs.1200 million of new bonds at an interest rate of 8 percent and use the proceeds for refunding of old bonds. The new issue will have a maturity of 4 years and involve a floatation cost of Rs. 24 million, which can be amortised in 4 equal annual instalments for tax purposes.

(i) What will be the initial outlay?

Solution:

(a) Cost of calling the old bonds	
Face Value	Rs. 1200 million
Call premium	66 million
	1266 million
(b) Net proceeds of the new issue	
Gross Proceeds	Rs. 1200 million
- Issue costs	24 million
	Rs. 1176 million
(c) Tax savings on tax-deductible expenses	24.3 million
Tax rate [Call premium + Unamortised issue costs on old bonds]	
0.30 [66 + 15]	
(d) Initial outlay: (a) – (b) – (c)	= Rs. 65.7 million

(ii) What will be the annual net cash savings?

Solution:

(a) Annual net cash outflow on old bonds	132.000
Interest expense	
- Tax savings on interest expense and amortisation	40.725
of issue expenses $0.30 (132 + 3.75) =$	91.275
(b) Annual net cash outflow on new bonds	96.000
Interest expense	
- Tax saving on interest expense and amortisation	30.600
of issue expenses $0.30 (96 + 6)$	65.400
(c) Annual net cash savings (a) – (b) million	25.875

(iii) What is the NPV of refunding the bond?

Solution:

Present value of annual net cash savings:	$r_d (1 - t) = .08 (1 - .30)$
	$= .056$
$= 25.875 \times 3.4971 = 90.487$ million	
- Initial outlay	$= -65.7$ million
	$= 24.787$ million
	$PVIFA_{4.55\% \ 6 \ yrs} = \frac{1 - \frac{1^4}{(1.056)^6}}{.056}$
	$= 3.4971$

3. Synex Limited has a Rs.1000 million, 10 percent (coupon rate) bond issue outstanding which has 5 years residual maturity. The bonds were issued 3 years ago at par for Rs.1000 million and Synex incurred flotation costs of Rs.24 million which are being amortised for tax purposes at the rate of Rs.3.0 million per year. If the bonds are called, the unamortised portion of the flotation costs (Rs.15.0 million) can be deducted for tax purposes. Synex's tax rate is 35 percent. Synex can call the bonds for Rs.1060 million. Assume that the call premium of Rs.60 million can be treated as a tax-deductible expense.

Synex has been advised by its merchant bankers that due to fall in interest rates the firm can issue Rs.1000 million of new debt at an interest rate of 7 percent and use the proceeds for refunding of old bonds. The new issue will have a maturity of 5 years and involve a floatation cost of Rs. 20 million, which can be amortised in 5 equal annual installments for tax purposes.

(i) What will be the initial outlay?

Solution:

(a) Cost of calling the old bonds	
Face value	Rs.1000 million
Call premium	<u>60 million</u>
	<u>1060 million</u>
(b) Net proceeds of the new issue	
Gross proceeds	Rs.1000 million
- Issue cost	<u>20 million</u>
	<u>980 million</u>
(c) Tax savings on tax-deductible expenses	Rs.26.25 million
Tax rate [Call premium + Unamortised issue costs on old bonds]	
0.35 [60 + 15]	
(d) Initial outlay: (a) – (b) – (c)	Rs.53.75 million

(ii) What will be the annual net cash savings?

Solution:

(a) Annual net cash outflow on old bonds	
Interest expense	100
- Tax savings on interest expense and amortisation of issue expenses 0.35 (100 + 3)	36.05
	<u>63.95</u>
(b) Annual net cash outflow on new bonds	
Interest expense	70
- Tax saving on interest expense and amortisation of issue expenses : 0.35 (70 + 4)	25.9
	<u>44.1</u>
(c) Annual net cash savings : (a) – (b)	19.85

Present value of annual net cash savings: $0.07 (1 - 0.35) = 0.0455$

$$19.85 \times \text{PVIFA}_{(0.0455, 5 \text{ yrs})}$$

$$\text{PVIFA} = \frac{\left(\frac{1}{1.0455} \right)^5}{0.0455} = 4.384$$

(iii) What is the NPV of refunding the bond?

Solution:

$$\begin{aligned} &= 19.85 \times 4.384 = 87.02 \\ &- \text{Initial outlay} = \frac{53.75}{33.27} \end{aligned}$$

Rs.33.27 million.

4. Consider the following data for government securities:

<u>Face value</u>	<u>Interest rate</u>	<u>Maturity (years)</u>	<u>Current price</u>
Rs. 100,000	0	1	95,000
Rs. 100,000	7 %	2	99,500
Rs. 100,000	7 %	3	99,200

What is the forward rate for year 3(r_3)?

Solution:

$$\frac{100,000}{(1 + r_1)} = 95,000 \Rightarrow r_1 = 5.26 \%$$

$$99,500 = \frac{7,000}{(1.0526)} + \frac{107,000}{(1.0526)(1 + r_2)} \Rightarrow r_2 = 9.48 \%$$

$$99,200 = \frac{7,000}{(1.0526)} + \frac{7,000}{(1.0526)(1.0948)} + \frac{107,000}{(1.0526)(1.0948)(1+r_3)}$$

$$\Rightarrow r_3 = 7.37 \%$$

5. Consider the following data for government securities:

<u>Face value</u>	<u>Interest rate (%)</u>	<u>Maturity (years)</u>	<u>Current price</u>
100,000	0	1	94,250
100,000	6%	2	99,500
100,000	7%	3	100,500

What is the forward rate for year 3(r_3)?

Solution:

$$\frac{100,000}{(1+r_1)} = 94,250 \quad \Rightarrow \quad r_1 = 6.10\%$$

$$99,500 = \frac{6,000}{(1.0610)} + \frac{106,000}{(1.061)(1+r_2)} \quad \Rightarrow \quad r_2 = 6.46\%$$

$$100,500 = \frac{7,000}{(1.061)} + \frac{7,000}{(1.061)(1.0646)} + \frac{107,000}{(1.061)(1.0646)(1+r_3)}$$

$$\Rightarrow \quad r_3 = 8.01\%$$

6. Consider the following data for government securities:

<u>Face value</u>	<u>Interest rate</u>	<u>Maturity (years)</u>	<u>Current price</u>
100,000	-	1	94,800
100,000	6%	2	99,500
100,000	7%	3	100,500

What is the forward rate for year 3(r_3)?

Solution:

$$\frac{100,000}{(1+r_1)} = 94,800 \quad \Rightarrow \quad r_1 = 5.49\%$$

$$99,500 = \frac{6,000}{(1.0549)} + \frac{106,000}{(1.0549)(1+r_2)} \quad \Rightarrow \quad r_2 = 7.11\%$$

$$100,500 = \frac{7,000}{(1.0549)} + \frac{7,000}{(1.0549)(1.0711)} + \frac{107,000}{(1.0549)(1.0711)(1+r_3)}$$

$$\Rightarrow \quad r = 8.01\%$$

7. Consider three bonds, A, B and C

	<i>Bond A</i>	<i>Bond B</i>	<i>Bond C</i>
Face value	1,000	1,000	100
Coupon (interest rate) payable annually	12 percent	13 percent	14 percent
Years to maturity	5	6	7
Redemption value	1,000	1,000	100
Current market price	Rs.900	Rs.850	92

What are the (a) yields to maturity (use the approximate formula) (b) durations, and (c) volatilities of these bonds?

Solution:

a)

Yield to maturity of bond A, using the approximate formula, is

$$= \frac{120 + (1000 - 900)/5}{0.4 \times 1000 + 0.6 \times 900} = 14.89 \%$$

Yield to maturity of bond B, using the approximate formula, is

$$= \frac{130 + (1000 - 850)/6}{0.4 \times 1000 + 0.6 \times 850} = 17.03 \%$$

Yield to maturity of bond C, using the approximate formula, is

$$= \frac{14 + (100 - 92)/7}{0.4 \times 100 + 0.6 \times 92} = 15.91 \%$$

(b) Duration of bond A is calculated as under:

Solution:

Year	Cash flow	Present value at 14.89 percent	Proportion of the bond's value	Proportion of the bond's value x time
1	120	104.45	0.116	0.116
2	120	90.91	0.101	0.201
3	120	79.13	0.088	0.263
4	120	68.87	0.076	0.305
5	1120	559.51	0.620	3.099
	Sum =	902.87	Duration =	3.98 years

Duration of bond B is calculated as under:

Year	Cash flow	Present value at 17.03 percent	Proportion of the bond's value	Proportion of the bond's value x time
1	130	111.08	0.130	0.130
2	130	94.92	0.111	0.222
3	130	81.11	0.095	0.284
4	130	69.30	0.081	0.324
5	130	59.22	0.069	0.346
6	1130	439.84	0.514	3.085
	Sum =	855.47	Duration=	4.39 years

Duration of bond C is calculated as under:

Year	Cash flow	Present value at 15.91 percent	Proportion of the bond's value	Proportion of the bond's value x time
1	14	12.08	0.131	0.131
2	14	10.42	0.113	0.226
3	14	8.99	0.097	0.292
4	14	7.76	0.084	0.336
5	14	6.69	0.073	0.363
6	14	5.77	0.063	0.375
7	114	40.56	0.440	3.077
	Sum =	92.27	Duration=	4.8 years

c)

$$\frac{\text{Volatility of bond A}}{1.1489} = 3.47$$

$$\frac{\text{Volatility of bond B}}{1.1703} = 3.75$$

$$\frac{\text{Volatility of bond C}}{1.1591} = 4.14$$

CHAPTER 30

- Optex Limited has decided to go for an equipment costing Rs. 60 million. Optex is considering two alternatives: (i) leasing the equipment, and (ii) borrowing and purchasing the equipment. GT capital is willing to lease the equipment to Optex for an annual lease rental of Rs.16 million for 5 years, the lease rental being payable in arrears. There is a management fees of Rs.1 million payable on signing the lease contract.

The tax relevant depreciation rate on the equipment is 25 percent as per the WDV method. The net salvage value of the equipment after five years is expected to be Rs.14 million. Optex has an effective tax rate of 30 percent and its post- tax cost of debt is 7 percent.

What is the net advantage of leasing (NAL) for Optex?

Solution:

		Rs. in million					
		0	1	2	3	4	5
1.	Cost of plant	+60.00					
2.	Management fee	-1.00					
3.	Tax shield on Management fee	0.30					
4.	Depreciation		15.000	11.250	8.438	6.328	4.746
5.	Loss of depreciation tax shield		-4.500	-3.375	-2.531	-1.898	-1.424
6.	Lease payment		-16.000	-16.000	-16.000	-16.000	-16.000
7.	Tax shield on lease payment		4.800	4.800	4.800	4.800	4.800
8.	Loss of salvage value						-14.000
9.	Cash flow of lease (1) + (2) + (3) + (5) + (6) + (7) + (8)	+59.3	-15.700	-14.575	-13.731	-13.098	-26.624
10.	Present value factors	1.000	0.935	0.873	0.816	0.763	0.713
11.	Present value Of (9)	+59.3	-14.680	-12.724	-11.204	-9.994	-18.983
NAL of leasing		59.3	-14.680	-12.724	-11.204	-9.994	-18.983
				= -8.285			

2. Prajay Limited has decided to go for a pollution control equipment costing Rs. 50 million. Prajay is considering two alternatives: (i) leasing the equipment, and (ii) borrowing and purchasing the equipment. GE capital is willing to lease the equipment to Prajay for an annual lease rental of Rs.13.2 million for 5 years, the lease rental being payable in arrears. There is a management fees of Rs. 1 million payable on signing the lease contract.

The tax relevant depreciation rate on the equipment is 25 percent as per the WDV method. The net salvage value of the equipment after five years is expected to be Rs.10.5 million. Prajay has an effective tax rate of 35 percent and its post- tax cost of debt is 6 percent.

What is the net advantage of leasing (NAL) for Prajay?

Solution:

	0	1	2	3	4	5
1. Cost of plant	+50.000					
2. Management fee	-1.000					
3. Tax shield on Management fee	0.350					
4. Depreciation		12.500	9.375	7.031	5.273	3.955
5. Loss of depreciation tax shield		-4.375	-3.281	-2.461	-1.846	-1.384
6. Lease payment		-13.200	-13.200	-13.200	-13.200	-13.200
7. Tax shield on lease payment		4.620	4.620	4.620	4.620	4.620
8. Loss of salvage value						-10.500
9. Cash flow of lease (1) + (2) + (3) + (5) + (6) + (7) + (8)	+49.350	-12.955	-11.861	-11.041	-10.426	-20.464
10. Present value of factor	1.000	0.943	0.890	0.840	0.792	0.747
11. Present value of (9)	+49.350	-12.217	-10.556	-9.274	-8.257	-15.287
NAL of leasing	49.350	-12.217	-10.556	-9.274	-8.257	-15.287
						= -6.241

3. Sanjeev Limited has decided to go for an air conditioning plant costing Rs. 40 million. Sanjeev Limited is considering two alternatives: (i) leasing the plant, and (ii) borrowing and purchasing the plant. GM capital is willing to lease the plant to Sanjeev Limited for an annual lease rental of Rs.10.8 million for 5 years, the lease rental being payable in arrears.

The tax relevant depreciation rate on the plant is 25 percent as per the WDV method. The net salvage value of the plant after five years is expected to be Rs.8.5 million. Sanjeev Limited has an effective tax rate of 35 percent and its post-tax cost of debt is 7 percent.

What is the net advantage of leasing (NAL) for Sanjeev Limited?

Solution:

	0	1	2	3	4	5
1. Cost of plant	+40000					
2. Depreciation		10.000	7.500	5.625	4.219	3.164
3. Loss of depreciation tax shield		-3.500	-2.625	-1.969	-1.477	-1.107
4. Lease payment		-10.800	-10.800	-10.800	-10.800	-10.800
5. Tax shield on lease payment		3.780	3.780	3.780	3.780	3.780
6. Loss of salvage value						-8.500
7. Cash flow of lease (1) +(3) + (4) + (5) + (6)	+40.000	-10.520	-9.645	-8.989	-8.497	-16.627
8. Present value factor	1.000	0.935	0.873	0.816	0.763	0.713
9. Present value of (7)	40.000	-9.836	-8.420	-7.335	-6.483	-11.855
NAL of Leasing	40.000	-9.836	-8.420	-7.335	-6.483	-11.855
		= -3.929				

4. Shiva Industries requires an asset costing Rs.3 million. Genuine Finance offers a hire-purchase proposal for a period of 3 years at a flat interest of 14 per cent.

Genuine also gives a lease proposal wherein the lease rental would be Rs.320 per Rs.1,000 per year for the first 5 years (primary period) and Rs.30,000 per year for the next 5 years (secondary period). Thereafter, the asset would revert to Genuine.

The depreciation rate on the asset is 25 per cent (WDV) and its net salvage value after 10 years would be Rs.350,000. Shiva has a tax rate of 35 percent and its post-tax cost of debt is 9 percent. Should Shiva choose the hire-purchase or the leasing option?

Solution:

Under the hire purchase proposal the total interest payment is

$$3,000,000 \times 0.14 \times 3 = \text{Rs. } 1,260,000$$

The interest payment of Rs. . 1,260,000 is allocated over the 3 years period using the sum of the years digits method as follows:

<u>Year</u>	<u>Interest allocation</u>	
1	$\frac{366}{666}$	x Rs. . 1,260,000 = Rs.692,432
2	$\frac{222}{666}$	x Rs. . 1,260,000 = Rs.420,000
3	$\frac{78}{666}$	x Rs. . 1,260,000 = Rs.147,568

The annual hire purchase installments will be:

$$\frac{\text{Rs.}3,000,000 + \text{Rs.} . 1,260,000}{3} = \text{Rs.}1,420,000$$

The annual hire purchase installments would be split as follows

<i>Year</i>	<i>Hire purchase installment</i>	<i>Interest</i>	<i>Principal repayment</i>
1	Rs. 1,420,000	Rs. 692,432	Rs.727,568
2	Rs. 1,420,000	Rs. 420,000	Rs. 1,000,000
3	Rs. 1,420,000	Rs. 147,568	Rs. 1,272,432

The lease rental will be as follows:

Rs. 960,000 per year for the first 5 years

Rs. 30,000 per year for the next 5 years

The cash flows of the leasing and hire purchase options are shown below

<i>Year</i>	<i>Leasing</i> $-LR_t(1-t_c)$	<i>Hire Purchase</i>			$-I_t(1-t_c)-PR_t + D_t(t_c)+NSV_t$
		$-I_t(1-t_c)$	$-PR_t$	$D_t(t_c)$	NSV_t
1	-960,000(1-.35)=-624,000	-692,432 (1-.35)	-727,568	750,000(0.35)	-915,149
2	-960,000(1-.35)=-624,000	-420,000 (1-.35)	-1,000,000	562,500(0.35)	-1,076,125
3	-960,000(1-.35)=-624,000	-147,568 (1-.35)	-1,272,432	421,875(0.35)	-1,220,695
4	-960,000(1-.35)=-624,000			316,406(0.35)	110,742
5	-960,000(1-.35)=-624,000			237,305(0.35)	83,057
6	- 30,000(1-.35)= - 19,500			177,979(0.35)	62,293
7	- 30,000(1-.35)= - 19,500			133,484(0.35)	46,719
8	- 30,000(1-.35)= - 19,500			100,113(0.35)	35,040
9	- 30,000(1-.35)= - 19,500			75,085(0.35)	26,280
10	- 30,000(1-.35)= - 19,500			56,314(0.35)	350,000 369,710

Present value of the leasing option

$$\begin{aligned}
 &= - \sum_{t=1}^5 \frac{624,000}{(1.09)^t} - \sum_{t=6}^{10} \frac{19,500}{(1.09)^t} \\
 &= -624,000 \text{ PVIFA}(9\%,5\text{yrs}) - 19,500 \text{ PVIFA}(9\%,5\text{yrs}) \text{ PVIF}(9\%,5\text{yrs}) \\
 &= -624,000 \times 3.890 - 19,500 \times 3.890 \times 0.650 \\
 &= -2,427,360 - 49,306 = -2,476,666
 \end{aligned}$$

Present value of the hire purchase option

$$\begin{aligned}
 &= -915,149/(1.09) - 1,076,125/(1.09)^2 - 1,220,695/(1.09)^3 + 110,742/(1.09)^4 + 83,057/(1.09)^5 \\
 &+ 62,293/(1.09)^6 + 46,719/(1.09)^7 + 35,040/(1.09)^8 + 26,280/(1.09)^9 + 369,710/(1.09)^{10} \\
 &= -2,306,951
 \end{aligned}$$

Since the hire purchase option costs less than the leasing option, Shiva should choose the hire purchase option .

