

PRACTICE FOR MAY 2011 EXAM (EASY)

1. SUM OF PARTS VALUATION / BREAK-EVEN APPROACH / SOPV APPROACH TO VALUATION

The “SOPV” approach suggests that the sum of the individual parts of a firm may be worth more than the current value of the whole. The “SOPV” approach involves three steps.

Step 1: Identify the firm’s various business segments and calculate the average capitalization ratios for firms in those industries.

Step 2: Calculate a “theoretical” market value based upon each of the average capitalization ratios.

Step 3: Average the “theoretical” market values to determine the “SOPV” value of the firm.

Practical:

Using the SOPV approach (or Break-up value approach), assign a value for ITC Ltd. Whose stock is currently trading at a total market price of Rs.8 million. For ITC, the accounting data set forth three business segments: Cigarettes, FMCG, and paper. Data for the firm’s three segments are as follows:

Rs. in lakhs

BUSINESS SEGMENT	Segment Sales	Segment Assets	Segment Income
Cigarettes	30	15	2
FMCG	16	14	3
Paper	40	60	12

Industry data for “pure-play” firms have been compiled and are summarized as follows:

BUSINESS SEGMENT	Capitalization/Sales	Capitalization/Assets	Capitalization /OperatingIncome
Cigarettes	1.5	1.2	20
FMCG	2.20	1.8	14
Paper	2	1.2	12

Solution:

ITC – Break-up valuation

BUSINESS SEGMENT	Capitalization/Sales	Segment Sales	Theoretical Values
Cigarettes	1.5	30	45
FMCG	2.20	16	35.2
Paper	2	40	80
Total Value			160.2

BUSINESS SEGMENT	Capital-to- Assets	Segment Assets	Theoretical Values
Cigarettes	1.2	15	18
FMCG	1.8	14	25.2
Paper	1.2	60	72
Total Value			115.2

BUSINESS SEGMENT	Capital-to- Op.Income	Segment Income	Theoretical Values
Cigarettes	20	2	40

FMCG	14	3	42
Paper	12	12	144
Total Value			226

Average theoretical value = $160.2 + 115.2 + 226 / 3 = \text{Rs. } 350.73$ (approx)

2. Spot rate 1 US \$ = RS. 48.0123

180 days Forward rate for 1 US \$ = Rs. 48.8190

Annualized interest rate for 6 months – Rupee = 12%

Annualized interest rate for 6 months – US \$ = 8%

Is there any arbitrage possibility? If yes how an arbitrage can take advantage of the situation, if he is willing to borrow Rs. 40,00,000 or US \$83,312.

Solution:

Stage 1:

Let us first of all use the IRP formula to compute the \$ interest rate that ought to have prevailed –

$$\frac{F}{S} = \frac{(1 + n \times i_{\text{Rs}}) \downarrow (Re))}{(1 + n \times i_{\$})}$$

$$\frac{48.8190}{48.0123} = \frac{1 + \frac{0.12}{2}}{1 + \frac{i_{\$}}{2}}$$

Therefore, $i_{\$} = 8.5\%$ (approx)

While \$ interest rate is actually only 8%. So, arbitrage should involve borrowing \$.

Stage 2:

Arbitrage Process

Step 1: Borrow \$ 83,312 @ 8% p.a. for 6m

Therefore \$ outflow after 6 m = $83,312 (1 + 0.08/2)$
 = \$ 86,644.48

Step 2: Sell \$ 83,312 spot @ Rs 48.0123 / \$ getting Rs 40,00,000

Step 3: Invest Rs 40,00,000 @ 12% p.a. for 6m

Therefore Re receivable after 6m = $40,00,000 (1 + 0.12/2)$
 = 42,40,000

Step 4: Use Rs 42,40,000 to buy \$ 6m forward @ Rs 48.8190.

So, \$ inflow after 6m = $42,40,000 / 48.8190 = \$ 86,851.43$

Therefore, Arbitrage Profit = $86851.43 - 86644.48 = \$ 206.95$

3. An exporter in U.K. is expecting to receive Euro 1 million after 3 months. He has collected the following information from his banker.

Euro/£

Spot = 1.5778/80

3 months forward = 1.5770/72

3 months interest rate (p.a.)

Euro – 4.5% - 5%

£ - 6% - 6.5%

Which of the following would you recommend for covering the exposure?

i. Forward market

ii. Money market

Solution:

The U.K. exporter has Euro 1 million receivable after 3 months & is therefore afraid of Euro depreciation.
 There are 2 hedging alternatives –

Alternative 1: Forward Cover

The firm sells Euro 1 million 3m forward to buy £ @ 1.5772 getting $\frac{1 \text{ million}}{1.5772}$
 = £ 634035

Alternative 2: Money Market Cover (Borrow-Sell-Invest)

Step 1: Borrow the present value of Euro 1 million, i.e. $\frac{1 \text{ million}}{1 + \frac{0.05}{4}} = \text{Euro } 987,654.32$
 $\frac{987654.32}{1.5780} = \text{£ } 625890$
 Step 2: Use Euro 987,654.32 to buy £ spot @ 1.5780 getting
 Step 3: Invest £ 625890 @ 6% p.a. for 3m.

Therefore, £ inflow after 3m = $625890 \left(1 + \frac{0.06}{4} \right) = \text{£ } 635,278.35$
 Since £ inflow after 3m is higher under Alternative 2, the firm should choose Money Market Cover.

4. An importer in U.K. has a payable of Euro 500,000 after 3 months. He has collected the following information from his banker.

Euro/£ spot	=	1.4200/1.4210
3 months forward	=	1.4245/1.4256
3 months interest rate (p.a.)		
Euro –		2.60% - 2.80%
£ -		3.00% - 3.20%

Which of the following would you recommend for covering the exposure?

- i. Forward market
- ii. Money market

Solution:

The U.K. exporter has Euro 500000 payable after 3 months & is therefore afraid of Euro appreciating.
 There are 2 hedging alternatives –

Alternative 1: Forward Cover

The firm buys Euro 5 million 3m forward by selling £ @ 1.4245 requiring $\frac{500000}{1.4245} = \text{£ } 351000.35$

Alternative 2: Money Market Cover (Invest-Buy-Borrow)

Step 1: Invest the present value of Euro 500000, i.e. $\frac{500000}{1 + \frac{0.026}{4}} = \text{Euro } 496770.99$
 $\frac{496770.99}{1.4200} = \text{£ } 349838.73$
 Step 2: Buy Euro 496770.99 by selling £ spot @ 1.4200 requiring
 Step 3: Borrow £ 349838.73 @ 3.20% p.a. for 3m.

$$1 + \frac{0.320}{4}$$

Therefore, £ inflow after 3m = 349838.73 () = £ 352637.44

Since £ outflow after 3m is lower under Alternative 1, the firm should choose Forward Cover.

5. You as a dealer in foreign exchange have the following position in Swiss Francs on 31st October, 2004:

Balance in the Nostro A/c Credit	1,00,000
Opening Position Overbought	50,000
Purchased a bill on Zurich	80,000
Sold forward TT	60,000
Forward purchase contract cancelled	30,000
Remitted by TT	75,000
Draft on Zurich cancelled	30,000

What steps would you take, if you are required to maintain a credit Balance of Sw. Fcs. 30,000 in the Nostro A/c and keep as overbought position on Sw. Fcs. 10,000?

Solution:

<u>Particulars</u>	<u>NOSTRO A/C Position</u>	
	<u>Long</u>	<u>Short</u>
Opening position	50,000	-
Purchased a bill on Z which	80,000	-
Sold forward TT	-	60,000
Forward purchase contract cancelled	-	30,000
Remitted by TT (Note)	-	75,000
Draft on Z which cancelled	30,000	-
Closing Position.	-	5,000

<u>NOSTRO A/C Balance</u>		
<u>Particulars</u>	<u>Dr.</u>	<u>Cr</u>
Opening Balance	-	100,000
Remitted by TT (Note)	75,000	-
Closing Balance	-	25,000

Note: We have assumed that the remittance by TT of 75,000 is on A/C of a spot sale (not old forward sale).

Target A/C balance = 30,000Cr.

Target Position = 10,000 long/overbought.

The dealer should buy Sw. Fcs 5,000 spot to make the A/C balance 30,000 Cr. This will make the net position squared off. So the dealer should also buy Sw. Fcs 10,000 forward.

6. AMK Ltd. an India based company has subsidiaries in U.S. and U.K.

Forecasts of surplus funds for the next 30 days from two subsidiaries are as below:

U.S. \$	12.5 million
U.K. £	6 million

Following exchange rate information is obtained:

	<u>\$/Rs.</u>	<u>£/Rs.</u>
Spot	0.0215	0.0149
30 days forward	0.0217	0.0150

Annual borrowing/deposit rates (simple) are available.