CHAPTER 31

1. Consider the following data:

- Number of shares outstanding : 80 million
- Current stock price : Rs 60
- Ratio of warrants issued to the number of outstanding shares : 0.05
- Exercise price : Rs 30
- Time to expiration of warrant : 3 years
- Annual standard deviation of stock price changes : 0.40
- Interest rate : 12 percent

What is the value of a warrant? Ignore the complication arising from dividends and/or dilution.

Solution:

$$\begin{aligned}
 d_1 &= \frac{1(S/E) + (r + \sigma^2/2) t}{\sigma \sqrt{t}} \\
 &= \frac{L_r (60 / 30) + [0.12 + (0.4)^2/2]3}{0.4(3)^{1/2}} \\
 &= \frac{0.6931 + 0.6}{0.6928} \\
 &= 1.8665 \\
 d_2 &= d_1 - \sigma \sqrt{t} \\
 &= 1.8665 - 0.6928 \\
 &= 1.1737 \\
 N(d_1) &= N(1.8665).
 \end{aligned}$$

From the tables we have $N(1.85) = 1 - 0.0322 = 0.9678$ and

$$N(1.90) = 1 - 0.0287 = 0.9713$$

By linear extrapolation, we get

$$\begin{aligned} N(1.8665) &= 0.9678 + (1.8665 - 1.8500)(0.9713 - 0.9678)/0.05 \\ &= 0.9678 + 0.001155 = 0.9690 \end{aligned}$$

$$N(d_2) = N(1.1737)$$

From the tables we have $N(1.15) = 1 - 0.1251 = 0.8749$

$$N(1.20) = 1 - 0.1151 = 0.8849$$

By linear extrapolation, we get

$$\begin{aligned} N(1.1737) &= 0.8749 + (1.1737 - 1.1500)(0.8849 - 0.8749)/0.05 \\ &= 0.8749 + 0.00474 = 0.8796 \end{aligned}$$

$$E/e^{rt} = 30/1.4333 = 20.93$$

$$C = S_0 N(d_1) - E \cdot e^{-rt} \cdot N(d_2)$$

$$= 60 \times 0.9690 - 20.93 \times 0.8796 = 39.73$$

Value of the warrant is Rs. 39.73.

2. Vishal Enterprises has just issued warrants. The following data is available:

- Number of shares outstanding = 60 million
- Current stock price = Rs 70
- Ratio of warrants issued to the number of outstanding shares = 8 percent
- Exercise price = Rs 40
- Time to expiration of warrants = 4 years
- Annual standard deviation of stock price changes = 30 percent
- Interest rate = 10 percent

What is the value of a warrant?

Solution:

$$\begin{aligned} d_1 &= \frac{1(S/E) + (r + \sigma^2/2) t}{\sigma \sqrt{t}} \\ &= \frac{L_n(70/40) + [0.10 + (0.3)^2/2]4}{0.3(4)^{1/2}} \\ &= \frac{0.5596 + 0.5800}{0.6} \\ &= 1.8993 \\ d_2 &= d_1 - \sigma \sqrt{t} \\ &= 1.8993 - 0.6 \\ &= 1.2993 \end{aligned}$$

$$N(d_1) = N(1.8993), \text{ which is very nearly equal to } N(1.90)$$

From the tables we have $N(1.90) = 1 - 0.0287 = 0.9713$

$$N(d_2) = N(1.2993), \text{ which is very nearly equal to } N(1.30)$$

From the tables we have $N(1.30) = 1 - 0.0968 = 0.9032$

$$E/e^{rt} = 40/1.4918 = 26.81$$

$$C = S_0 N(d_1) - E \cdot e^{-rt} \cdot N(d_2) \\ = 70 \times 0.9713 - 26.81 \times 0.9032 = 43.78$$

Value of the warrant is Rs. 43.78.

3. Shivalik Combines issues a partly convertible debenture for Rs 900, carrying an interest rate of 12 percent. Rs 300 will get compulsorily converted into two equity shares of Shivalik Combines a year from now. The expected price per share of Shivalik Combines's equity a year from now would be Rs 200. The non-convertible portion will be redeemed in three equal installments of Rs 200 each at the end of years 4, 5 and 6 respectively. The tax rate for Shivalik is 35 percent and the net price per share Shivalik would realise for the equity after a year would be Rs 180.
- (a) What is the value of convertible debenture? Assume that the investors' required rate of return on the debt component and the equity component are 12 percent and 16 percent respectively.
- (b) What is the post-tax cost of the convertible debenture to Shivalik ?

Solution:

- (a) No. of shares after conversion in one year = 2
 Value of the shares at the price of Rs.200 = $2 \times 200 = \text{Rs.}400$
 PV of the convertible portion at the required rate of 16% = $400/1.16 = \text{Rs.}344.82$

Payments that would be received from the debenture portion:

Year	Payments	PVIF _{12%,t}	PV
1	108	0.893	96.44
2	72	0.797	57.38
3	72	0.712	51.26
4	272	0.636	172.99
5	248	0.567	140.62
6	224	0.507	113.57
		Total=	632.26

Value of the convertible debenture = 344.82 + 632.26 = Rs. 977.08

(b)

The cash flow for Shivalik is worked out as under:

Year	Cash flow	
0		900
1	$=-360-108*(1-0.35)$	-430
2	$=-72*(1-0.35)$	-47
3	$=-72*(1-0.35)$	-47
4	$=-200-72*(1-0.35)$	-247
5	$=-200-48*(1-0.35)$	-232
6	$=-200-24*(1-0.35)$	-216

The post-tax cost of the convertible debenture to Shivalik is the IRR of the above cash flow stream.

Let us try a discount rate of 10 %. The PV of the cash flow will then be

$$= 900 - 430/(1.1) - 47/(1.1)^2 - 47/(1.1)^3 - 247/(1.1)^4 - 232/(1.1)^5 - 216/(1.1)^6$$

$$= 0.25 \text{ which is very near to zero.}$$

So the post-tax cost of the convertible debenture to Shivalik is 10%

4. Brilliant Limited issues a partly convertible debenture for 1000, carrying an interest rate of 10 percent. 360 will get compulsorily converted into two equity shares of Brilliant Limited a year from now. The expected price per share of Brilliant Limited's equity a year from now would be Rs 300. The non-convertible portion will be redeemed in four equal installments of Rs 160 each at the end of years 3, 4, 5 and 6 respectively. The tax rate for Brilliant is 33 percent and the net price per share Brilliant would realise for the equity after a year would be Rs 220.

- (a) What is the value of convertible debenture? Assume that the investors' required rate of return on the debt component and the equity component are 13 percent and 18 percent respectively.
- (b) What is the post-tax cost of the convertible debenture to Brilliant?

Solution:

- (a) No. of shares after conversion in one year = 2
 Value of the shares at the price of Rs.300 = 2 x 300 = Rs.600
 PV of the convertible portion at the required rate of 18% = 600/1.18 = Rs.508.47
 Payments that would be received from the debenture portion:

Year	Payments	PVIF _{13%,t}	PV
1	100	0.885	88.5
2	64	0.783	50.11
3	224	0.693	155.23
4	208	0.613	127.50
5	192	0.543	104.26
6	176	0.480	84.48
		Total=	610.08

Value of the convertible debenture = 508.47 + 610.08 = Rs. 1118.55

(b)

The cash flow for Brilliant is worked out as under:

Year	Cash flow	
0		1000
1	=-440-100*(1-0.33)	-361.80
2	=-64*(1-0.33)	-42.88
3	=-160-64*(1-0.33)	-202.88
4	=-160-48*(1-0.33)	-192.16
5	=-160-32*(1-0.33)	-181.4
6	=-160-16*(1-0.33)	-170.72

The post-tax cost of the convertible debenture to Brilliant is the IRR of the above cash flow stream.

Let us try a discount rate of 4 %. The PV of the cash flow will then be
 $= 1000 - 361.8/(1.04) - 42.88/(1.04)^2 - 202.88/(1.04)^3 - 192.16/(1.04)^4 - 181.4/(1.04)^5 - 170.72/(1.04)^6 = -16.17$

Trying a discount rate of 5 %. The PV of the cash flow will then be

$= 1000 - 361.8/(1.05) - 42.88/(1.05)^2 - 202.88/(1.05)^3 - 192.16/(1.05)^4 - 181.4/(1.05)^5 - 170.72/(1.05)^6 = 13.66$

By extrapolation, we have the IRR = $4 + 16.17/(16.17 + 13.66) = 4.54 \%$

So the post-tax cost of the convertible debenture to Brilliant is 4.54 %

CHAPTER 32

1. The profit and loss account and balance sheet of a company for two years (1 and 2) are given below. Assume a tax rate of 30 percent for year 2.

Profit and Loss Account	1	2
• Net sales	40,000	50,000
• Income from marketable securities	800	1,000
• Non-operating income	600	1,000
• Total income	41,400	52,000
• Cost of goods sold	25,000	30,000
• Selling and administrative expenses	6,000	7,200
• Depreciation	2,400	3,000
• Interest expenses	2,500	2,600
• Total costs and expenses	35,900	42,800
• PBT	5,500	9,200
• Tax provision	1,500	2,700
• PAT	4,000	6,500
• Dividends	1,400	1,800
• Retained earnings	2,600	4,700
Balance Sheet		
• Equity capital	6,000	6,000
• Reserves and surplus	10,000	14,700
• Debt	16,000	19,300
	32,000	40,000
• Fixed assets	20,000	24,500
• Investments (marketable securities)*	7,000	8,500
• Net current assets	5,000	7,000
	32,000	40,000
* All of this represents excess marketable securities		

- (i) What is the EBIT for year 2?

Solution:

Profit before tax	9200
+ Interest expense	+ 2600
- Interest income	- 1000
- Non – operating income	<u>- 1000</u>
	9,800

(ii) What is the tax on EBIT for year 2?

Solution:

Tax provision from profit and loss account	2700
+ Tax shield on interest expense	780
- Tax on interest income	- 300
- Tax on non - operating income	<u>- 300</u>
Tax on EBIT	2880

(iii) What is the FCFF for year 2?

Solution:

EBIT	9,800
- Tax on EBIT	- 2,880
- Net investment	- 6,500
+ Non – operating cash flow (1000 x 0.7)	700
	1120

(iv) Show the break-up of the financing flow

Solution:

After tax interest expense	1820
+ Cash dividend	+ 1800
+ Increase in borrowing	- 3300
+ Δ Excess marketable securities	+ 1500
- After tax income on excess marketable securities	- 700
	<u>1120</u>

2. The profit and loss account and balance sheet of a company for two years (1 and 2) are given below. Assume a tax rate of 30 percent for year 2.

Profit and Loss Account	1	2
• Net sales	30,000	35,000
• Income from marketable securities	600	1,000
• Non-operating income	400	800
• Total income	31,000	36,800
• Cost of goods sold	18,000	21,000
• Selling and administrative expenses	3,800	4,600
• Depreciation	1,900	2,200

• Interest expenses	1,700	1,600
• Total costs and expenses	25,400	29,400
• PBT	5,600	7,400
• Tax provision	1,400	1,900
• PAT	4,200	5,500
• Dividends	1,200	1,400
• Retained earnings	3,000	4,100
Balance Sheet		
• Equity capital	5,000	5,000
• Reserves and surplus	5,000	9,100
• Debt	15,000	14,900
	25,000	29,000
• Fixed assets	15,000	18,500
• Investments (marketable securities)*	5,000	6,500
• Net current assets	5,000	4,000
	25,000	29,000
* All of this represents excess marketable securities		

(i) What is the EBIT for year 2?

Solution:

Profit before tax	7400
+ Interest expense	+ 1600
- Interest income	- 1000
- Non – operating income	<u>- 800</u>
	7200

(ii) What is the tax on EBIT for year 2?

Solution:

Tax provision from income statement	1900
+ Tax shield on interest expense	480
- Tax on interest income	- 300
- Tax on non - operating income	<u>- 240</u>
Tax on EBIT	1840

(iii) What is the FCFF for year 2?

Solution:

EBIT	7200
- Tax on EBIT	- 1840
- Net investment	- 2500
+ Non – operating cash flow	+ 560
	3420

(iv) Show the break-up of the financing flow

Solution:

	Rs. in million
After tax interest expense	1120
+ Cash dividend	+ 1400
+ Reduction in borrowing	+ 100
+ Δ Excess marketable securities	+ 1500
- After tax income on excess marketable securities	- 700
	3420

3. The profit and loss account and the balance sheet for Magna Corporation for two years (year 1 and year 2) are given below :

Profit and Loss Account	1	2
• Net sales	16800	19320
• Income from marketable securities	420	630
• Non-operating income	210	420
• Total income	17430	20370

• Cost of goods sold	9660	11340
• Selling and administrative expenses	2100	2310
• Depreciation	1050	1260
• Interest expenses	1008	1176
• Total costs and expenses	13818	16086
• PBT	3612	4284
• Tax provision	1092	1344
• PAT	2520	2940
• Dividend	1260	1680
• Retained earnings	1260	1260
Balance Sheet		
	1	2
• Equity capital	6300	6300
• Reserves and surplus	5040	6300
• Debt	7560	8820
	18900	21420
• Fixed assets	12600	13650
• Investments	3780	4200
• Net current assets	2520	3570
	18900	21420

Assume that the tax rate is 40 percent.

(i) What is the EBIT (also called PBIT) for year 2?

Solution:

PBT	4284
+ Interest expense	+1176
- Interest income	- 630
- Non-operating income	- 420
	4410
	4410

(ii) What is the tax on EBIT for year 2 ?

Solution:

Tax provision from profit and loss account	1344
+ Tax shield on interest expense	+ 470.4
- Tax on interest income	- 252
- Tax on non-operating income	- 168
	<hr/>
Tax on EBIT	1394.4
	<hr/>

(iii) What is the NOPLAT for year 2 ?

Solution:

EBIT	4410
- Tax on EBIT	- 1394.4
	<hr/>
	3015.6
	<hr/>

(iv) What is the FCFF for year 2 ?

Solution:

NOPLAT	3015.6
- Net investment	-2100.0
+ Non-operating cash flow	252.0
	<hr/>
	1167.6
	<hr/>

4. Boldman Sachs, an investment banking firm, is engaged in valuing MLF Realty, a firm which specialises in the construction of housing and commercial complexes. MLF is currently riding a construction boom and is expected to grow at a healthy

rate for the next four years at least. Thereafter the growth rate is expected to decline rather gradually for a few years before it stabilises at a modest level

You have recently moved to Boldman Sachs after a few years of experience in another financial services firm. Your first assignment at Boldman Sachs is to value MLF. Based on extensive discussion with management and industry experts you have gathered the following information.

Base Year (Year 0) Information

• Revenues	Rs. 1400 crore
• EBIT (20 % of revenues)	Rs. 280 crore
• Capital expenditure	Rs. 350 crore
• Depreciation and amortisation	Rs. 266 crore
• Working capital as a percentage of revenues	20 percent
• Tax rate (come)	30 percent (for all time to come)

Inputs for the High Growth Period

• Length of the growth period	=	4 years
• Growth rate in revenues, depreciation, EBIT and capital expenditure	=	25 percent
• Working capital as a percentage of revenues	=	20 percent
• Cost of debt(pre-tax)	=	10 percent
• Debt – equity ratio	=	1.0
• Risk- free rate	=	7.4 percent
• Market risk premium	=	6 percent
• Equity beta	=	1.2667

Inputs for the Transition Period

• Length of the transition period	=	3 years
• Growth rate in revenues, depreciation, EBIT and Capital expenditures will decline from 25 percent in year 4 to 10 percent in year 7 in linear increments of 5 percent per year.		
• Working capital as a percentage of revenues	=	20 percent
• The cost of debt, debt-equity ratio, risk –free rate, market risk premium and equity beta will be the same as in the high growth period.		

Inputs for the Stable Growth Period

• Growth rate in revenues, EBIT, capital expenditure and depreciation	=	10 percent
• Working capital as a percentage of revenues	=	20 percent

- The cost of debt, risk-free rate and market risk premium will be the same as in the previous stages.
 - Debt-equity ratio = 2 : 3
 - Equity beta = 1.322
- a. What is the cost of capital in the three periods(high growth, transition, and stable)?

What value would you impute to MLF Realty using the DCF method?

Solution:

- a. WACC during the high growth and transit periods:

$$r_e = 7.4 + 6 \times 1.2667 = 15 \%$$

$$WACC = 0.5 \times 10 \times (1 - 0.30) + 0.5 \times 15 = 11 \%$$

WACC during the stable period:

$$r_e = 7.4 + 6 \times 1.322 = 15.332 \%$$

$$WACC = 2/5 \times 10 \times (1 - 0.30) + 3/5 \times 15.332 = 12 \%$$

- b.