Rs.	6.4%/6.2%
\$	1.6%/1.5%
£	3.9%/3.7%

The Indian operation is forecasting a cash deficit of Rs. 500 million.

It is assumed that interest rates are based on a year of 360 days.

- (i) Calculate the cash balance at the end of 30 days period in Rs. for each company under each of the following scenarios ignoring transaction costs and taxes:
- (a) Each company invests/finance its own cash balances/deficits in local currency independently.
 - (b) Cash balances are pooled immediately in India and the net balances are invested/borrowed for the 30 days period.
- (ii) Which method do you think is preferable from the parent company's point of view?

Solution: (i)

(a) US Subsidiary

The surplus of \$ 12.5 million is invested @ 1.5% p.a. for 1month.

Therefore \$ inflow after 1 month = $12.5(1 + 0.015/12) = \$12.52$ million.

Given 30 days forward rate \$0.0217/Re,

Re inflow = $12.52/0.0217 = \text{Rs } 576.96$ million.

UK subsidiary

The surplus of £ 6 million is invested @ 3.7% p.a. for 1month,

Therefore £ inflow after 1 month = $6(1 + 0.037/12) = \text{£ } 6.02$ million

i.e. $6.02/0.0150 = \text{Rs } 401.33$ million

Indian Parent

The deficit of Rs 500 million is borrowed @ 6.4% p.a. for 1 month,

Therefore, Re outflow = $500(1 + 0.064/12) = \text{Rs } 502.67$ million.

Therefore Net cash balance after 1 month = $576.96 + 401.33 - 502.67 = \text{Rs } 475.62$ million.

(b) Centralised Cash Management

Pooling of US surplus = $12.5/0.0215 =$ Rs 581.40 million.

Add: Pooling of UK surplus = $6/0.0149$ Rs 402.68 million

Less: Deficit of Indian Parent Rs 500.00 million

Net Surplus $\longrightarrow$ **Rs 484.08 million**

This is invested for 1month @ 6.2% p.a.

Therefore, cash balance after 1month = $484.08(1 + 0.062/12) = \text{Rs } 486.58$ million.

- (ii) Since centralized management results in higher cash balance, it is preferred by the Indian parents.

7. Jai Bharath Industries exported handicrafts to Germany under a letter of credit and submitted all the shipping documents to its banker on November 28, 2002. The amount of the receivable is Euro 3,00,000. The bank could negotiate the bill on December 02, 2002 and collected an exchange margin of 0.125%. The spot exchange rates as on November 28, 2002 and December 02, 2002 are given below:

		November 28, 2002	December 02, 2002
Mumbai	Rs. / \$	48.00/05	47.95/99
London	\$ / £	1.5665/67	1.5668/70
	Euro / £	1.6100/02	1.6097/99

You are required to calculate:

- a. The amount of gain or loss to the exporter due to delay in negotiation of bill under the LC.

b. Actual rupee inflow to the exporter.

SOLUTION:

The Indian exporter wants to convert Euro 300000 into rupees on Nov 28th. Since Re/€ rates are not directly quoted in India, the bank has to arrange for a synthetic quote using the rates quoted in Mumbai and London. There is a delay in negotiation of the bill under the account and the transaction is executed on Dec 2nd.

Nov 28th

$$\text{Implied Re/£} = 48 \times 1.5665 / 48.05 \times 1.5667 \\ = 75.19 / 75.28$$

$$\text{Implied Re/€} = \frac{75.19}{75.28} \times \frac{1.6102}{1.6100} \\ = 46.70 / 46.76$$

Hence, the rate for selling Euro net of commission = $46.70 - 0.125\% \text{ of } 46.70 = 46.64$

Dec 2:

$$\text{Implied Re/£} = \frac{\frac{47.95}{1.5668}}{\frac{47.99}{1.5670}} = 75.13 / 75.20$$

$$\frac{73.13}{1.6099} \times \frac{1.6099}{75.20}$$

$$\text{Implied Re/€} = \frac{1.6097}{1.6099} = 46.67 / 46.72$$

So the rate for selling Euro net of margin = $46.67 - 0.125\% \text{ of } 46.67 = 46.61$

a. Therefore, loss due to delay in negotiation of bill under L/C = $(46.64 - 46.61) \times 300000 = \text{Rs } 9000$

b. Actual Re inflow to the exporter = $300000 \times 46.61 = \text{Rs } 1,39,83,000$

8. An Indian importer has a payable of \$100,000. The seller has given the Indian importer the following two options.

- i. Pay immediately with a cash discount of 2% on the payable
- ii. Pay after 3 months with interest at 6% p.a.

The borrowing rate for the importer in Rupees is 10% p.a. The following are the exchange rates as on December 02, 2002.

Rs/\$ Spot 48.25/48.50

3 month forward 22/28

Which of the above two options is advisable for the importer?

SOLUTION:

Outflow under option i = Rs. 4871825

Outflow under option ii = Rs. 4951170

So, option (i) is advisable for the importer

9. Followings are the spot exchange rates quoted at three different forex markets:

USD/INR	48.30 in Mumbai
GBP/INR	77.52 in London
GBP/USD	1.6231 in New York

The arbitrageur has USD 1,00,00,000. Assuming that there are no transaction costs, explain whether there is any arbitrage gain possible from the quoted spot exchange rates.

SOLUTION:

Given ,	Bank A	-	Rs/\$	48.30
	Bank B	-	Re/£	77.52

Bank C - \$/£ 1.6231

Implied Re/\$ using the rates quoted by B & C = $77.52/1.6231 = 47.76$

Since actual rate quoted by Bank A is higher, \$ is overvalued by Bank A.

Step 1) Sell \$ 100, 00,000 to Bank A @ 48.30 getting Rs 483, 00,000

Step 2) Sell Rs 483, 00,000 to Bank B getting $483,000,000/77.52 = £6230650$.

Step 3) Sell £ 6230650 to Bank C getting \$ 10,11,2968.

Therefore arbitrage profit = \$112968

10. M/s Vishal Industries have issued earlier a 11.5% convertible bond of face value Rs.1,000 maturing in 2007 A.D. After a period of 3 years on the option of the investor each of these bonds can be converted into 50 equity shares of face value Rs.10 at a premium of Rs.10 each. The investment value of similar non-convertible bond is Rs.870. The current market prices of the bond and the share are Rs.970 and Rs.18.50 respectively. The dividend per share for 2000-2001 is Rs.2.12.

You are **required** to calculate

- Premium over conversion value
- Premium over investment value
- Conversion parity price of share
- Break even period.

SOLUTION:

a. Premium over conversion value = $(\text{Bond Price} - \text{Conversion Value}) / \text{Conversion Value}$
 $= (970 - 18.5 \times 50) / (18.50 \times 50)$
 $= 0.0486 = 4.86\%$

b. Premium over investment value = $(\text{Bond Price} - \text{Investment Value}) / \text{Investment Value}$
 $= (970 - 870) / 870$
 $= 0.1149 = 11.49\%$

Conversion parity price of share = $\text{Bond Price} / \text{Number of shares on conversion per bond}$
 $= 970 / 50$
 $= \text{Rs. } 19.40$

The ratio indicates that the price should rise by about 0.9 (i.e. $19.4 - 18.5$) which is 4.86% of Rs.18.5 so that parity is reached.

d. Break even period = $\text{Conversion Premium} / (\text{Interest Income} - \text{Dividends})$
 $= (970 - 18.5 \times 50) / (11.5 - 2.12 \times 50)$
 $= 45/9 = 5 \text{ years}$

The period of 5 years indicates that with the present projections the bond holders should plan for a holding horizon of 5 year before converting into stock.

11. Following are the covered after-tax lending and borrowing rates for three units of a Multinational Corporation located in the United States, Singapore and India.

	Lending (%)	Borrowing (%)
United States	4.5	5
Singapore	3.5	4
India	4.6	5.4

Currently, the Singapore and India units owe \$2 million and \$3 million, respectively to their US parent. The Singapore unit also has \$1 million in receivables from its India affiliate. The timing of these payments can be changed by up to 60 days in either direction. If US Parent is in deficit of funds, while both the Singapore and India subsidiaries have surplus cash available, you are **required** to:

- Determine the MNC's optimal leading and lagging strategies
- Calculate the net profit impact of these adjustments
- Indicate the change in the MNC's optimal strategy, if the US parent has surplus cash available.