Period	Growth Rate %	EBIT	EBIT (1-t)	CAPEX	Dep	CAPEX - DEP	WC	WC	FCFF	WACC (%)	PV
1	25	350	245	437.50	332.50	105	350	70	70	11	63.06
2	25	437.50	306.25	546.88	415.63	131.25	437.50	87.5	87.5	11	71.02
3	25	546.88	382.82	683.59	519.53	164.06	546.88	109.37	109.37	11	79.98
4	25	683.59	478.51	854.49	649.41	205.08	683.60	136.73	136.7	11	90.05
5	20	820.31	574.22	1025.39	779.29	246.10	820.31	136.72	191.4	11	113.58
6	15	943.36	660.35	1179.19	896.19	283.00	943.36	123.05	254.3	11	135.96
7	10	1037.70	726.39	1297.11	985.81	311.30	1037.70	94.34	320.75	11	154.49
											708.14

$$FCFF_8 = FCFF_7(1.10) = 320.75 \times (1.10) = 352.83$$

$$\text{Terminal Value} = \frac{FCFF_8}{WACC - g} = \frac{352.83}{0.12 - 0.10} = 17641.50$$

$$\text{Present value of terminal value} = 17641.50 / (1.11)^7 = 8497.01$$

$$\text{Present value of FCFF in the high growth and transit periods} = 708.14$$

$$\text{Value of the firm} = \text{Rs. } 9205.15 \text{ crores}$$

5. Multisoft Limited was set up about twelve years ago by a product-minded technocrat. In the first five years, the company did exceptionally well, thanks to the excellent response received by three of its initial products. The company recorded a compound annual growth rate of 80 percent during this period. Subsequently, however, the company floundered, as its product offerings were superseded by the offerings of competitors. In response, the management of Multisoft emphasised software services. This strategy has worked well and the company's performance improved significantly in the last few years. The management is quite optimistic about future and believes that its growth is more predictable now.

Recently, Gautam Prabhu, the CEO of Multisoft Limited had a very fruitful discussion with the CEO of Matrix Software wherein they explored the possibility of a merger.

Gautam Prabhu believes that the compensation for the merger, if consummated, will be in the form of the stock of Multisoft Limited. He has requested you to value the equity of Multisoft and asked his CFO, Ranjan Kaul, to provide you with the information about the current and projected financials of Multisoft.

The following information has been provided to you.

Base Year (Year 0) Information

• Revenues	Rs. 2000 million
• EBIT	Rs. 750 million
• Capital expenditure	Rs. 500 million
• Depreciation	Rs. 140 million
• Working capital as a percentage of revenues	30 percent
• Corporate tax rate	15 percent
• Paid up capital (Rs.10 par)	Rs. 600 million
• Market value of debt	Rs. 300 million

Inputs for the High Growth Period

• Length of the high growth period	=	3 years
• Growth rate in revenues, depreciation, EBIT and capital expenditure	=	40 percent
• Working capital as a percentage of revenues	=	30 percent
• Cost of debt (pre-tax)	=	10 percent
• The tax rate will increase to 30 percent in linear increments of 5 percent per year		
• Debt-equity ratio	=	0.5 : 1
• Risk-free rate	=	7 percent
• Market risk premium	=	6 percent
• Equity beta	=	1.3

Inputs for the Transition Period

- Length of the transition period = 5 years
- Growth rate in revenues, depreciation, EBIT, and capital expenditures will decline from 40 percent in year 3 to 10 percent in year 8 in linear increments of 6 percent each year
- Working capital as a percentage of revenues = 30 percent
- Debt-equity ratio = 0.5 : 1
- Cost of debt (pre-tax) = 10 percent
- Risk-free rate = 6 percent
- Market risk premium = 7 percent
- Equity beta = 1.2
- Tax rate = 30 percent

Inputs for the Stable Growth Period

- Growth rate in revenues, EBIT, capital expenditure, and depreciation = 10 percent
- Working capital as a percentage of revenues = 30 percent
- Debt-equity ratio = 0.284 : 1
- Cost of debt (pre-tax terms) = 10 percent
- Risk-free rate = 7 percent
- Market risk premium = 7 percent
- Equity beta = 1.1
- Tax rate = 30 percent

Required

- a. What will be the WACC (upto one decimal point) year-wise?
- b. What is the present value of the FCF in the high growth period?
- c. What is the present value of the FCF in the transition period?
- d. What is the present value of the terminal value?
(Answers to (b), (c), and (d) must be in rupees in million upto one decimal point)
- e. What is the intrinsic value per share?

Solution:

(a) WACC

High growth period

Year	Cost of equity	Cost of debt	WACC
1	$7 + 1.3 (6) = 14.8\%$	$10 (1 - 0.20) = 8\%$	$2/3 \times 14.8 + 1/3 \times 8 = 12.5$
2	$7 + 1.3 (6) = 14.8\%$	$10 (1 - 0.25) = 7.5\%$	$2/3 \times 14.8 + 1/3 \times 7.5 = 12.4$
3	$7 + 1.3 (6) = 14.8\%$	$10 (1 - 0.30) = 7.0\%$	$2/3 \times 14.8 + 1/3 \times 7.0 = 12.2$

Transition period

Cost of equity	WACC	Cost of debt
$6 + 1.2 (7) = 14.4\%$	$10 (1 - 0.3) = 7\%$	$2/3 \times 14.4 + 1/3 \times 7 = 11.9$

Stable period

Cost of equity	WACC	Cost of debt
$7 + 1.1 (7) = 14.7\%$	$10 (1 - 0.3) = 7\%$	$1/1.284 \times 14.7 + 0.284 / 1.284 \times 7 = 13.0\%$

Year	Growth rate %	EBIT	Tax rate (%)	EBIT (1 - T)	Capex	Depr ⁿ	WC	Δ WC	FCF	WACC %	PV Factor	PV
0		750	15		500	140	600					
1	40	1050	20	840	700	196	840	240	96	12.5	0.889	85.3
2	40	1470	25	1102.5	980	274.4	1176	336	60.9	12.4	0.791	48.2
3	40	2058	30	1440.6	1372	384.2	1646.4	470.4	(17.6)	12.2	0.705	(12.4)
4	34	2757.7	30	1930.4	1838.5	514.8	2206.2	559.8	46.9	11.9	0.630	29.5
5	28	3529.9	30	2470.9	2353.3	658.9	2823.9	617.7	158.8	11.9	0.563	89.4
6	22	4306.5	30	3014.5	2871.0	803.9	3445.2	621.3	326.1	11.9	0.503	164.0
7	16	4995.5	30	3496.8	3330.3	932.5	3996.4	551.2	547.8	11.9	0.450	246.5
8	10	5495.0	30	3846.5	3663.4	1025.7	4396.0	399.6	809.2	11.9	0.402	325.3
9	10	6044.5	30	4231.2	4029.7	1128.3	4835.6	439.6	890.2	13.0	0.356	316.9

(b) Present value of FCF in the high growth period
 $= 85.3 + 48.2 - 12.4 = \text{Rs.}121.1 \text{ million}$

(c) PV of FCF in the transition period
 $= 29.5 + 89.4 + 164.0 + 246.5 + 325.3$
 $= \text{Rs.}854.7 \text{ million}$

(d) PV of terminal value
 $= \frac{890.2}{0.13 - 0.10} \times 0.402 = \text{Rs.}11928.7 \text{ million}$

(e) Intrinsic value per share

$$\frac{\text{Value of firm} - \text{Value of debt}}{\text{Number of shares}}$$

$$= \frac{121.1 + 854.7 + 11928.7 - 300}{60}$$

$$= \text{Rs.}210.1$$

6. Telesoft International was set up seven years ago to develop telecommunication software. Though the company started with a bang, it entered a turbulent phase because of the shrinkage in the global telecom market in the initial years of this decade. Thanks to recovery in the last 18 months or so and a firm indication of strong growth in the next few years, the management of Telesoft International is quite upbeat about the future.

Recently, Pankaj Behl, the CEO of Telesoft International had a preliminary dialogue with the CEO of a another company engaged in developing telecommunication software to explore a possible merger. Both the CEOs felt enthusiastic about this.

Pankaj Behl believes that the compensation for the merger, if consummated, will be in the form of the stock of Telesoft International. He has requested you to value the equity of Telesoft and asked Vijay Rao, Finance Director, Telesoft International to provide you with information about the current and projected financials of Telesoft International.

The following information has been provided to you.

Base Year (Year 0) Information

Revenues	= Rs. 1200 million
EBIT	= Rs. 350 million
Capital expenditure	= Rs. 280 million
Depreciation	= Rs. 140 million
Working capital as a percentage of revenues	= 30 percent
Corporate tax rate	= 10 percent
Paid up equity capital (Rs.10 par)	= Rs. 300 million
Market value of debt	= Rs. 300 million

Inputs for the High Growth Period

Length of the high growth period	= 4 years
Growth rate in revenues, depreciation, EBIT and capital expenditure	= 30 percent
Working capital as a percentage of revenues	= 30 percent
Cost of debt	= 10 percent (pre-tax)
Tax rate will increase to 30 percent in linear increment of 5 percent	
Debt-equity ratio	= 0.8:1
Risk-free rate	= 7 percent
Market risk premium	= 7 percent
Equity beta	= 1.4

Inputs for the Transition Period

Length of the transition period	= 4 years
Growth rate in revenues, depreciation, EBIT, and capital expenditures will decline from 30 percent in year 4 to 10 percent in year 8 in linear increments of 5 percent each year	
Working capital as a percentage of revenues	= 30 percent
Debt-equity ratio	= 0.8:1
Cost of debt	= 10 percent (pre-tax)
Risk-free rate	= 8 percent
Market risk premium	= 6 percent
Equity beta	= 1.1
Tax rate	= 30 percent

Inputs for the Stable Growth Period

Growth rate in revenues, EBIT, capital expenditure and depreciation	= 10 percent
Working capital as a percentage of revenues	= 30 percent
Debt-equity ratio	= 0.5:1.0
Cost of debt	= 10 percent (pre-tax)
Risk-free rate	= 8 percent
Market risk premium	= 7 percent
Equity beta	= 1.0
Tax rate	= 30 percent

- a. What will be the WACC, year-wise?
- b. What is the present value of the FCF in the high growth period?
- c. What is the present value of the FCF in the transition period?
- d. What is the present value of the terminal value?
- e. What is the intrinsic value value per share?

Solution:

(a) WACC

High growth period

Year	Cost of equity	Cost of debt	WACC
1	$7 + 1.4 \times (7) = 16.8\%$	$10 (1 - 0.15) = 8.5\%$	$(5/9) \times 16.8 + (4/9) \times 8.5 = 13.1\%$
2	$7 + 1.4 \times (7) = 16.8\%$	$10 (1 - 0.20) = 8.0\%$	$(5/9) \times 16.8 + (4/9) \times 8.0 = 12.9\%$
3	$7 + 1.4 \times (7) = 16.8\%$	$10 (1 - 0.25) = 7.5\%$	$(5/9) \times 16.8 + (4/9) \times 7.5 = 12.7\%$
4	$7 + 1.4 \times (7) = 16.8\%$	$10 (1 - 0.30) = 7.0\%$	$(5/9) \times 16.8 + (4/9) \times 7.0 = 12.4\%$

Transition period

<i>Cost of equity</i>	<i>Cost of debt</i>	<i>WACC</i>
$8 + 1.1(6) = 14.6\%$	$10(1-0.3) = 7.0\%$	$(5/9) \times 14.6 + (4/9) \times 7 = 11.2\%$

Stable period

<i>Cost of equity</i>	<i>Cost of debt</i>	<i>WACC</i>
$8 + 1.0 (7) = 15.0\%$	$10 (1-0.3) = 7\%$	$(2/3) 75.0 + (1/3) \times 7.0 = 12.3\%$

(b)

Year	Growth rate%	EBIT	Tax rate %	EBIT (1-T)	Cap Exp	Dep'n	WC	Δ WC	FCF	WACC %	PV Factor	PV of FCF
0		350	10		280	140	360					
1	30	455	15	387	364	182	468	108	97	13.1%	0.884	85.7
2	30	592	20	474	473	237	608	140	98	12.9%	0.783	76.7
3	30	769	25	577	615	308	791	183	87	12.7%	0.695	60.5
4	30	1000	30	700	800	400	1028	237	63	12.4%	0.618	38.9
5	25	1250	30	875	1000	500	1285	257	118	11.2%	0.556	65.6
6	20	1499	30	1049	1200	600	1542	257	192	11.2%	0.500	96.0
7	15	1724	30	1207	1379	690	1774	232	286	11.2%	0.450	128.7
8	10	1897	30	1328	1517	759	1951	177	393	11.2%	0.404	158.8
9	10	2087	30	1461	1669	835	2146	195	432	12.3%		

PV of FCF in the high growth period.

$$85.7 + 76.7 + 60.5 + 38.9$$

$$= \text{Rs. } 261.8 \text{ million}$$

(c) PV of FCF in the transition period
 $65.6 + 96.0 + 128.7 + 158.8 = \text{Rs.}449.1$ million

(d) PV of the terminal value
 $\frac{432}{0.123 - 0.10} \times 0.404 = \text{Rs.}7588.2$ million

(e) Intrinsic value per share

$$\frac{\text{Value of firm} - \text{Value of debt}}{\text{No. of shares}}$$

$$= \frac{(261.8 + 449.1 + 7588.2) - 300}{30}$$

$$= \text{Rs.} 266.6$$

7. You are looking at the valuation of a stable firm, Solidaire Limited, done by an investment analyst. Based on an expected free cash flow of Rs.70 million for the following year and an expected growth rate of 10 per cent, the analyst has estimated the value of the firm to be Rs.3000 million. However, he committed a mistake of using the book values of debt and equity. You do not know the book value weights employed by him but you know that the firm has a cost of equity of 22 per cent and a post-tax cost of debt of 9 per cent. The market value of equity is twice its book value, whereas the market value of its debt is eight-tenths of its book value. What is the correct value of the firm?

Solution:

$$3000 = \frac{70}{r - 0.10} \Rightarrow r = 0.1233 \text{ or } 12.33 \%$$

$$0.1233 = x \times 0.22 + (1-x) \times 0.09 \Rightarrow x = 0.26$$

The weight assigned to equity is 0.26

$$\text{So } D/E = 0.74 / 0.26 = 2.85$$

Since the market value of equity is twice its book value and the market value of debt is eight-tenths of its book value, the market value weights of equity and debt are in the proportion: 0.26×2 and 0.74×0.8

That is 0.52 and 0.59

Solution:

		Income Statement Projections			
	Current Values (Year 0)	1	2	3	Residual value 3 +
• Sales	50,000	65,000	84,500	109,850	109,850
• Gross margin (20%)	10,000	13,000	16,900	21,970	21,970
• Selling and general administration (8%)	4,000	5,200	6,760	8,788	8,788
• Profit before tax	6,000	7,800	10,140	13,182	13,182
• Tax	1,800	2,340	3,042	3,955	3,955
• Profit after tax	4,200	5,460	7,098	9,227	9,227

		Balance Sheet Projections			
• Fixed assets	25,000	32,500	42,250	54,925	54,925
• Net current assets	5,000	6,500	8,450	10,985	10,985
• Total assets	30,000	39,000	50,700	65,910	65,910
• Equity	30,000	39,000	50,700	65,910	65,910

		Cash Flow Projections			
Profit after tax	5,460	7,098	9,227	9,227	
+ Depreciation	2,500	3,250	4,225	5,493	
- Capital expenditure	10,000	13,000	16,900	5,493	
- Increase in net current assets	1,500	1,950	2,535	–	
= Operating cash flow	(3540)	(4602)	(5983)	9,227	
Present value factor	0.877	0.769	0.675		
Present value	(3105)	(3539)	(4038)		

- Present value of the operating cash flow stream = (10682)
- Residual value = $9227 / 0.4 = 65,907$
- Present value of residual value = $65907 \times 0.675 = 44,487$
- Total shareholder value = $44,487 - 10682 = 33,805$
- 4200
- Pre-strategy value = $\frac{\quad}{0.14} = 30,000$
- Value of the strategy = $33,805 - 30,000 = 3,805$

2. The income statement for year 0 (the year which has just ended) and the balance sheet at the end of year 0 for Megastar Limited are as follows.

<i>Income statement</i>		<i>Balance Sheet</i>	
Sales	200,000	Equity	250,000
Gross margin (25%)	50,000	Fixed assets	150,000
Selling & general administration (10%)	20,000	Net current assets	100,000
Profit before tax	43,000		
Tax	14,190		
Profit after tax	28,810		
		250,000	250,000

Megastar Limited is debating whether it should maintain the status quo or adopt a new strategy. If it maintains the status quo:

- The sales will remain at 200,000
- The gross margin will remain at 25% and the selling, general, and administrative expenses will be 10 % of sales
- Depreciation charges will be equal to new investments
- The asset turnover ratios will remain constant
- The discount rate will be 15 percent
- The income tax rate will be 33 percent

If Megastar Limited adopts a new strategy, its sales will grow at the rate of 30 percent per year for three years. Thereafter, sales will remain constant. The margins, the turnover ratios, the capital structure, the income tax rate, and the discount rate, however, will remain unchanged.

Depreciation charges will be equal to 20 percent of the net fixed assets at the beginning of the year. After three years, capital expenditure will be equal to depreciation.

What value will the new strategy create?