SOLUTION:

a. Both Singapore and India subsidiaries (which have surplus cash) should speed up their payments to the US parent (which is in deficit of cash), since the borrowing rate (5%) in US is more than the lending rates in Singapore (3.5%) and India (4.6%). However, the Indian unit should lag its payments to its Singapore affiliate, since lending rate in Singapore (3.5%) is less than the lending rate in India (4.6%).

b. Speeding up the payments by Singapore and India subsidiaries to the US parent:

The US parent reduces its borrowings by \$5,000,000, when it receives funds 60 days earlier from its affiliates.

Therefore, the interest savings by the US parent = $\$5,000,000 \times (5/100) \times (60/360) = \41666.67 .

Since both Singapore and India affiliates are paying 60 days earlier to their US parent, the available cash with them will be reduced by \$2 million and \$3 million respectively.

Therefore, The interest foregone by Singapore affiliate = $\$2,000,000 \times (3.5/100) \times (60/360) = \11666.67

The interest foregone by India affiliate = $\$3,000,000 \times (4.6/100) \times (60/360) = \23000

The net savings from this transaction = Interest saving by the US parent – Interest foregone by Singapore and Indian affiliates = $\$41666.67 - (\$11666.67 + \$23,000) = \7000

Lagging the payment by Indian subsidiary to its Singapore affiliate:

Cash available with India subsidiary will be more by \$1,000,000, when it lags the payment by 60 days

Interest earned by it = $\$1,000,000 \times (4.6/100) \times (60/360) = \7666.67

Interest foregone by Singapore affiliate = $\$1,000,000 \times (3.5/100) \times (60/360) = \$5,833.33$

The net savings from this transaction = $\$7666.67 - \$5833.33 = \$1833.34$.

c. If the US parent has surplus cash, Singapore subsidiary should lead its payments to the US parent, since lending rate in US (4.5%) is more than the lending rate in Singapore (3.5%). However, Indian subsidiary should lag the payment to the US parent, since lending rate in US (4.5%) is less than the lending rate in India (4.6%).

Similarly Indian subsidiary should lag the payment to its Singapore affiliate, since interest rate in India (4.6%) is more than the lending rate in Singapore (3.5%).

12. Carbon Jewelers Ltd. has imported diamonds worth \$50 million from a company in South Africa. The payment for the imports has to be settled in dollars after one month. Treasurer of the company is thinking to cover the payable through options. Following European options on dollars of maturity one month are quoted at the market:

Strike price (Rs.) Option Premium (Rs.)

47.00 Call 0.50

47.00 Put 0.05

The treasurer is considering the following three alternatives:

- Buying a call option
- Writing a put option
- Buying a call and writing a put option simultaneously.

Due to recent wide fluctuations in the rupee-dollar exchange rate, the treasurer is of the opinion that exchange rate of dollar may remain between Rs.46 and Rs.48 after one month.

You are **required** to show the pay-off profile of all the three alternatives and suggest the treasurer about the best alternative of hedging with reasons for the same.

SOLUTION:

Pay-off profile of buying a call option:

Spot Price	Option Exercised	Premium	Net cost per dollar	Net cash outflow
46.00	No	-0.50	46.50	2325
46.20	No	-0.50	46.70	2335
46.50	No	-0.50	47.00	2350
46.70	No	-0.50	47.20	2360
47.00	No	-0.50	47.50	2375
47.20	Yes	-0.50	47.50	2375
47.50	Yes	-0.50	47.50	2375
48.00	Yes	-0.50	47.50	2375

Pay-off profile of writing a put option:

Spot Price	Option Exercised	Premium	Net cost per dollar	Net cash outflow
46.00	Yes	0.05	46.95	2347.5
46.20	Yes	0.05	46.95	2347.5
46.50	Yes	0.05	46.95	2347.5
46.70	Yes	0.05	46.95	2347.5
47.00	No	0.05	46.95	2347.5
47.20	No	0.05	47.15	2357.5
47.50	No	0.05	47.45	2372.5
48.00	No	0.05	47.95	2397.5

Pay-off profile of buying call and writing a put option:

Spot Price	Option Exercised		Premium	Net cost per dollar	Net cash outflow
	Call	Put			
46.00	No	Yes	-0.45	47.45	2372.5
46.20	No	Yes	-0.45	47.45	2372.5
46.50	No	Yes	-0.45	47.45	2372.5
46.70	No	Yes	-0.45	47.45	2372.5
47.00	No	No	-0.45	47.45	2372.5
47.20	Yes	No	-0.45	47.45	2372.5
47.50	Yes	No	-0.45	47.45	2372.5
48.00	Yes	No	-0.45	47.45	2372.5

So if the treasurer buys the call options, the maximum possible outflow will be Rs.2375 million. If exchange rate of dollar remain below Rs.47/\$, the outflow will be lower.

If the treasurer writes the put options the minimum outflow is capped at Rs.2347.5 million but there is a risk of greater outflow if rupee depreciates beyond Rs.47 per dollar.

For buying call and writing put, outflow is capped at Rs.2372.5 million. So if the treasurer expects rupee dollar exchange rate will remain below Rs.47, buying call option alone is best alternative. If he expects

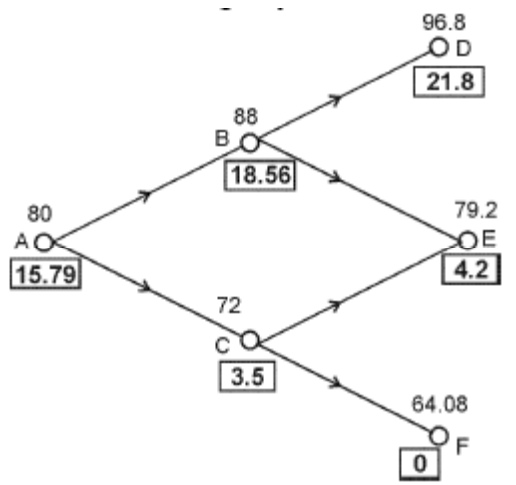
that rupee will depreciate beyond Rs.47, buying call and writing put simultaneously is the best alternative.

13. A company's stock is currently traded at the market at Rs.80. A two year American call option on the company's stock with strike price of Rs.75 is available at the market. The price of the stock in the two years time either move up or down by 10% in each year. The risk-free interest rate is 8%.

You are **required** to use Two-step Binomial Model to find out the price of the two year American call option on the company's stock.

SOLUTION:

The situation can be represented in the following way:



Using single-period model, the probability of price increase, $p = \frac{R - d}{u - d} = \frac{1.08 - 0.90}{1.10 - 0.90} = 0.90$

Probability of price decrease = $1 - 0.90 = 0.10$

The value of American call option at node D, E and F will be equal to the value of European call option on these nodes.

Value at node D : $96.8 - 75 = 21.8$

Value at node E : $79.2 - 75 = 4.2$

Value at node F : as stock price is less than strike price, so call has zero value.

Using single-period model, the value of call option at node B is

$$\begin{aligned}
 C &= \frac{C_u p + C_d (1 - p)}{R} \\
 &= \frac{21.8 \times 0.9 + 4.2 \times 0.1}{1.08} = 18.56
 \end{aligned}$$

At node B pay-off from early exercise is Rs.13, which is less than the value calculated using single-period model. Hence at node B early exercise is not advisable and value of American call option will be Rs.18.56.

Value at node C is

$$C = \frac{4.2 \times 0.9 + 0 \times 0.1}{1.08} = 3.50$$

At node C, value of early exercise is zero, hence at node C value of call is Rs.3.50.
 Value of American call option at node A is

$$C = \frac{18.56 \times 0.9 + 3.5 \times 0.1}{1.08} = 15.79$$

The value of early exercise at node A is Rs.5, which is less than the value arrived through single-period binomial model. Hence, the value of two-year American call option is Rs.15.79.

14. Mr. XYZ has categorized all the available stocks in the market into the following types:

- i. Small cap value stocks
- ii. Small cap growth stocks
- iii. Large cap value stocks
- iv. Large cap growth stocks

He has also estimated the weights of the above categories of stocks in the market index. Further more, the sensitivity of returns on these categories of stocks to the three important factors are estimated to be:

Category of Stocks	Weight in the Market Index	Factor I (Beta)	Factor II (Price/Book)	Factor III (Average Capitalization)
Small cap value	10%	0.90	0.75	1.25
Small cap growth	25%	0.80	1.39	1.35
Large cap value	15%	0.85	2.05	6.75
Large cap growth	50%	1.165	2.75	8.65
Risk Premium		6.85%	-3.5%	0.65%

The risk free rate of return is 4.5% . **Required:**

- a. Using Arbitrage Pricing Theory, determine the expected return on the market index.
- b. Using Capital Asset Pricing Model, determine the expected return on the market index.
- c. Mr. XYZ wants to construct a portfolio constituting only the 'small cap value' and 'large cap growth' stocks. If the target beta for the portfolio is one, determine the composition of his portfolio.