Solution:

Year	Current values	Income statement projections			
		1	2	3	4
Sales	200,000	260,000	338,000	439,400	439,400
Gross margin	50,000	65,000	84,500	109,850	109,850
Selling and general administration	20,000	26,000	33,800	43,940	43,940
Profit before tax	43,000	55,900	72,670	94,471	94,471
Tax	14,190	18,447	23,981	31,175	31,175
Profit after tax	28,810	37,453	48,689	63,296	63,296
		Balance sheet projections			
Fixed assets	150,000	195,000	253,500	329,550	329,550

Net current assets	100,000	130,000	169,000	219,700	219,700
Total assets	250,000	325,000	422,500	549,250	549,250
Equity	250,000	325,000	422,500	549,250	549,250
		Cash Flow projections			
Profit after tax		37,453	48,689	63,296	63,296
Depreciation		30,000	39,000	50,700	65,910
Capital expenditure		75,000	97,500	126,750	65,910
Increase in net current assets		30,000	39,000	50,700	0
Operating cash flow		(37,547)	(48,811)	(63,454)	63,296
Present value of the operating cash flow stream	(111,280)				
Residual value = 63,296/0.15	421,970				
Present value of the residual value = 421,970/(1.15) ³	277,452				
Total shareholder value=(111,280) +277452	166,172				
Pre-strategy value = 28810/0.15	192,067				
Value of the strategy =192,067 – 166,172	(25,895)				

3. A new plant entails an investment of Rs.630 million (Rs.480 million in fixed assets and Rs.150 million in net working capital). The plant has an economic life of 8 years and is expected to produce a NOPAT of Rs.80 million every year. After 8 years, the net working capital will be realised at par but fixed assets will fetch nothing. The cost of capital for the project is 12 percent. Assume that the straight-line method of depreciation is used for tax as well as shareholder reporting purposes.
- What will be the ROCE for year 3 ? Assume that the capital employed is measured at the beginning of the year.
 - What will be the EVA (Rs.in million) for year 3 ?
 - What will be the ROGI for year 3 ?
 - What will be the CVA (Rs.in million) for year 3 ?
 - What will be the CFROI for year 3?

Solution:

	(Rs.in million)		
	1	2	3
• Net fixed assets (beginning)	480	420	360
• Net working capital (beginning)	150	150	150
• Capital employed (beginning)	630	570	510
• NOPAT	80	80	80
• Depreciation (Accounting)	60	60	60
• Economic depreciation	39.02	39.02	39.02
• Cash investment	630	630	630
• Cost of capital	12%	12%	12%
• Capital charge	75.6	68.4	61.2

$$\text{Economic depreciation} = \frac{480}{\text{FVIFA}_{12\%, 8\text{yr}}} = \frac{480}{12.30} = 39.02$$

$$\text{ROCE}_3 = \text{NOPAT}_3 / \text{CE} = 80 / 510 = 15.69\%$$

$$\begin{aligned} \text{EVA}_3 &= \text{NOPAT} - \text{COC} \times \text{CE} \\ &= 80 - 0.12 \times 510 = 18.8 \end{aligned}$$

$$\text{ROGI}_3 = \frac{\text{NOPAT} + \text{DEP}}{\text{CASH INVESTMENT}} = \frac{80 + 60}{630} = 22.22\%$$

$$\begin{aligned} \text{CVA}_3 &= \text{Operating cash flow} - \text{Eco.depreciation} - \text{Capital charge on full capital invested} \\ &= (80 + 60) - 39.02 - 0.12 \times 630 = 25.38 \end{aligned}$$

$$\text{CFROI} = \frac{\text{Operating cash flow} - \text{Economic depreciation}}{\text{Cash investment}} = \frac{140 - 39.02}{630} = 16.03\%$$

3. A new plant entails an investment of Rs.800 (Rs.600 million in fixed assets and Rs.200 million in net working capital). The plant has an economic life of 10 years and is expected to produce a NOPAT of Rs.90 million every year. After 10 years, the net working capital will be realised at par whereas fixed assets will fetch nothing. The cost of capital for the project is 10 percent. Assume that the straight line method of depreciation is used for tax as well as reporting purposes.
- What will be the ROCE for year 3 ? Assume that the capital employed is measured at the beginning of the year.
 - What will be the EVA for year 3 ?
 - What will be the ROGI for year 3 ?
 - What will be the CVA for year 3 ?
 - What will be the CFROI for year 3 ?

Solution:

	1	2	3
• Net value of fixed assets (beginning)	600	540	480
• Investment in net working capital	200	200	200
• Capital employed (beginning)	800	740	680
• NOPAT	90	90	90
• Depreciation (Accounting & tax)	60	60	60
• Economic depreciation	37.65	37.65	37.65
• Cash investment	800	800	800
• Cost of capital	10%	10%	10%
• Capital charge	80	74	68

$$\text{Economic depreciation} = \frac{600}{\text{FVIFA}_{10\%, 10\text{yr}}} = \frac{600}{15.937} = 37.65$$

$$\text{ROCE} = \text{NOPAT}_3 / \text{CE} = 90 / 680 = 13.24\%$$

$$\begin{aligned} \text{EVA}_3 &= \text{NOPAT} - \text{COC} \times \text{CE} \\ &= 90 - 0.10 \times 680 = 22 \end{aligned}$$

$$\text{ROGI}_3 = \frac{\text{NOPAT} + \text{DEP}}{\text{Cash Invest}} = \frac{90 + 60}{800} = 18.75\%$$

$$\begin{aligned} \text{CVA}_3 &= \text{Operating cash flow} - \text{Eco.depr}^n - \text{Capital charge on full cap.invested} \\ &= 150 - 37.65 - 80 = 32.35 \end{aligned}$$

$$\text{CFROI} = \frac{\text{Operating cash flow} - \text{Economic deprn}}{\text{Cash investment}} = 14.04\%$$

4. A new plant entails an investment of Rs.1000 million (Rs. 800 million in fixed assets and Rs.200 million in net working capital).The net working capital will be maintained at that level throughout the project life. The plant has an economic life of 10 years and it is expected to produce a NOPAT of Rs.140 million every year. After 10 years, the net working capital will be realised at par whereas fixed assets will fetch nothing. The cost of capital for the project is 15 percent. Assume that the straight line method of depreciation is used for tax as well as reporting purposes.

- (i) What will be the EVA for year 3?
- (ii) What will be the ROGI for year 3?
- (iii) What will be the CVA for year 3?
- (iv) What will be the CFROI for year 3?

Solution:

	1	2	3
• Net value of fixed assets (beginning)	800	720	640
• Investment in current assets	200	200	200
• Capital employed (beginning)	1000	920	840
• NOPAT	140	140	140
• Depreciation (Accounting and tax)	80	80	80
• Economic depreciation	39.40	39.40	39.40
• Cash investment	1000	1000	1000
• Cost of capital	15%	15%	15%

$$\text{Economic depreciation} = \frac{800}{\text{FVIFA}_{15\%, 10}} = \frac{800}{20.304} = 39.40$$

$$\begin{aligned} \text{EVA}_3 &= \text{NOPAT}_3 - \text{COC} \times \text{CE} \\ &= 140 - 0.15 \times 840 = 14 \end{aligned}$$

$$\text{ROGI}_3 = \frac{\text{NOPAT} + \text{DEP}}{\text{Cash Investment}} = \frac{140 + 80}{1000} = 22\%$$

$$\begin{aligned} \text{CVA}_3 &= \text{OPERATING CASH FLOW} - \text{ECONOMIC DEPRECIATION} - \\ &\quad \text{CAPITAL CHARGE ON FULL CAPITAL INVESTMENT.} \\ &= 220 - 39.40 - 0.15 (1000) = 30.60 \end{aligned}$$

$$\begin{aligned} \text{CFROI}_3 &= \frac{\text{OPERATING CASH FLOW} - \text{ECONOMIC DEPRECIATION}}{\text{CASH INVESTMENT}} \\ &= \frac{220 - 39.40}{1000} = 18.06\% \end{aligned}$$

5. Biotech International earns a return on equity of 20 percent. The dividend payout ratio is 0.25. Equity shareholders of Biotech require a return of 16 percent. The book value per share is Rs.60.

(i) What is the market price per share, according to the Marakon model ?

Solution:

$$g = (1-b)r = 0.75 \times 0.20 = 0.15$$

$$\frac{M}{B} = \frac{r - g}{k - g} = \frac{0.20 - 0.15}{0.16 - 0.15} = 5$$

$$B = \text{Rs. } 60 \qquad M = 5 B = \text{Rs. } 300$$

- (ii) If the return on equity falls to 19 percent, what should be the payout ratio be to ensure that the market price per share remains unchanged.

Solution:

$$\frac{0.19 - g}{0.16 - g} = 5 \Rightarrow g = 0.1525$$

$$g = (1-b) r$$

$$0.1525 = (1-b) \times 0.19$$

$$b = 0.1974 \text{ or } 19.74 \%$$

6. Miocon Limited is considering a capital project for which the following information is available.

Initial outlay	: 50000	Depreciation method	: Sinking fund
Project life	: 5 years	(for tax purposes)	
Salvage value	: 0	Tax rate	: 30 %
Annual revenues	: 60000	Debt-equity ratio	: 1 : 1
Annual costs	: 30000	Cost of equity	: 14%
(excluding depreciation, interest, and taxes)		Cost of debt	: 6%
		(post-tax)	

Calculate the EVA of the project over its life.

Solution:

<u>Sinking Fund Depreciation</u>					
A x PVIFA (10%, 5years) = 50,000					
A x 3.791 = 50,000 \Rightarrow A = 13,189					
Depreciation Schedule					
	1	2	3	4	5
• Investment (beginning)	50,000	41,811	32,803	22,894	11,994
• Depreciation	8,189	9,008	9,909	10,900	11,994
• 10% capital charge	5,000	4,181	3,280	2,289	1,199
• Annuity	13,189	13,189	13,189	13,189	13,189
1. Revenues	60,000	60,000	60,000	60,000	60,000
2. Costs	30,000	30,000	30,000	30,000	30,000
3. PBDIT	30,000	30,000	30,000	30,000	30,000
4. Depreciation	8,189	9,008	9,909	10,900	11,994
5. PBIT	21,811	20,992	20,091	19,100	18,006

6. NOPAT (5) x 0.7	15,268	14,694	14,064	13,370	12,604
7. Capital at charge	50,000	41,811	32,803	22,894	11,994
8. Capital charge (7 x 0.10)	5,000	4,181	3,280	2,289	1,199
9. EVA	10,268	10,513	10,784	11,081	11,405

7. Janbaz Limited is considering a capital project for which the following information is available.

Initial outlay	: 200,000	Depreciation method	: Sinking fund
Project life	: 4 years	(for tax purposes)	
Salvage value	: 0	Tax rate	: 30%
Annual revenues	: 250,000	Debt-equity ratio	: 1:1
Annual costs	: 160,000	Cost of equity	: 15%
		Cost of debt (post tax)	: 7%

The initial outlay is entirely for acquiring fixed assets.
Calculate the EVA of the project over its life.

Solution:

Sinking Fund Depreciation					
$A \times PVIFA (11\%, 4\text{yrs}) = 200,000$ $A \times 3.102 = 200,000 \quad A = 64475$					
	Depreciation Schedule				
	1	2	3	4	5
• Investment (beginning)	200,000	157,525	110,378	58,045	
• Depreciation	42,475	47,147	52,333	58,090	
• 11% Capital charge	22,000	17,328	12,142	6,385	
• Annuity	64,475	64,475	64,475	64,475	
	1	2	3	4	5
1. Revenues	250,000	250,000	250,000	250,000	
2. Costs	160,000	160,000	160,000	160,000	
3. PBDIT	90,000	90,000	90,000	90,000	
4. Depreciation	42,475	47,147	52,333	58,090	
5. PBIT	47,525	42,853	37,667	31,910	
6. NOPAT (5) x (0.7)	33,268	29,997	26,367	22,337	
7. Capital at charge	200,000	157,525	110,378	58,045	
8. Capital charge (7 x 0.11)	22,000	17,328	12,142	6,385	
9. EVA	11,268	12,669	14,225	15,952	

8. Polytex Limited is considering a capital project for which the following information is available .

Investment outlay :	10000	Depreciation method :	Sinking fund
Project life :	5 years	(for tax purposes)	
Salvage value :	0	Tax rate :	30 %
Annual revenues :	14000	Debt-equity ratio :	1 :1
Annual costs :	9000	Cost of equity :	16%
(excluding depreciation interest, and taxes)		Cost of debt :	8%
		(post-tax)	

Calculate the EVA of the project over its life and the NPV.

Solution:

Sinking Fund Depreciation

$$A \times PVIFA (12\%, 5\text{yrs}) = 10,000$$

$$A \times 3.605 = 10,000 \rightarrow A = 2774$$

Depreciation Schedule					
	1	2	3	4	5
• Investment(beginning)	10,000	8426	6663	4689	2478
• Depreciation	1574	1763	1974	2211	2478
• 12% Capital charge	1200	1011	800	563	297
• Annuity	2774	2774	2774	2774	2774

	1	2	3	4	5
1. Revenues	14000	14000	14000	14000	14000
2. Costs	9000	9000	9000	9000	9000
3. PBDIT	5000	5000	5000	5000	5000
4. Depreciation	1574	1763	1974	2211	2477
5. PBIT	3426	3237	3026	2789	2523
6. NOPAT (5) x (0.7)	2398	2266	2118	1952	1766
7. Capital at charge	10000	8426	6663	4689	2478
8. Capital charge (7x 0.12)	1200	1011	800	563	297
9. EVA	1198	1255	1318	1389	1469

$$NPV = \sum \frac{EVA_t}{(1.12)^t}$$

$$= 1198/1.12 + 1255/(1.12)^2 + 1318/(1.12)^3 + 1389/(1.12)^4 + 1469/(1.12)^5$$

$$= 4724.53$$

9. Simtek Limited is considering a capital project for which the following information is available.

Investment outlay :	8000	Depreciation method :	Sinking fund
Project life :	5 years	(for tax purposes)	
Salvage value :	0	Tax rate :	30 %
Annual revenues :	10000	Debt-equity ratio :	0.6 :1
Annual costs :	6400	Cost of equity :	15%
(excluding depreciation interest, and taxes)		Cost of debt :	7%
		(post-tax)	

- (i) What will be the depreciation charge for year 3?

Solution:

$\text{Post-tax cost of capital: } \frac{6}{16} \times 7 + \frac{10}{16} \times 15$ $2.63 + 9.37 = 12.00 \text{ percent}$																				
<p>Sinking Fund Depreciation</p> $A \times \text{PVIFA} (12\%, 5\text{yrs}) = 8000$ $A \times 3.605 = 8000 \Rightarrow A = 2219$																				
<p><i>Depreciation Schedule</i></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">1</th> <th style="text-align: center;">2</th> <th style="text-align: center;">3</th> </tr> </thead> <tbody> <tr> <td>• Investment (beginning)</td> <td style="text-align: center;">8000</td> <td style="text-align: center;">6741</td> <td style="text-align: center;">5331</td> </tr> <tr> <td>• Depreciation</td> <td style="text-align: center;">1259</td> <td style="text-align: center;">1410</td> <td style="text-align: center;">1579</td> </tr> <tr> <td>• 12 percent charge</td> <td style="text-align: center;">960</td> <td style="text-align: center;">809</td> <td style="text-align: center;">640</td> </tr> <tr> <td></td> <td style="text-align: center;">2219</td> <td style="text-align: center;">2219</td> <td style="text-align: center;">2219</td> </tr> </tbody> </table>		1	2	3	• Investment (beginning)	8000	6741	5331	• Depreciation	1259	1410	1579	• 12 percent charge	960	809	640		2219	2219	2219
	1	2	3																	
• Investment (beginning)	8000	6741	5331																	
• Depreciation	1259	1410	1579																	
• 12 percent charge	960	809	640																	
	2219	2219	2219																	

- (ii) What will be the EVA for year 3?

Solution:

1. Revenues	10000
2. Costs	6400
3. PBDIT	3600
4. Depreciation	1579
5. PBIT	2021
6. NOPAT	1415
7. Capital at charge	5331
8. Capital charge	640
9. EVA	775

- (iii) Over time will the EVA of this project, increase, decrease or remains unchanged?

Solution:

The book capital decreases over time, thanks to depreciation. Hence the capital charge decreases. This leads to an increase in EVA over time.

10. Karishma Limited expects to earn a supernormal rate of return of 50 percent on new investments to be made over the next 6 years. The projected new investment per year is Rs.400 million. If the weighted average cost of capital for Karishma Limited is 23 percent, what is the value of the forward plan?

Solution:

$$I = \text{Rs.400 million}$$

$$r = 0.50$$

$$c^* = 0.23$$

$$T = 6 \text{ years}$$

$$\begin{aligned} \text{Value of forward plan} &= \frac{400 (0.50 - 0.23)^6}{0.23 (1.23)} \\ &= \text{Rs.2290.56 million} \end{aligned}$$

11. Pinnacle Corporation expects to earn a supernormal rate of return of 60 percent on new investments to be made over the next 4 years. The projected new investment per year is Rs.200 million. If the weighted average cost of capital for Pinnacle Corporation is 18 percent, what is the value of the forward plan?

Solution:

$$I = \text{Rs.200 million}$$

$$r = 0.60$$

$$c^* = 0.18$$

$$T = 4 \text{ years}$$

$$\begin{aligned} \text{Value of forward plan} &= \frac{200 (0.60 - 0.18)^4}{0.18 (1.18)} \\ &= \text{Rs. 1581.92 million} \end{aligned}$$

CHAPTER 34

1. Anil Company (the transferor company) and Sunil Company (the transferee company) amalgamate in an exchange of stock to form Anil and Sunil Company. The pre-amalgamation balance sheets of Sunil Company and Anil Company are as follows:

	<i>Sunil Company</i> (Rs. in million)	<i>Anil Company</i> (Rs. in million)
Fixed assets	45	25
Current assets	<u>40</u>	<u>15</u>
Total assets	<u>85</u>	<u>40</u>
Share capital (Rs.10 face value)	30	10
Reserves and surplus	20	20
Debt	<u>35</u>	<u>10</u>
	<u>85</u>	<u>40</u>

The share swap ratio fixed is 2:5. The fair market value of the fixed assets and current assets of Anil Company was assessed at Rs.50 million and Rs.20 million respectively. Prepare the post-amalgamation balance sheet of Sunil & Anil Company under the 'pooling' and 'purchase' methods.

Solution:

The pre-amalgamation balance sheets of Sunil Company and Anil Company and the post-amalgamation balance sheet of the combined entity, Sunil and Anil Company, under the 'pooling' method as well as the 'purchase' method are shown below:

	Before Amalgamation		After Amalgamation	
	Sunil	Anil	Sunil & Anil Company Pooling method	Purchase method
Fixed assets	45	25	70	95
Current assets	40	15	55	60
Total assets	<u>85</u>	<u>40</u>	<u>125</u>	<u>155</u>
Share capital (face value @ Rs.10)	30	10	34	34
Capital reserve			6	56
Reserves & surplus	20	20	40	20
Debt	<u>35</u>	<u>10</u>	<u>45</u>	<u>45</u>
Total liabilities	<u>85</u>	<u>40</u>	<u>125</u>	<u>155</u>

2. Yan Company (the transferor company) and Yin Company (the transferee company) amalgamate in an exchange of stock to form Yin Yan Company. The pre-amalgamation balance sheets of Yin Company and Yan Company are as follows:

	<i>Yin Company</i> <i>(Rs. in million)</i>	<i>Yan Company</i> <i>(Rs. in million)</i>
Fixed assets	120	50
Current assets	<u>240</u>	<u>80</u>
Total assets	<u>360</u>	<u>130</u>
Share capital (Rs.10 face value)	150	40
Reserves and surplus	150	10
Debt	<u>60</u>	<u>80</u>
	<u>360</u>	<u>130</u>

The exchange ratio fixed is one share for every two shares of transferor company. The fair market value of the fixed assets, current assets and debt of Yan Company was assessed at Rs.40 million, Rs.60 million and Rs.90 million respectively. Prepare the post-amalgamation balance sheet of Yin Yan Company under the 'pooling' and 'purchase' methods.

Solution:

	Yin & Yan Company			
	Yin	Yan	Pooling method	Purchase method
Fixed assets	120	50	170	160
Current assets	240	80	320	300
Goodwill				10
Total assets	360	130	490	470
Share capital (face value @ Rs.10)	150	40	170	170
Capital reserve			20	
Reserves & surplus	150	10	160	150
Debt	60	80	140	150
Total liabilities	360	130	490	470

3. Bharat Company (the transferor company) and Jai Company (the transferee company) amalgamate in an exchange of stock to form Jai Bharat Company. The pre-amalgamation balance sheets of Jai Company and Bharat Company are as follows:

	<i>Jai Company</i> (Rs. in million)	<i>Bharat Company</i> (Rs. in million)
Fixed assets	80	40
Current assets	<u>100</u>	<u>40</u>
Total assets	<u>180</u>	<u>80</u>
Share capital (Rs.10 face value)	70	30
Reserves and surplus	50	20
Debt	<u>60</u>	<u>30</u>
	<u>180</u>	<u>80</u>

The exchange ratio fixed is two shares for every five shares of the transferor company. The fair market value of the fixed assets, current assets and debt of Bharat Company was assessed at Rs.30 million, Rs.20 million and Rs.40 million respectively. Prepare the post-amalgamation balance sheet of Jai Bharat Company under the 'pooling' and 'purchase' methods.

Solution:

	Before Amalgamation		After Amalgamation	
	Jai	Bharat	Jai Bharat Company	
			Pooling method	Purchase method
Fixed assets	80	40	120	110
Current assets	100	40	140	120
Goodwill				2
Total assets	180	80	260	232
Share capital (face value @ Rs.10)	70	30	82	82
Capital reserve			18	
Reserves & surplus	50	20	70	50
Debt	60	30	90	100
Total liabilities	180	80	260	232

4. Vijay Company plans to acquire Ajay Company. The following are the relevant financials of the two companies.

	<i>Vijay Company</i>	<i>Ajay Company</i>
Total earnings, E	Rs.200 million	Rs.100 million
Number of outstanding shares	20 million	10 million
Market price per share	Rs.200	Rs.120

- (i) What is the maximum exchange ratio acceptable to the shareholders of Vijay Company if the PE ratio of the combined company is 18 and there is no synergy gain?

Solution:

$$ER_1 = \frac{-S_1}{S_2} + \frac{PE_{12}(E_{12})}{P_1 S_2}$$

$$= \frac{20}{10} + \frac{18(300)}{200 \times 10} = 0.7$$

- (ii) What is the minimum exchange ratio acceptable to the shareholders of Ajay Company if the PE ratio of the combined company is 18 and there is a synergy gain of 6 percent?

Solution:

$$ER_2 = \frac{P_2 S_1}{(PE_{12})(E_1 + E_2)(1+S) - P_2 S_2}$$

$$= \frac{120 \times 20}{(18)(200 + 100)(1.06) - 120 \times 10} = 0.53$$

- (iii) If there is no synergy gain, at what level of PE multiple will the lines ER₁ and ER₂ intersect?

Solution:

The lines ER₁ and ER₂ will intersect at a point corresponding to the weighted average of the two PE multiples wherein the weights correspond to the respective earnings of the two firms.

$$PE_{12} = \frac{200}{300} \times 20 + \frac{100}{300} \times 12$$

$$= 13.333 + 4 = 17.33$$

- (iv) If the expected synergy gain is 8 percent, what exchange ratio will result in a post-merger earnings per share of Rs.11?

Solution:

$$\frac{(E_1 + E_2) (1 + S)}{N_1 + N_2 \times ER} = \frac{(200 + 100) (1.08)}{20 + 10 \times ER} = 11$$

$$ER = 0.945$$

- (v) Assume that the merger is expected to generate gains which have a present value of Rs. 400 million and the exchange ratio agreed to is 0.6. What is the true cost of the merger from the point of view of Vijay Company?

Solution:

$$\text{Cost} = \alpha \text{ PV (Vijay and Ajay)} - \text{PV (Ajay)}$$

$$\alpha = \frac{0.60 \times 10}{20 + 0.6 \times 10} = 0.231$$

$$\text{PV (Vijay \& Ajay)} = 4000 + 1200 + 400 = 5600 \text{ million}$$

$$\text{Cost} = 0.231 \times 5600 - 1200 = \text{Rs.93.6 million}$$

5. Jeet Company plans to acquire Ajeet Company. The following are the relevant financials of the two companies.

	<i>Jeet Company</i>	<i>Ajeet Company</i>
Total earnings, E	Rs.1600 million	Rs.600 million
Number of outstanding shares	40 million	30 million
Market price per share	Rs .900	Rs.360

- (i) What is the maximum exchange ratio acceptable to the shareholders of Jeet Company if the PE ratio of the combined company is 21 and there is no synergy gain?

Solution:

$$\begin{aligned}
 ER_1 &= \frac{-S_1 + PE_{12}(E_{12})}{-S_2 + P_1S_2} \\
 &= \frac{-40 + 21 \times 2200}{30 + 900 \times 30} \\
 &= 0.378
 \end{aligned}$$

- (ii) What is the minimum exchange ratio acceptable to the shareholders of Ajeet Company if the PE ratio of the combined company is 20 and there is a synergy benefit of 8 percent?

Solution:

$$\begin{aligned}
 ER_2 &= \frac{P_2S_1}{(PE_{12})(E_1 + E_2)(1 + S) - P_2S_2} \\
 &= \frac{360 \times 40}{20 \times (2200)(1.08) - 360 \times 30} \\
 &= 0.392
 \end{aligned}$$

- (iii) If there is no synergy gain, at what level of PE multiple will the lines ER₁ and ER₂ intersect?

Solution:

The lines ER₁ and ER₂ will intersect at a point corresponding to the weighted average of the two PE multiples wherein the weights correspond to the respective earnings of the two firms.

$$\begin{aligned}
 PE_{12} &= \frac{1600}{2200} \times 22.5 + \frac{600}{2200} \times 18 \\
 &= 16.36 + 4.91 \\
 &= 21.27
 \end{aligned}$$

- (iv) If the expected synergy gain is 10 percent, what exchange ratio will result in a post-merger earnings per share of Rs.30 ?

Solution:

$$\frac{(E_1 + E_2) (1 + S)}{N_1 + N_2 \times ER} = \frac{(1600 + 600) (1.10)}{40 + 30 \times ER} = 30$$

$$\frac{2420}{40 + 30ER} = 30$$

$$ER = 1.355$$

- (v) Assume that the merger is expected to generate gains which have a present value of Rs. 5000 million and the exchange ratio agreed to is 0.45. What is the true cost of the merger from the point of view of Jeet Company?

Solution:

$$\text{Cost} = \alpha \text{ PV (Jeet \& Ajeet) } - \text{PV (Ajeet)}$$

$$\alpha = \frac{0.45 \times 30}{40 + 0.45 \times 30} = 0.252$$

$$\text{PV (Jeet \& Ajeet)} = 36000 + 10800 + 5000 = 51800$$

$$\text{PV (Ajeet)} = 10800$$

$$\text{Cost} = 0.252 (51800) - 10800 = 2253.6$$

6. Shaan Company plans to acquire Aan Company. The following are the relevant financials of the two companies.

	<i>Shaan Company</i>	<i>Aan Company</i>
Total earnings, E	Rs.750 million	Rs.240 million
Number of outstanding shares	50 million	20 million
Market price per share	Rs.250	Rs.150

- (i) What is the maximum exchange ratio acceptable to the shareholders of Shaan Company if the PE ratio of the combined company is 15 and there is no synergy gain?

Solution:

$$\begin{aligned}
 ER_1 &= \frac{-S_1}{S_2} + \frac{PE_{12}(E_{12})}{P_1 S_2} \\
 &= -\frac{50}{20} + \frac{15 \times 990}{250 \times 20} = 0.47
 \end{aligned}$$

- (ii) What is the minimum exchange ratio acceptable to the shareholders of Aan Company if the PE ratio of the combined entity is 15 and there is a synergy benefit of 6 percent?

Solution:

$$\begin{aligned}
 ER_2 &= \frac{P_2 S_1}{(PE_{12})(E_1 + E_2)(1+S) - P_2 S_2} \\
 &= \frac{150 \times 50}{15 \times 990 \times 1.06 - 150 \times 20} = 0.589
 \end{aligned}$$

- (iii) If there is no synergy gain, at what level of PE multiple will the lines ER_1 and ER_2 intersect?

Solution:

The lines ER_1 and ER_2 will intersect at a point corresponding to the weighted average of the two PE multiples wherein the weights correspond to the respective earnings of the two firms.

$$\begin{aligned}
 PE_{12} &= \frac{750}{990} \times 16.67 + \frac{240}{990} \times 12.5 \\
 &= 15.66
 \end{aligned}$$

- (iv) If the expected synergy gain is 6 percent, what exchange ratio will result in a post-merger earnings per share of Rs.16?

Solution:

$$\frac{(E_1 + E_2) (1 + S)}{N_1 + N_2 \times ER} = \frac{(750 + 240) (1.06)}{50 + 20 \times ER} = 16$$

$$ER = 0.779$$

- (v) Assume that the merger is expected to generate gains which have a present value of Rs. 600 million and the exchange ratio agreed to is 0.60. What is the true cost of the merger from the point of view of Shaan Company?

Solution:

$$\text{Cost} = \alpha \text{ PV (Shaan \& Aan)} - \text{PV (Aan)}$$

$$\alpha = \frac{0.60 \times 20}{50 + 20 \times 0.60} = \frac{12}{62} = 0.194$$

$$\text{PV (Shaan \& Aan)} = 12500 + 3000 + 600 = 16100$$

$$\text{PV (Aan)} = 3000$$

$$\text{Cost} = 0.194 \times 16100 - 3000 = \text{Rs.123.4 million.}$$

7. Arun Company has a value of Rs.40 million and Varun Company has a value of Rs.20 million. If the two companies merge, cost savings with a present value of Rs.5 million would occur. Arun proposes to offer Rs.22 million cash compensation to acquire Varun. What is the net present value of the merger to the two firms?

Solution:

$$\begin{aligned} PV_A &= \text{Rs.40 million, } PV_V = \text{Rs.20 million} \\ \text{Benefit} &= \text{Rs.5 million, Cash compensation} = \text{Rs.22 million} \\ \text{Cost} &= \text{Cash compensation} - PV_V = \text{Rs.2 million} \\ \text{NPV to Arun} &= \text{Benefit} - \text{Cost} = \text{Rs.3 million} \\ \text{NPV to Varun} &= \text{Cash Compensation} - PV_V = \text{Rs.2 million} \end{aligned}$$

8. Kamal Company has a value of Rs.80 million and Jamal Company has a value of Rs.30 million. If the two companies merge, cost savings with a present value of Rs.10 million would occur. Kamal proposes to offer Rs.35 million cash compensation to acquire Jamal. What is the net present value of the merger to the two firms?

Solution:

$PV_K = \text{Rs.}80 \text{ million}$, $PV_J = \text{Rs.}30 \text{ million}$
 Benefit = Rs.10 million, Cash compensation = Rs 35 million
 Cost = Cash compensation – $PV_J = \text{Rs.}5 \text{ million}$
 NPV to Alpha = Benefit – Cost = Rs.5 million
 NPV to Beta = Cash Compensation – $PV_J = \text{Rs.}5 \text{ million}$

9. America Limited plans to acquire Japan Limited. The relevant financial details of the two firms, prior to merger announcement, are given below:

	<i>America Limited</i>	<i>Japan Limited</i>
Market price per share	Rs. 100	Rs.40
Number of shares	800,000	300,000

The merger is expected to bring gains which have a present value of Rs.12 million. America Limited offers two share in exchange for every three shares of Japan Limited.

- Required : (a) What is the true cost of America Limited for acquiring Japan Limited ?
 (b) What is the net present value of the merger to America Limited ?
 (c) What is the net present value of the merger to Japan Limited ?

Solution:

Let *A* stand for America Limited and *J* for Japan Limited and *AJ* for the combined entity.

$PV_A = \text{Rs.}100 \times 800,000 = \text{Rs.}80 \text{ million}$
 $PV_J = \text{Rs.}40 \times 300,000 = \text{Rs.}12 \text{ million}$
 Benefit = Rs.12 million
 $PV_{AJ} = 80 + 12 + 12 = \text{Rs.}104 \text{ million}$
 Exchange ratio = 2:3

The share of Japan Limited in the combined entity will be :

$$\alpha = \frac{200,000}{800,000 + 200,000} = 0.2$$

- a) True cost to America Limited for acquiring Japan Limited
 Cost = $\alpha PV_{AJ} - PV_J$
 = $0.2 \times 104 - 12 = \text{Rs.8.8 million}$
- b) NPV to America Limited
 = Benefit - Cost
 = $12 - 8.8 = \text{Rs.3.2 million}$
- c) NPV to Japan Limited
 = Cost = Rs.8.8 million

10. Amir Limited plans to acquire Jamir Limited. The relevant financial details of the two firms, prior to merger announcement, are given below:

	<i>Amir Limited</i>	<i>Jamir Limited</i>
Market price per share	Rs. 500	Rs.100
Number of shares	600,000	200,000

The merger is expected to bring gains which have a present value of Rs.20 million. Amir Limited offers one share in exchange for every four shares of Jamir Limited.

- Required: (a) What is the true cost of Amir Limited for acquiring Jamir Limited?
 (b) What is the net present value of the merger to Amir Limited ?
 (c) What is the net present value of the merger to Jamir Limited ?

Solution:

Let *A* stand for Amir Limited and *J* for Jamir Limited and *AJ* for the combined entity.

$$PV_A = \text{Rs.}500 \times 600,000 = \text{Rs.}300 \text{ million}$$

$$PV_J = \text{Rs.}100 \times 200,000 = \text{Rs.}20 \text{ million}$$

$$\text{Benefit} = \text{Rs.}20 \text{ million}$$

$$PV_{AJ} = 300 + 20 + 20 = \text{Rs.}340 \text{ million}$$

$$\text{Exchange ratio} = 1:4$$

The share of Jamir Limited in the combined entity will be:

$$\alpha = \frac{50,000}{600,000 + 50,000} = 0.0769$$

- a) True cost to Amir Limited for acquiring Jamir Limited
 Cost = $\alpha PV_{AJ} - PV_J$
 = $0.0769 \times 340 - 20 = \text{Rs.}6.146 \text{ million}$

b) NPV to Amir Limited

$$\begin{aligned} &= \text{Benefit} - \text{Cost} \\ &= 20 - 6.146 = \text{Rs.13.854 million} \end{aligned}$$

c) NPV to Jamir Limited

$$= \text{Cost} = \text{Rs.6.146 million}$$

11. As the financial manager of National Company you are investigating the acquisition of Regional Company. The following facts are given:

	<i>National Company</i>	<i>Regional Company</i>
Earning per share	Rs.8.00	Rs.3.00
Dividend per share	Rs.5.00	Rs.2.50
Price per share	Rs.86.00	Rs.24.00
Number of shares	8,000,000	3,000,000

Investors currently expect the dividends and earnings of Regional to grow at a steady rate of 6 percent. After acquisition this growth rate would increase to 12 percent without any additional investment.

- Required : (a) What is the benefit of this acquisition ?
(b) What is the cost of this acquisition to National Company if it (i) pays Rs.30 per share cash compensation to Regional Company and (ii) offers two shares for every five shares of Regional Company?

Solution:

Let the suffixes *A* stand for National Company, *B* for Regional Company and *AB* for the combined company.

a) $PV_B = \text{Rs.24} \times 3,000,000 = \text{Rs.72 million}$

The required return on the equity of Regional Company is the value of k in the equation.

$$\text{Rs.24} = \frac{\text{Rs.2.50} (1.06)}{k - .06}$$

$$k = 0.1704 \text{ or } 17.04 \text{ per cent.}$$

If the growth rate of Regional rises to 12 per cent as a sequel to merger, the intrinsic value per share would become:

$$\frac{2.50 (1.12)}{0.1704 - .12} = \text{Rs.55.56}$$

Thus the value per share increases by Rs.31.56 Hence the benefit of the acquisition is:

$$3 \text{ million} \times \text{Rs.}31.56 = \text{Rs.}94.68 \text{ million}$$

- (b) (i) If National pays Rs.30 per share cash compensation, the cost of the merger is 3 million x (Rs.30 – Rs.24) = Rs.18 million.
- (ii) If National offers 2 shares for every 5 shares it has to issue 1.2 million shares to shareholders of Regional.