SOLUTION:

a. Portfolio's return

$$\text{Small cap value} = 4.5 + 0.90 \times 6.85 + 0.75 \times (-3.5) + 1.25 \times 0.65 = 8.8525\%$$

$$\text{Small cap growth} = 4.5 + 0.80 \times 6.85 + 1.39 \times (-3.5) + 1.35 \times 0.65 = 5.9925\%$$

$$\text{Large cap value} = 4.5 + 0.85 \times 6.85 + 2.05 \times (-3.5) + 6.75 \times 0.65 = 7.535\%$$

$$\text{Large cap growth} = 4.5 + 1.165 \times 6.85 + 2.75 \times (-3.5) + 8.65 \times 0.65 = 8.478\%$$

Expected return on market index :

$$0.10 \times 8.8525 + 0.25 \times 5.9925 + 0.15 \times 7.535 + 0.50 \times 8.478 = 7.7526\%$$

b. Using CAPM,

$$\text{Small cap value} = 4.5 + 6.85 \times 0.90 = 10.665\%$$

$$\text{Small cap growth} = 4.5 + 6.85 \times 0.80 = 9.98\%$$

$$\text{Large cap value} = 4.5 + 6.85 \times 0.85 = 10.3225\%$$

$$\text{Large cap growth} = 4.5 + 6.85 \times 1.165 = 12.48\%$$

Expected return on market index

$$= 0.10 \times 10.665 + 0.25 \times 9.98 + 0.15 \times 10.3225 + 0.50 \times 12.48$$

= 11.35%

c. Let us assume that Mr. XYZ will invest X_1 % in small cap value stock and X_2 % in large cap growth stock

$$X_1 + X_2 = 1$$

$$0.90 X_1 + 1.165 X_2 = 1$$

$$0.90 X_1 + 1.165 (1 - X_1) = 1$$

$$0.90 X_1 + 1.165 - 1.165 X_1 = 1$$

$$0.165 = 0.265 X_1$$

$$X_1 = 0.165 / 0.265$$

$$X_1 = 0.623$$

$$X_2 = 0.377$$

62.3% in Small cap value

37.7% in Large cap growth.

15. Given below is the monthly closing prices of M/s Infotech Ltd. for year 2000:

	Rs.
January	1325
February	1310
March	1340
April	1355
May	1375
June	1430
July	1470
August	1495
September	1510
October	1500
November	1480
December	1430

Using the above data you are **required** to prepare a six month exponential moving average (EMA) for the period of July to December of Year 2000.

SOLUTION:

$$\text{Smoothing factor for 6 month EMA} = \frac{2}{6} = \frac{1}{3} = 0.33$$

Month	Closing price (1)	EMA for previous month (2)	(3) = (1) - (2)	(4) = 0.33 × (3)	EMA (5) = (2) + (4)
1	1325	—	—	—	—
2	1310	—	—	—	—
3	1340	—	—	—	—
4	1355	—	—	—	—
5	1375	—	—	—	—
6	1430	—	—	—	1355.83*
7	1470	1355.83	114.17	37.68	1393.51
8	1495	1393.51	101.49	33.49	1427.00
9	1510	1427.00	83.00	27.39	1454.39
10	1500	1454.39	45.61	15.05	1469.44
11	1480	1469.44	10.56	3.48	1472.92
12	1430	1472.92	-42.92	-14.16	1458.76

* The value in 6th row last column i.e. 1355.83 is the SMA (Simple Moving Average) of the first 6 closing prices.

16. A bond issued by ABC Co. is selling presently at the face value of Rs.100 and pays coupon at the rate of 10% p.a. in arrears and will be redeemed at Rs.110 after 3 years.

a. The n year spot rate of interest, **yn**, is given by **yn**(%) = 9.0 + n/10 for n = 1,2 and 3.