So shareholders of Regional will end up with

$$\alpha = \frac{1.2}{8 + 1.2} = 0.1304 \text{ or } 13.04 \text{ per cent}$$

shareholding of the combined entity,

The present value of the combined entity will be

$$\begin{aligned} PV_{AB} &= PV_A + PV_B + \text{Benefit} \\ &= \text{Rs.}86 \times 8 \text{ million} + \text{Rs.}24 \times 3 \text{ million} + \text{Rs.}94.68 \text{ million} \\ &= \text{Rs.}854.68 \text{ million} \end{aligned}$$

So the cost of the merger is :

$$\begin{aligned} \text{Cost} &= \alpha PV_{AB} - PV_B \\ &= .1304 \times 854.68 - 72 = \text{Rs.}39.45 \text{ million} \end{aligned}$$

12. As the financial manager of Satya Limited you are investigating the acquisition of Devaraj Limited. The following facts are given:

	<i>Satya Limited</i>	<i>Devaraj Limited</i>
Earning per share	Rs.12.00	Rs.4.00
Dividend per share	Rs.10.00	Rs.3.00
Price per share	Rs.110.00	Rs.38.00
Number of shares	5,800,000	1,400,000

Investors currently expect the dividends and earnings of Devaraj to grow at a steady rate of 4 percent. After acquisition this growth rate would increase to 10 percent without any additional investment.

- Required: (a) What is the benefit of this acquisition ?
- (b) What is the cost of this acquisition to Satya Limited if it (i) pays Rs.100 per share cash compensation to Devaraj Limited and (ii) offers three shares for every seven shares of Devaraj Limited ?

Solution:

Let the suffixes *A* stand for Satya Limited, *B* for Devaraj Limited and *AB* for the combined company

a) $PV_B = \text{Rs.}38 \times 1,400,000 = \text{Rs.}53.2 \text{ million}$

The required return on the equity of Devaraj Limited is the value of *k* in the equation.

$$\text{Rs.}38 = \frac{\text{Rs.}3 (1.04)}{k - .04}$$

$$k = 0.1221 \text{ or } 12.21 \text{ per cent.}$$

If the growth rate of Devaraj Limited rises to 10 per cent as a sequel to merger, the intrinsic value per share would become :

$$\frac{3(1.10)}{0.1221 - .10} = \text{Rs.}149.32$$

Thus the value per share increases by Rs.111.32 Hence the benefit of the acquisition is

$$1.4 \text{ million} \times \text{Rs.}111.32 = \text{Rs.}155.85 \text{ million}$$

(b) (i) If Satya Limited pays Rs.100 per share cash compensation, the cost of the merger is $1.4 \text{ million} \times (\text{Rs.}100 - \text{Rs.}38) = \text{Rs.}86.8 \text{ million.}$

(iii) If Satya Limited offers 3 shares for every 7 shares it has to issue 0.6 million shares to shareholders of Devaraj Limited.

So shareholders of Devaraj Limited will end up with

$$\alpha = \frac{0.6}{5.8 + 0.6} = 0.09375 \text{ or } 9.375 \text{ per cent}$$

shareholding of the combined entity,

The present value of the combined entity will be

$$\begin{aligned} PV_{AB} &= PV_A + PV_B + \text{Benefit} \\ &= \text{Rs.}110 \times 5.8 \text{ million} + \text{Rs.}38 \times 1.4 \text{ million} + \text{Rs.}155.85 \text{ million} \\ &= \text{Rs.}847.05 \text{ million} \end{aligned}$$

So the cost of the merger is :

$$\begin{aligned} \text{Cost} &= \alpha PV_{AB} - PV_B \\ &= .09375 \times 847.05 - 53.2 = \text{Rs.}26.21 \text{ million} \end{aligned}$$

13. Companies *P* and *Q* are valued as follows:

	<i>P</i>	<i>Q</i>
Earnings per share	Rs. 12.00	Rs.4.00
Price per share	Rs.110.00	Rs.28.00
Number of shares	60,000	21,000

P acquires *Q* by offering one shares of *P* for every three shares of *Q*. If there is no economic gain from the merger, what is the price-earnings ratio of *P*'s stock after the merger?

Solution:

The expected profile of the combined entity after the merger is shown in the last column below.

	<i>P</i>	<i>Q</i>	<i>Combined entity</i>
Number of shares	60,000	21,000	81,000
Aggregate earnings	Rs.720,000	Rs.84,000	Rs.804,000
Market value	Rs.6,600,000	Rs.588,000	Rs. 7,188,000
P/E	9.17	7.0	8.94

14. Companies *M* and *N* are valued as follows:

	<i>M</i>	<i>N</i>
Earnings per share	Rs.45.00	Rs.12.00
Price per share	Rs.360.00	Rs.53.00
Number of shares	100,000	32,000

M acquires *N* by offering one shares of *M* for every three shares of *N*. If there is no economic gain from the merger, what is the price-earnings ratio of *M*'s stock after the merger?

Solution:

The expected profile of the combined entity after the merger is shown in the last column below.

	<i>M</i>	<i>N</i>	<i>Combined entity</i>
Number of shares	100,000	32,000	132,000
Aggregate earnings	Rs.4,500,000	Rs.384,000	Rs.4,884,000
Market value	Rs.36,000,000	Rs.1,696,000	Rs. 37,696,000
P/E	8	4.42	7.72

15. X Limited is planning to acquire Y Limited. The management of X Limited estimates its equity-related post tax cash flows, without the merger, to be as follows:

Year	1	2	3	4	5
Cash flow (Rs. in million)	60	80	100	150	120

Beyond year 5, the cash flow is expected to grow at a compound rate of 8 percent per year for ever.

If Y Limited is acquired, the equity-related cash flows of the combined firm are expected to be as follows:

Year	1	2	3	4	5
Cash flow (Rs. in million)	100	120	150	250	200

Beyond year 5, the cash flow is expected to grow at a compound rate of 10 percent per year. The number of outstanding shares of X Limited and Y Limited prior to the merger are 20 million and 12 million respectively. If the management wants to ensure that the net present value of equity-related cash flows increase by at least 50 percent, as a sequel to the merger, what is the upper limit on the exchange ratio acceptable to it ? Assume cost of capital to be 15 percent.

Solution:

Value of X Limited's equity as a stand-alone company.

$$\frac{60}{(1.15)} + \frac{80}{(1.15)^2} + \frac{100}{(1.15)^3} + \frac{150}{(1.15)^4} + \frac{120}{(1.15)^5} + \frac{120 \times 1.08}{0.15 - 0.08} \times \frac{1}{(1.15)^5}$$

= Rs. 1244.33 million

Value of the equity of the combined company

$$\frac{100}{(1.15)} + \frac{120}{(1.15)^2} + \frac{150}{(1.15)^3} + \frac{250}{(1.15)^4} + \frac{200}{(1.15)^5} + \frac{200 (1.10)}{0.15 - 0.10} \times \frac{1}{(1.15)^5}$$

= Rs. 2706.27million

Let *a* be the maximum exchange ratio acceptable to the shareholders of X Limited. Since the management of X Limited wants to ensure that the net present value of equity-related cash flows increases by at least 50 percent, the value of *a* is obtained as follows.

$$\frac{20}{20 + a} \times 2706.27 = 1.50 \times 1244.33$$

Solving this for *a* we get

$$a = 0.75$$

16. P Limited is planning to acquire Q Limited. The management of P Limited estimates its equity-related post tax cash flows, without the merger, to be as follows:

Year	1	2	3	4	5
Cash flow (Rs. in million)	20	30	40	40	30

Beyond year 5, the cash flow is expected to grow at a compound rate of 4 percent per year for ever.

If Q Limited is acquired, the equity-related cash flows of the combined firm are expected to be as follows :

Year	1	2	3	4	5
Cash flow (Rs. in million)	30	50	60	50	40

Beyond year 5, the cash flow is expected to grow at a compound rate of 8 percent per year. The number of outstanding shares of P Limited and Q Limited prior to the merger are 10 million and 8 million respectively. If the management wants to ensure that the net present value of equity-related cash flows increase by at least 20 percent, as a sequel to the merger, what is the upper limit on the exchange ratio acceptable to it ? Assume cost of capital to be 13 percent.

Solution:

Value of P Limited's equity as a stand-alone company.

$$\frac{20}{(1.13)} + \frac{30}{(1.13)^2} + \frac{40}{(1.13)^3} + \frac{40}{(1.13)^4} + \frac{30}{(1.13)^5} + \frac{30 \times 1.04}{0.13 - 0.04} \times \frac{1}{(1.13)^5}$$

= Rs. 297.89 million

Value of the equity of the combined company

$$\frac{30}{(1.13)} + \frac{50}{(1.13)^2} + \frac{60}{(1.13)^3} + \frac{50}{(1.13)^4} + \frac{40}{(1.13)^5} + \frac{40 (1.08)}{0.13 - 0.08} \times \frac{1}{(1.13)^5}$$

= Rs. 628.61 million

Let a be the maximum exchange ratio acceptable to the shareholders of P Limited. Since the management of P Limited wants to ensure that the net present value of equity-related cash flows increases by at least 20 percent, the value of a is obtained as follows.

$$\frac{10}{10 + a \times 8} \times 628.61 = 1.20 \times 297.89$$

Solving this for a we get

$$a = 0.95$$

17. Rajagiri Mills Limited is interested in acquiring the textile division of Pricom Industries Limited. The planning group of Rajagiri Mills Limited has developed the following forecast for the textile division of Pricom Industries Limited.

Rs.in millions

<i>Year</i>	1	2	3	4	5	6
Asset value (at the beginning)	100	120	138	151.8	163.9	177.1
NOPAT	20	23	27.6	30.4	32.8	35.4
Net investment	30	32.5	32.5	30.4	32.8	25.3
Growth rate (%)	20	15	10	8	8	6

The growth rate from year 7 onward will be 6 percent. The discount rate to be used for this acquisition is 20 percent. What is the value of this acquisition?

Solution:

	1	2	3	4	5	6	7
FCF	(10)	(8.5)	(4.9)	0	0	10.1	10.7
PVIF	0.833	0.694	0.579	0.482	0.402	0.335	
PV	(8.33)	(5.90)	(2.837)	0	0	3.383	

PV (FCF) during the explicit forecast period = - 13.68

$$V_H = \frac{FCF_7}{r - g} = \frac{10.706}{0.20 - 0.06} = 76.471$$

$$PV(V_H) = \frac{76.471}{(1.20)^6} = 25.60$$

$V_0 = - 13.68 + 25.60 = \text{Rs. } 11.92 \text{ million.}$

18. CMX Limited is interested in acquiring the cement division of B&T Limited. The planning group of CMX Limited has developed the following forecast for the cement division of B & T Limited.

Rs.in millions

<i>Year</i>	1	2	3	4	5	6
Asset value (at the beginning)	100	140	175	210	241.5	277.7
NOPAT	20	25	30	34.5	39.7	43.7
Net investment	35	36.5	37	37.4	43.0	42.0
Growth rate (%)	40	25	20	15	15	10

The growth rate from year 7 onward will be 10 percent. The discount rate to be used for acquisition is 12 percent. What is the value of this acquisition?

Solution:

	1	2	3	4	5	6	7
FCF	(15)	(11.5)	(7)	(2.9)	(3.3)	1.7	
PVIF	0.893	0.797	0.712	0.636	0.567	0.507	
PV	(13.40)	(9.17)	(4.98)	(1.84)	(1.87)	(0.86)	
PV (FCF)	during the explicit forecast period = -3.4						
V_H	=	$\frac{FCF_7}{r - g}$	=	$\frac{1.87}{0.12 - 0.10}$	=	93.5	
PV (V_H)	=	$93.5 / (1.12)^6 = 47.37$					
V_0	=	-30.40	+	47.37	=	Rs. 16.97 million	

19. Rex Limited is interested in acquiring the cement division of Flex Limited. The planning group of Rex Limited has developed the following forecast for the cement division of Flex Limited

<i>Year</i>	1	2	3	4	5	6
Asset value	100	125	150	172.5	193.2	212.50
NOPAT	14	17.5	21	24.2	27.1	29.80
Net investment	20	22.5	22.5	24.2	24.1	25.3
Growth rate(%)	25	20	15	12	10	8

The growth rate from year 7 onward will be 8 percent. The discount rate to be used for this acquisition is 15 percent.

What is the value of this acquisition?

Solution:

	1	2	3	4	5	6	7
FCF	(6)	(5)	(1.5)	0	3	4.5	4.9
PV	0.870 (5.22)	0.756 (3.78)	0.658 (0.99)	–	0.497 1.50	0.432 1.94	
PV (FCF) during the implicit forecast period							
$V_H = \frac{FCF_7}{r - g} = \frac{4.9}{0.15 - 0.08} = 70$							
$PV(V_H) = 70 \times \frac{1}{(1.15)^6} = 30.26$							
$V_0 = -6.55 + 30.26$ $= \text{Rs.}23.71$							

MINI CASE

Astra Pharma is a fairly diversified pharmaceutical company that has presence of most of the therapeutic segments. It has grown at a healthy rate over the past fifteen years, thanks to a balanced programme of internal growth and acquisitions.

In a recent strategy session, the management of Astra Pharma identified the cardiovascular segment as a thrust area for the next few years. Though Astra Pharma has a reasonable presence in this segment, the management is keen on pursuing aggressive growth opportunities in this segment, especially through acquisitions. On the advice of the management, the business development group at the head office examined several independent pharmaceutical companies with a primary focus on the cardiovascular segment. This group looked at things like revenues, growth rate, profit margin, market capitalisation, attitude of incumbent management, and so on. Based on such analysis, it zeroed in on Max Drugs as a potentially suitable candidate for acquisition by Astra Pharma.

Max Drug is a two decade old company with a turnover of Rs.3040 million last year. Max has had a chequered history, with a general upward trend.

The financial statements of Astra Pharma and Max Drugs for last year are given below:

Astra Pharma Balance Sheet

Shareholder's Funds (40 million shares, Rs 10 par)	4600	Fixed assets (net)	3300
Loan funds	600	Investments	500
		Net current assets	1400
	5200		5200

Astra Pharma Profit and Loss Account

Sales	9680
Profit before depreciation, interest, and taxes	1920
Depreciation	500
Profit before interest and taxes	1420
Interest	80
Profit before tax	1340
Tax	440
Profit after tax	900

Max Drugs Balance Sheet

Shareholder's Funds (10 million shares, Rs 10 par)	1300	Fixed assets (net)	940
Loan funds	500	Investments	250
		Net current assets	610
	1800		1800

Max Drugs Profit and Loss Account

Sales	1520
Profit before depreciation, interest, and taxes	230
Depreciation	70
Profit before interest and taxes	160
Interest	30
Profit before tax	130
Tax	35
Profit after tax	95

The market price per share of Astra Pharma is Rs.360 and the market price per share for Magnum Drugs is Rs. 110.

- (a) Calculate the exchange ratio that gives equal weightage to book value per share, earnings per share, and market price per share.

- (b) If the merger is expected to generate a synergy gain of 5 percent, what is the maximum exchange ratio Astra Pharma should accept to avoid initial dilution of earnings per share?
- (c) What will be the post-merger EPS of Astra Pharma if the exchange ratio is 1:3? Assume that there is no synergy gain.
- (d) What is the maximum exchange ratio acceptable to the shareholders of Astra Pharma if the PE ratio of the combined entity is 15 and there is no synergy gain?
- (e) What is the minimum exchange ratio acceptable to the shareholders of Max Drugs if the PE ratio of the combined entity is 14 and there is a synergy benefit of 2 percent?
- (f) Assuming that there is no synergy gain, at what level of the PE ratio will the lines ER_1 and ER_2 intersect?
- (g) Assume that the merger is expected to generate gains which have a present value of Rs. 1000 million and the exchange ratio agreed to is 1:3. What is the true cost of the merger from the point of view of Astra Pharma?
- (h) What are the limitations of earnings per share as the basis for determining the exchange ratio?
- (i) List the five sins that plague acquisitions?

Solution:

	Astra	Max
Earnings E	900 million	95 million
No. Outstanding shares S	40 million	10 million
Shareholders' funds	4600 million	1300 million
Market price per share P	Rs.360	Rs.110
EPS	Rs 22.5	Rs 9.5
Book value	Rs 115	Rs 130
PE ratio	16	11.58

- (a) Exchange ratio that gives equal weightage to book value per share, earnings per share and market price per share = $(130/115 + 9.5/22.5 + 110/360)/3 = 0.62$
- (b) If there should not be initial dilution of EPS, the EPS of the merged company should be at least Rs.22.5.

$$\text{So, } [(900 + 95) (1.05)] / [40 + ER \times 10] = 22.5$$

$$1044.75 = 900 + 225 ER$$

Therefore maximum exchange ratio $ER = 0.64$

[Alternatively: As the EPS of Astra if remains unchanged, the PE of the merged company has to be 16 and therefore maximum exchange ratio Astra Pharma should accept is

$$= -S_1 / S_2 + PE_{12}(E_{12})/P_1S_2 = -40/10 + [16 \times 995(1.05)] / (360 \times 10) = 0.64]$$

- (c) Post-merger EPS of Astra Pharma
 $= 995,000,000 / [40,000,000 + 10,000,000/3] = \text{Rs. } 22.96$
- (d) Maximum exchange ratio acceptable to the shareholders of Astra Pharma
 $= -S_1 / S_2 + PE_{12}(E_{12})/P_1S_2 = -40/10 + (15 \times 995)/(360 \times 10) = 0.15$
- (e) Minimum exchange ratio acceptable to the shareholders of Max Drugs
 $= P_2S_1 / (P_{12}E_{12} - P_2S_2) = (110 \times 40) / [14 \times (995 \times 1.02) - 110 \times 10] = 0.34$
- (f) To get the level of the PE ratio where the lines ER_1 and ER_2 will intersect we have to solve the following for PE_{12}

$$\frac{-S_1}{S_2} + \frac{(E_1 + E_2) PE_{12}}{P_1S_2} = \frac{P_2S_1}{PE_{12}(E_1 + E_2) - P_2S_2}$$

$$-40/10 + 995 PE_{12} / 360 \times 10 = (110 \times 40) / [PE_{12} \times 995 - 110 \times 10]$$

$$\frac{995PE_{12} - 14,400}{3,600} = \frac{4,400}{995 PE_{12} - 1100}$$

$$990,025PE_{12} - 14,328,000 PE_{12} - 1,094,500PE_{12} + 15,840,000 = 15,840,000$$

$$990,025 PE_{12} = 15,422,500 PE_{12}$$

$$PE_{12} = 15.58$$

- (g) At the exchange ratio of 1:3, shareholders of Max drugs will get 10/3million shares of Astra Pharma. So they will get

$$\alpha = (10/3) / (40 + 10/3) = 7.69\% \text{ share of Astra Pharma.}$$

The present value of Astra Pharma after the merger will be

$$= 40 \times 360 + 10 \times 110 + 1000 = \text{Rs. } 16500 \text{ million}$$

Therefore the true cost of the merger from the point of view of Astra Pharma

$$= 0.0769 \times 16500 - (10 \times 110) = \text{Rs.}168.85 \text{ million}$$

(h) An exchange ratio based on earnings per share fails to take into account the following:

- (i) The difference in the growth rate of earnings of the two companies.
 - (ii) The gains in earnings arising out of merger.
 - (iii) The differential risk associated with the earnings of the two companies.
- (i) The five sins that plague acquisitions are the following:
- a) Straying too far afield.
 - b) Striving for bigness.
 - c) Leaping before looking.
 - d) Overpaying.
 - e) Failing to integrate well.

CHAPTER 37

1. If the spot rate of the US dollar is Rs.40.00 and the three month forward rate is Rs.40.25, what is the annualised forward premium on the dollar?

Solution:

The annualised premium is:

$$\frac{\text{Forward rate} - \text{Spot rate}}{\text{Spot rate}} \times \frac{12}{\text{Forward contract length in months}}$$

$$= \frac{40.25 - 40.00}{40.00} \times \frac{12}{3} = 0.025 \text{ or } 2.5 \%$$

2. If the spot rate of the US dollar against Japanese yen 114.00 and the six month forward rate is Rs.110, what is the annualised forward premium on the yen ?

Solution:

The annualised premium is :

$$= \frac{114 - 110}{114} \times \frac{12}{6} = 0.0702 \text{ or } 7.02 \%$$

3. You have \$300 million to invest. You are considering deposits in the US or U.K. The US interest rate on 1 –year deposit of this size is 5.25 percent. The current spot rate is 2.0341 dollars per sterling pound. The rate of interest on a 1-year deposit of this size in U.K. is 5.75 percent. What forward exchange rate will make you indifferent between investing in the US and depositing in the U.K. ?

Solution:

$$300 (1.0525) = \frac{300}{2.0341} \times 1.0575 \times F$$

$$F = 2.0245$$

A forward exchange rate of 2.0245 dollars per sterling pound will mean indifference between investing in the U.S and in the U.K.

4. You have Rs.100,000 to invest. You are considering deposit in India or the US. The US interest rate on 1 –year deposit of this size is 5.25 percent while the rate for a one year deposit in India is 8 percent .The current spot rate is Rs.39.50 per dollar What forward exchange rate will make you indifferent between investing in India and the the US .

Solution:

$$100,000(1.08) = \frac{100,000}{39.50} \times 1.0525 \times F$$

$$F = 40.53$$

A forward exchange rate of Rs.40.53 per dollar will mean indifference between investing in India and the U.S.

5. The exchange rate between US dollar and yen is as follows:

Spot	114.54 yen per dollar
30-day forwards	114.11 yen per dollar
90-day forwards	113.34yen per dollar
180-day forwards	112.30 yen per dollar

- Required: (a) What is the annual percentage premium of the yen on the dollar ?
 (b) What is the most likely spot rate 6 months hence?
 (c) If the interest on 6-month deposit in the US is 2.48 percent (for 6 months), what is it likely to be in Japan?

Solution:

- (a) The annual percentage premium of the yen on the dollar may be calculated with reference to 30-days forwards

$$\frac{114.54 - 114.11}{114.54} \times \frac{12}{1} = 4.50 \%$$

(b) The most likely spot rate 6 months hence will be : 112.30 yen / dollar

$$\frac{\text{Forwards rate}}{\text{Spot rate}} = \frac{1 + \text{domestic interest rate}}{1 + \text{foreign interest rate}}$$

$$\frac{112.3}{114.54} = \frac{1 + \text{domestic interest rate in Japan}}{1.0248}$$

Domestic interest rate in Japan = 0.00476 = 0.48 per cent for 6 months.

6. The exchange rate between euro and Australian dollar (AUD) is as follows:

Spot	1.5915 AUD per EUR
30-day forwards	1.5950 AUD per EUR
90-day forwards	1.6008 AUD per EUR

- Required: (a) What is the annual percentage premium of the euro on the AUD ?
 (b) What is the most likely spot rate 3 months hence?
 (c) If the interest on 3-month deposit in Euro land is 2.28 percent (for 3 months), what is it likely to be in Australia ?

Solution:

The annual percentage premium of the euro may be calculated with reference to 30-days forwards

$$\frac{1.5950 - 1.5915}{1.5915} \times \frac{12}{1} = 2.64 \%$$

(b) The most likely spot rate 3 months hence will be : 1.6008 AUD per euro

$$\frac{\text{Forwards rate}}{\text{Spot rate}} = \frac{1 + \text{domestic interest rate}}{1 + \text{foreign interest rate}}$$

$$\frac{1.6008}{1.5915} = \frac{1 + \text{domestic interest rate in Japan}}{1.0228}$$

Domestic interest rate in Japan = 0.0288 = 2.88 per cent(for 3 months)

7. Navabharat Corporation, an Indian company, is considering a project to be set up in US. The project will entail an initial outlay of USD 500 million and is expected to generate the following cash flow over its five year life:

Year	1	2	3	4	5
Cash flow	100	250	400	400	300

(in USD millions)

The current spot exchange rate is Rs.39.40 per US dollar, the risk-free rate in India is 8 percent and the risk-free rate in the US is 5.5 percent.

Navabharat Corporation's required rupee return on a project of this kind is 17 percent.

Calculate the NPV of the project using the home currency approach.

Solution:

$$S_0 = \text{Rs.}39.40, r_h = 8 \text{ per cent}, r_f = 5.5 \text{ per cent}$$

Hence the forecasted spot rates are :

Year	Forecasted spot exchange rate
1	Rs.39.40 (1.08 / 1.055) ¹ = Rs.40.33
2	Rs. 39.40 (1.08 / 1.055) ² = Rs.41.29
3	Rs. 39.40 (1.08 / 1.055) ³ = Rs.42.27
4	Rs. 39.40 (1.08 / 1.055) ⁴ = Rs.43.27
5	Rs. 39.40 (1.08 / 1.055) ⁵ = Rs.44.29

The expected rupee cash flows for the project

Year	Cash flow in dollars (million)	Expected exchange rate	Cash flow in rupees (million)
0	-200	39.40	-7,880
1	100	40.33	4,033
2	250	41.2	10,300
3	400	42.27	16,908
4	400	43.27	17,308
5	300	44.29	13,287

Given a rupee discount rate of 17 per cent, the NPV in rupees is:

$$\text{NPV} = -7,880 + \frac{4,033}{(1.17)^1} + \frac{10,300}{(1.17)^2} + \frac{16,908}{(1.17)^3}$$

$$+ \frac{17,308}{(1.17)^4} + \frac{13,287}{(1.17)^5}$$

$$= \text{Rs. } 28,944.92 \text{ million}$$

The dollar NPV is :

$$28,944.92 / 39.40 = 734.64 \text{ million dollars}$$

8. Ashoka Limited , an Indian company, is considering a project to be set up in US. The project will entail an initial outlay of USD 800 million and is expected to generate the following cash flow over its six year life:

Year	1	2	3	4	5	6
Cash flow	200	350	500	800	700	500

(in USD millions)

The current spot exchange rate is Rs.39.00 per US dollar, the risk-free rate in India is 7 percent and the risk-free rate in the US is 5 percent.

Ashoka Limited's required rupee return on a project of this kind is 22 percent.

Calculate the NPV of the project using the home currency approach.

Solution:

$$S_0 = \text{Rs.}39 , r_h = 7 \text{ per cent} , r_f = 5 \text{ per cent}$$

Hence the forecasted spot rates are:

Year	Forecasted spot exchange rate
1	Rs.39 (1.07 / 1.05) ¹ = Rs.39.74
2	Rs. 39 (1.07 / 1.05) ² = Rs.40.50
3	Rs. 39 (1.07 / 1.05) ³ = Rs.41.27
4	Rs. 39 (1.07 / 1.05) ⁴ = Rs.42.06
5	Rs. 39 (1.07 / 1.05) ⁵ = Rs.42.86
6	Rs. 39 (1.07 / 1.05) ⁶ = Rs.43.67

The expected rupee cash flows for the project

Year	Cash flow in dollars (million)	Expected exchange rate	Cash flow in rupees (million)
0	-800	39.00	- 31,200
1	200	39.74	7,948
2	350	40.50	14,175
3	500	41.27	20,635
4	800	42.06	33,648
5	700	42.86	30,002
6	500	43.67	21,835

Given a rupee discount rate of 22 per cent, the NPV in rupees is :

$$\begin{aligned}
 \text{NPV} = & -31,200 + \frac{7,948}{(1.22)^1} + \frac{14,175}{(1.22)^2} + \frac{20,635}{(1.22)^3} \\
 & + \frac{33,648}{(1.22)^4} + \frac{30,002}{(1.22)^5} + \frac{21,835}{(1.22)^6} \\
 = & \text{Rs. 29,114 million}
 \end{aligned}$$

The dollar NPV is:

$$29,114 / 39 = 746.51 \text{ million dollars}$$

9. The 90-day interest rate is 1.25 percent in the U S and 1.50 percent in U K and the current spot exchange rate is \$ 2.02/£. What will be the 90-day forward rate?

Solution:

$\frac{\text{Forward rate}}{\text{Spot rate}} = \frac{1 + \text{domestic interest rate}}{1 + \text{foreign interest rate}}$
$\frac{F}{2.02} = \frac{1 + .0125}{1 + .0150}$
$F = \$ 2.015 / \text{£}$

10. The 90-day interest rate is 1.27 percent in the U S and 1.07 percent in Euro land and the current spot exchange rate is \$ 1.4203/euro. What will be the 90-day forward rate?

Solution:

$$\frac{\text{Forward rate}}{\text{Spot rate}} = \frac{1 + \text{domestic interest rate}}{1 + \text{foreign interest rate}}$$
$$\frac{F}{1.4203} = \frac{1 + .0127}{1 + .0107}$$

F = \$ 1.4231/ euro

11. The current spot rate for the British pound is Rs.81 The expected inflation rate is 4 percent in India and 2.7 percent in U K. What is the expected spot rate of British pound a year hence?

Solution:

$$\frac{\text{Expected spot rate a year from now}}{\text{Current spot rate}} = \frac{1 + \text{expected inflation in home country}}{1 + \text{expected inflation in foreign country}}$$
$$\frac{\text{Expected spot rate a year from now}}{\text{Rs.81}} = \frac{1.04}{1.027}$$

So, the expected spot rate a year from now is : $81 \times (1.04 / 1.027) = \text{Rs.82.03}$

12. The current spot rate for the euro is Rs.56.40 The expected inflation rate is 5 percent in India and 3 percent in Euro land. What is the expected spot rate of euro a year hence?

Solution:

$$\frac{\text{Expected spot rate a year from now}}{\text{Current spot rate}} = \frac{1 + \text{expected inflation in home country}}{1 + \text{expected inflation in foreign country}}$$
$$\frac{\text{Expected spot rate a year from now}}{56.40} = \frac{1.05}{1.03}$$

So, the expected spot rate a year from now is : $56.40 \times (1.05 / 1.03) = \text{Rs.57.50}$

13. Suppose India and UK produce only one good, copper. Suppose the price of copper in India is Rs.28000 and in the UK it is \$400.
- According to the law of one price, what should the British Pound : Rupee spot exchange rate be?
 - Suppose the price of copper over the next year is expected to rise is Rs.30,000 in India and \$460 in the UK. What should the one year British Pound: Rupee forward rate be?

Solution:

- (a) The spot exchange rate of one British Pound should be :

$$\frac{28000}{400} = \text{Rs.}70$$

- (b) One year forward rate of one British Pound should be :

$$\frac{30000}{460} = \text{Rs.} 65.22$$

14. Suppose India and Singapore produce only one good, tin. Suppose the price of tin in India is Rs.8000 and in Singapore it is Singapore dollar 300.

- According to the law of one price, what should the Singapore dollar: Rupee spot exchange rate be?
- Suppose the price of tin over the next year is expected to rise to Rs.10,000 in India and \$330 in Singapore. What should the one year Singapore dollar: Rupee forward rate be?

Solution:

- (a) The spot exchange rate of one Singapore dollar should be :

$$\frac{8000}{300} = \text{Rs.}26.67$$

- (b) One year forward rate of one Singapore dollar should be :

$$\frac{10000}{330} = \text{Rs.} 30.30$$

15. The inflation rate in US is expected to be 2.7 percent per year, and the inflation rate in Japan is expected to be 0.4 percent per year. If the current spot rate is 114 yen/\$ what will be the expected spot rate in 3 years?

Solution:

$\text{Expected spot rate 3 years from now} = \text{Current spot rate} \times \frac{(1 + \text{expected inflation in Japan})^3}{(1 + \text{expected inflation in UK})^3}$

$$= 114 \times \frac{(1.004)^3}{(1.027)^3} = 106.51 \text{ yen / \$}$$

16. The inflation rate in euro currency area is expected to be 1.7 percent per year, and the inflation rate in India is expected to be 3.5 percent per year. If the current spot rate is Rs. 56.4 per euro what will be the expected spot rate in 2 years?

Solution:

$$\begin{aligned} \text{Expected spot rate} &= \text{Current spot rate} \times \frac{(1 + \text{expected inflation in India})^2}{(1 + \text{expected inflation in euro currency area})^2} \\ \text{2 years from now} & \\ &= 56.4 \times \frac{(1.035)^2}{(1.017)^2} = \text{Rs.58.41 per euro} \end{aligned}$$

17. Suppose the spot rate between AUD and USD is 0.8500 USD per AUD. This is denoted as AUD/USD. The 90-day forward is 0.8530. U.S dollars can be lent or borrowed at a rate of 5% p.a, while the rates for AUD deposits or loans is 4.5 % p.a. How much risk-less profit can you make on a borrowing of 100 USD.

Solution:

	Spot	<u>90-day forward</u>
AUD/ USD	0.8500	0.8530

Borrow 100 USD and convert it into AUD 117.65

Invest AUD 117.65 @ 4.5% p.a. for 90 days and get 117.65 [1 + 0.045 (90/360)]
 = AUD 118.9736

Convert AUD into USD at the forward rate and receive dollars

$$= \text{AUD } 118.9736 \times 0.8530 = \$ 101.4845$$

Repay USD by paying 100 [1 + 0.05 (90/360)] = \$ 101.25

$$\begin{aligned} \text{Riskless profit} &= \$ 101.4845 - \$ 101.2500 \\ &= 0.2345 \end{aligned}$$

18. Suppose the spot rate between USD and INR is 46.50 INR per USD. This is denoted as USD/INR. The 90-day forward is 47.20. Indian rupee can be lent or borrowed at a rate 8 % p.a. while the rate for USD deposits or loans is 6.5% p.a. How much risk-less profit can you make on a borrowing of Rs. 10,000?

Solution:

USD/INR	<u>Spot</u>	<u>90 – day forward</u>
	46.50	47.20
Borrow 10,000 INR and convert it into USD 215.05		
Invest USD 215.05 @ 6.5 % p.a for 90 days and get		
215.05 [1 + 0.065 (90/360)]		
= USD 218.54		
Convert USD into INR at the forward rate and receive INR		
USD 218.54 X 47.20 = INR 10315.088		
Repay INR loan by paying 10,000 [1 + 0.08 (90/360)] = 10,200		
Riskless profit = 10315.088 - 10200		
= INR 115.088 = INR 115.09		

19. An Indian firm has a liability of £500,000 on account of purchases from a British supplier, which is payable after 180 days. The 180-day money market rate for deposits in UK is 2.5 percent. What steps should the Indian firm take to do a money market hedge?

Solution:

- (i) Determine the present value of the foreign currency liability (£500,000) by using 180-day money market deposit rate applicable to the foreign country. This works out to :

$$\frac{£500,000}{(1.025)} = £ 487,805$$

- (ii) Obtain £487,805 on today's spot market
- (iii) Invest £487,805 in the UK money market. This investment will grow to £500,000 after 180 days

20. An Indian firm has a receivable of £400,000 on account of exports to a British firm, which is payable after 90 days. The 90-day money market borrowing rate in UK is 2.0 percent. What steps should the Indian firm take to do a money market hedge?

Solution:

- (i) Determine the present value of the foreign currency asset (£400,000) by using the 90-day money market borrowing rate of 2 per cent.

$$\frac{400,000}{(1.02)} = \text{£ } 392,157$$

- (ii) Borrow £392,157 in the UK money market and convert them to rupees in the spot market.
- (iii) Repay the borrowing of £392,157 which will compound to £400,000 after 90 days with the collection of the receivable.