Assuming the pure expectations theory holds good calculate

i. The implied one year forward rates applicable at times t = 1 and t = 2

ii. The value of the bond at time t = 0

SOLUTION:

a. i. We can find forward rates $f_{1,1}$ and $f_{2,1}$ using the spot rates y_1 , y_2 and y_3 :

$$(1 + y_2)^2 = (1 + y_1) (1 + f_{1,1}) \text{ and}$$

$$(1 + y_3)^3 = (1 + y_2)^2 (1 + f_{2,1})$$

For $f_{1,1}$

$$(1.092)^2 = (1.091) (1 + f_{1,1})$$

$$f_{1,1} = 0.093 \text{ i.e. } 9.3\%$$

For $f_{2,1}$

$$(1.093)^3 = (1.092)^2 (1 + f_{2,1})$$

$$\Rightarrow f_{2,1} = 0.05 \text{ i.e. } 9.5\%$$

ii. The value of the bond at t = 0

$$= 10 (\text{PVIF}_{9.1\%,1} + \text{PVIF}_{9.2\%,2} + \text{PVIF}_{9.3\%,3}) + 110 \times \text{PVIF}_{9.3\%,3}$$

$$= 10 (0.9166 + 0.8386 + 0.7658) + 110 \times 0.7658 = \text{Rs.}109.45$$

17. Assuming lease amortized in 5 years, calculate alternate rental structure from the following :

Investment Outlay Rs.100 Lakh

Pre Tax Rate 20%

Scrap Value Nil

Schemes:

(a) Equal Annual Plan

(b) Stepped Up Plan (15% increase per annum)

(c) Balloon Plan (he pays Rs. 100,000 in the fourth year)

(d) Deferred plan (deferment of 2 years)

Calculate Lease Rentals.

SOLUTION:

Scheme (a)

$$100 = \text{LR} \times \text{PVIFA} (20,5)$$

$$100 = \text{LR} \times 2.991$$

$$\text{LR} = 33.434 \text{ lakhs per year.}$$

Scheme (b)

$$100 = \text{LR} \times \text{PVIF} (20,1) + (1.15) \text{LR} \times \text{PVIF} (20,2) + (1.15)^2 \text{LR} \times \text{PVIF} (20,3) + (1.15)^3 \text{LR} \times \text{PVIF} (20,4) + (1.15)^4 \text{LR} \times \text{PVIF} (20,5)$$

$$\text{LR} = 26.09 \text{ lakhs per year.}$$

Scheme (c)

$$100 = \text{LR} \times \text{PVIF} (20,4) + \text{LR} \times \text{PVIF} (20,5)$$

$$4 \times 0.482 + \text{LR} \times 0.402$$

$$1.928 + \text{LR} \times 0.402$$

$$98.072 = 0.402 \times \text{LR}$$

$$\text{LR} = 243.96 \text{ lakhs per year.}$$

Scheme (d)

$$\begin{aligned}
 100 &= LR \times PVIF(20,3) + LR \times (20,4) + LR \times PVIF(20,5) \\
 &= LR(0.579 + 0.482 + 0.402) \\
 &= LR \times 1.463 \\
 LR &= 68.35 \text{ lakhs per year.}
 \end{aligned}$$

18. Consider the following information related to a bond:

Par Value	Rs. 1000
Time to Maturity	15 years
Coupon rate (Interest payable annually)	8%
Current Market Price	Rs. 847.88
Yield to Maturity (YTM)	10%

Other things remaining the same, if the bond starts paying interest semi-annually, find the change in the market price of the bond.

SOLUTION:

The equation expressing the relationship between Market Price of the bond and YTM is as follows

$$P_0 = C_0 \times PVIFA_{(k, n)} + F \times PVIF_{(k, n)}$$

Substituting the given values in the equation, we get

$$\begin{aligned}
 P_0 &= 40 \times PVIFA_{(5\%, 30)} + 1000 \times PVIF_{(5\%, 30)} \\
 &= 896.2
 \end{aligned}$$

Therefore, the change in market price = $(846.28 - 847.88) / 847.88 = -0.189\%$.

19. A foreign institutional investor (FII) proposes to invest \$10 million in an Indian security with a beta of 1.10 and standard deviation of returns 7%. The holding period of investment will be one year. The current rupee-dollar exchange rate is Rs.45.45 / \$. The expected depreciation of rupee against dollar over the period is 2% with a standard deviation of 10%. The expected return from the market portfolio in India is 12% and the correlation between the return on security and the exchange rate is 0.50. The risk free rate of return in India is 5%.

You are **required** to calculate the expected return and risk for the FII.

SOLUTION:

$$\begin{aligned}
 \text{Expected return from the security} &= R_f + \beta (R_m - R_f) \\
 &= 0.05 + 1.10 (0.12 - 0.05) \\
 &= 12.70\%
 \end{aligned}$$

Let the rupee – dollar exchange rate after one year will be x

$$\frac{\frac{1}{45.45} - \frac{1}{x}}{\frac{1}{45.45}} = 0.02$$

$$\text{or } \frac{1}