21. Sagar Ltd has a short-term fund surplus of Rs.100 million. The funds can be parked for a six-month period. The company observes the following rates in the market.
Eurodollar 6 month LIBOR : 5 % p.a. (This is the interest rate for a USD deposit)
USD/ INR spot : 46.70/46.80
USD/ INR 6months forward : 46.90/ 47.00

If Sagar Ltd. parks its funds in the US dollar, what rupee rate of return will it finally get over the 6 month period, if covered forward?

Solution:

$$\text{Amount deposited in USD} = \frac{100,000,000}{46.80} = \$2,136,752.14$$

$$\begin{aligned} \text{Maturity value of the USD} &= 2,136,752.14 [1 + 0.05 (180/360)] \\ &= \$ 2,190,170.94 \end{aligned}$$

Rupee equivalent at the forward rate of 46.90 per USD

$$\begin{aligned} &= \$ 2,190,170.94 \times 46.90 \\ &= \text{Rs.}102,719.017.10 \end{aligned}$$

$$\text{Rupee rate of return} = 2.719 \%$$

22. Eastern Industries Ltd has a short- term fund surplus of Rs.120 million. The funds can be parked for a six month period. The company observes the following rates in the market. Eurodollar 6 month LIBOR : 5% p.a (This is the interest rate for a USD deposit)

USD/INR spot : 43.50/43.60

USD/INR 6 month forward : 43.80/43.90

If Eastern Industries parks its funds in the U.S dollar, What return will it finally get over the 6-month period, if covered forward?

Solution:

Amount deposited in USD	=	120,000,000	=	\$2,752,293.58
		43.60		
Maturity value of the USD deposit	=	2,752,293.58	[1 + 0.05 (180/360)]	
	=	\$2,821,100.92		
Rupee equivalent at the forward rate of 43.80 per USD				
	=	123,564,220.30		
Rate of return =				
		3,564,220.30/120,000,000 =		
		0.0297 or 2.97 %		

23. A foreign exchange dealer in London normally quotes spot, one-month, and three-month forward. When you ask over the telephone for current quotations for the Japanese yen against the U.S. dollar, you hear:

110.50 / 55, 50 / 55, 70 / 75

- (i) What would you receive in dollars if you sold Yen 20,000,000 spot?

Solution:

$$\frac{20,000,000}{110.55} = \$ 180,913.6137$$

- (ii) What would it cost you to purchase JPY 30,000,000 forward three-months with dollars?

Solution:

$$\begin{aligned} \text{Three months outright} &= (110.50 + 0.70) / (110.55 + 0.75) \\ &= 111.20 / 111.30 \\ &= \frac{30,000,000}{111.20} = \$ 269,784.1727 \end{aligned}$$

24. A foreign exchange dealer in London normally quotes spot, one-month and three-month forward. When you ask over the telephone for current quotations for the Japanese Yen against the US dollar, you hear

115.80/90, 40/45, 60/65

- (i) What would you receive in dollars if you sold Yen 30,000,000 spot?

Solution:

$$\frac{30,000,000}{115.90} = \$258,843.83$$

- (ii) What would it cost you to purchase JPY 40,000,000 forward three-months with dollars ?

Solution:

$$\begin{aligned} \text{Three months outright} &= (115.80 + 0.60) / (115.90 + 0.65) \\ &= 116.40 / 116.55 \\ &= \frac{40,000,000}{116.40} = \$343,642.61 \end{aligned}$$

25. Suppose an Indian firm has a 3-month payable of JPY 80 million. The market rates are as follows:

Mumbai	USD/INR	Spot	:	43.50/60
		3-months	:	44.50/60
Singapore	USD/JPY	Spot	:	115.20/30
		3-months	:	115.10/20

If the firm buys JPY forward against INR, how much will it have to pay?

Solution:

$$\begin{aligned} \text{USD required} &= \frac{80,000,000}{115.10} = \text{USD } 695,047.78 \\ \text{Rupees required} &= \text{USD } 695,047.78 \times 44.60 \\ &= \text{Rs. } 30,999,130.99 \end{aligned}$$

26. Suppose an Indian firm has a 3-month payable of JPY 80 million. The market rates are as follows:

Mumbai:	USD/ INR spot	:	46.20/ 30
	3 months	:	45.80/ 90
Singapore:	USD/ JPY spot	:	118.50/ 60
	3 months	:	118.40/ 50

a. If the firm buys JPY forward against INR, how much will it have to pay?

Solution:

$$\begin{aligned} \text{USD required} &= \frac{80,000,000}{118.40} = \text{USD } 675,675.68 \\ \text{Rupees required} &= \text{USD } 675,675.68 \times 45.90 \\ &= \text{Rs. } 31,013,513.71 \end{aligned}$$

CHAPTER 40

1. Price changes of two pharmaceutical stocks, P and Q , are positively correlated. The historical relationship is as follows:

Average percentage change in $P = 0.01 + 0.50$ (Percentage change in Q)
Changes in Q account for 50 per cent of the variation of changes in P ($R^2 = 0.5$).

- If an investor owns Rs.2 million of P , how much of Q should he sell to minimise his risk?
- What is his hedge ratio?
- How should he create a zero value hedge?

Solution:

- (a) The investor must short sell Rs.4 million (Rs.2 million / 0.50) of Q
 - (b) His hedge ratio is 0.50
 - (c) To create a zero value hedge he must deposit Rs.2 million in a bank.
2. The stock index is currently at 5,000 and the six month stock index futures is trading at 5,100. The risk-free annual rate is 8 per cent. What is the average annual dividend yield on the stocks in the index?

Solution:

$$\frac{\text{Futures price}}{(1+\text{Risk-free rate})^{0.5}} = \text{Spot price} - \frac{\text{Spot price} \times \text{Dividend yield}}{(1+\text{Risk-free rate})^{0.5}}$$
$$\frac{5100}{(1.08)^{0.5}} = 5000 - \frac{5000 \times \text{Dividend yield}}{(1.08)^{0.5}}$$

The dividend yield on a six months basis is 1.92 per cent. On an annual basis it is approximately 3.84 per cent.

3. The stock index is currently at 18,000 and the three month stock index futures is trading at 18,200. The risk-free annual rate is 9 per cent. What is the average annual dividend yield on the stocks in the index?

Solution:

$$\frac{\text{Futures price}}{(1+\text{Risk-free rate})^{0.25}} = \text{Spot price} - \frac{\text{Spot price} \times \text{Dividend yield}}{(1+\text{Risk-free rate})^{0.25}}$$
$$\frac{18200}{(1.09)^{0.25}} = 18000 - \frac{18000 \times \text{Dividend yield}}{(1.09)^{0.25}}$$

The dividend yield on a three months basis is 1.067 per cent. On an annual basis it is approximately 4.268 per cent.

4. The following information about copper scrap is given:

- Spot price : Rs.10,000 per ton
- Futures price : Rs.10,800 for a one year contract
- Interest rate : 12 per cent
- PV (storage costs) : Rs.500 per year

What is the PV (convenience yield) of copper scrap?

Solution:

$$\frac{\text{Futures price}}{(1+\text{Risk-free rate})^1} = \text{Spot price} + \text{Present value of storage costs} - \text{Present value of convenience yield}$$
$$\frac{10,800}{(1.12)^1} = 10,000 + 500 - \text{Present value of convenience yield}$$

Hence the present value of convenience yield is Rs.857.14 per ton.

5. The following information about gunmetal scrap is given:

- Spot price : Rs.150,000 per ton
- Futures price : Rs.160,000 for a one year contract
- Interest rate : 13 per cent
- PV (storage costs) : Rs.800 per year

What is the PV (convenience yield) of gunmetal scrap?

Solution:

$$\frac{\text{Futures price}}{(1+\text{Risk-free rate})^1} = \text{Spot price} + \text{Present value of storage costs} - \text{Present value of convenience yield}$$
$$\frac{160,000}{(1.13)^1} = 150,000 + 800 - \text{Present value of convenience yield}$$

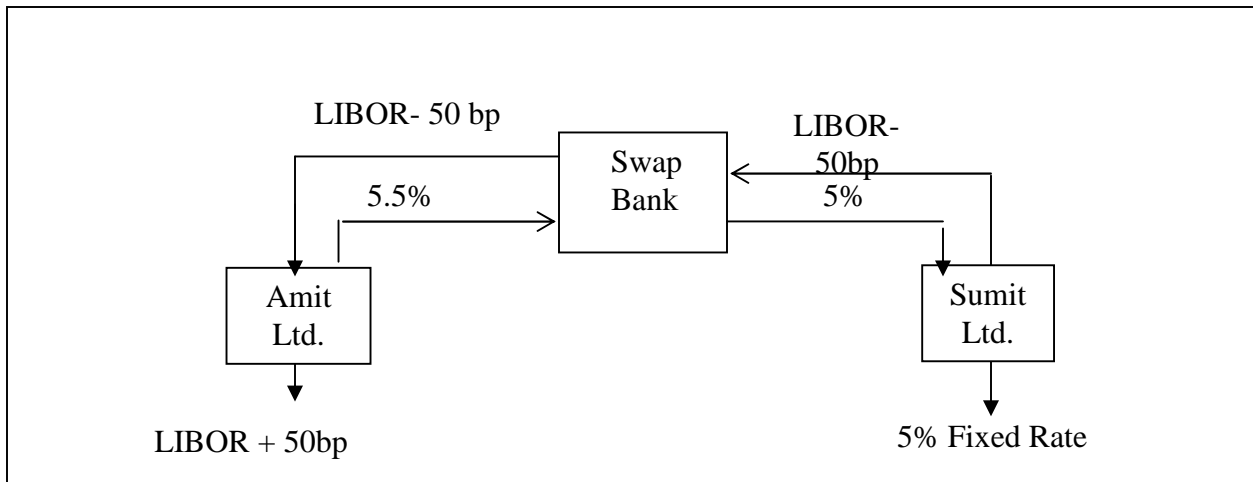
Hence the present value of convenience yield is Rs.9,207 per ton.

6. Consider the following data

	Amit Corpn.	Sumit Corpn.
• Desired Funding	Fixed Rate 5 years 50 million	Floating Rate 5 years 50 million
• Cost of Fixed Rate Funding	7.0 %	5.0 %
• Cost of Floating Rate Funding	6-month LIBOR +50 bp	6 month LIBOR

Show how both the parties can save on funding cost by entering into a coupon swap with the help of a swap bank. Assume that the bank wishes to earn 0.5 % and the balance of savings is shared equally between the two firms.

Solution:



7. Consider the following data

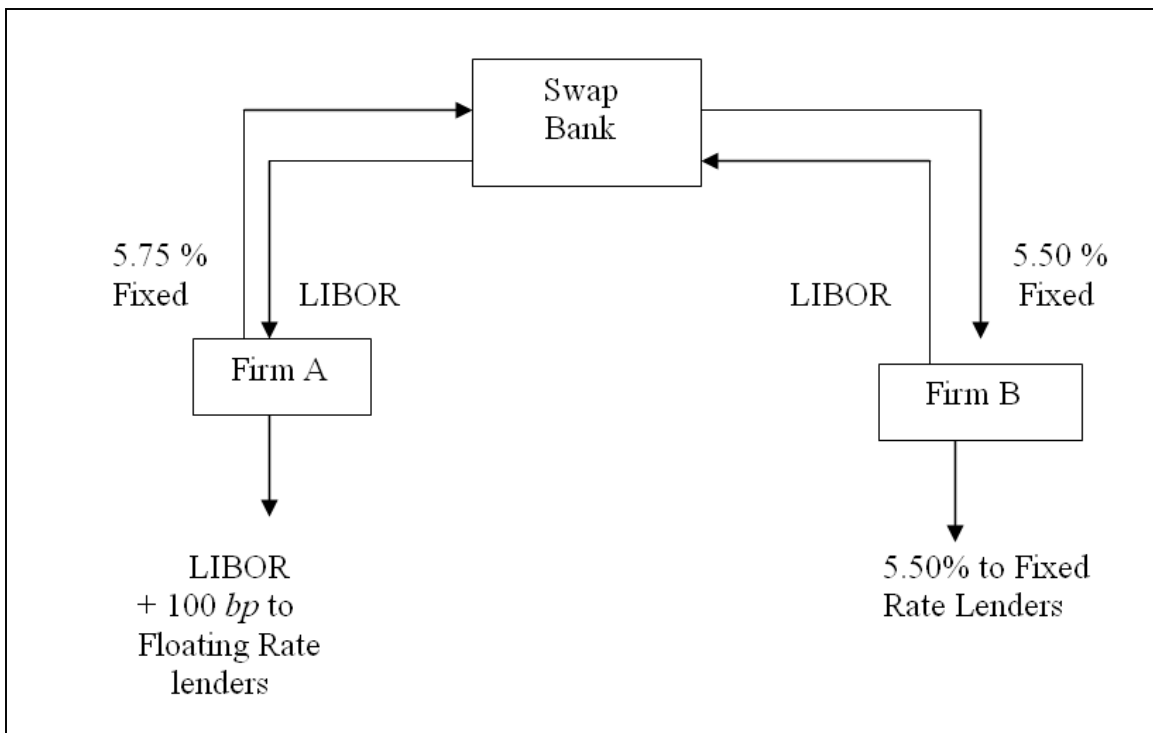
	<i>Firm A</i>	<i>Firm B</i>
• Desired Funding	Fixed Rate \$ 5 years 40 million	Floating Rate \$ 5 years 40 million
• Cost of Fixed Rate Funding	7 %	5.50 %
• Cost of Floating Rate Funding	6-month LIBOR + 100 bp	6 month LIBOR+25 bp

Show by way of a diagram how the parties can save on funding cost by entering into a coupon swap with the help of a swap bank. Assume that the cost saved is shared equally by the two firms and the bank.

Solution:

The total savings that will be effected will be

$[(7\% - 5.5\%) - (\text{LIBOR} + 1.00\% - \text{LIBOR} - 0.25\%)] = 0.75\%$. The share of each in the savings is therefore 0.25%. To realise this, a swap can be arranged as shown in the following diagram.

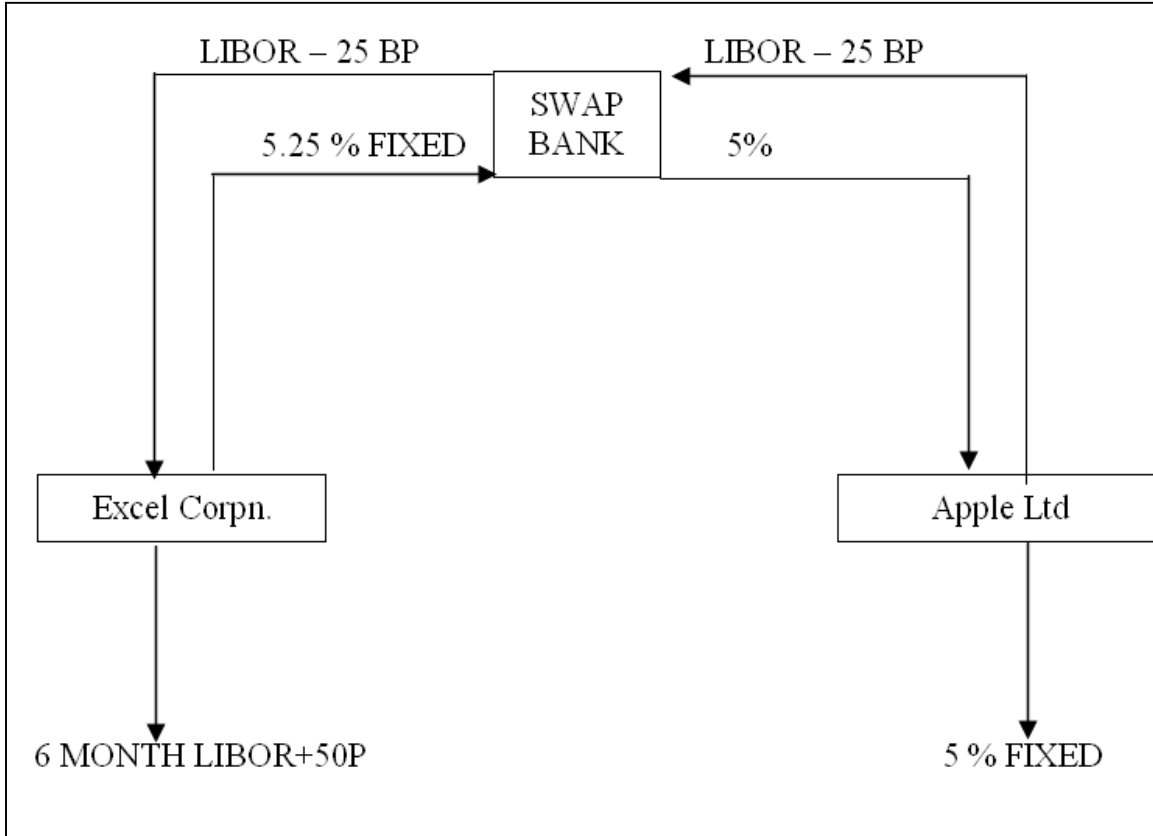


8. Consider the following data:

	<i>Excel Corpn.</i>	<i>Apple Ltd</i>
Desired Funding	Fixed Rate \$ 5 years 200 million	Floating Rate \$ 5 years 200 million
Cost of Fixed Rate Funding:	6.25%	5%
Cost of Floating Rate Funding:	6month LIBOR+50bp	6 month LIBOR

Both the companies have approached you, a swap banker, for arranging a swap in such a way that the savings is split equally among all the three. Show diagrammatically how you will arrange such a swap.

Solution:



9. As a swap banker, you are approached by client A who has to fund itself in fixed rate EUR though it prefers floating rate USD funding. Its funding cost in EUR is 5.25% while it is willing to pay floating at six-month LIBOR plus 50 bp. You have another client B which has easy access to floating USD market at Sub-LIBOR cost of LIBOR-50 bp. It would like EUR funding at no more than 5% to acquire some EUR fixed rate assets. Show how the swap can be executed. Assume that swap bank incurs savings in one currency and an additional payment obligation in other currency.

Solution:

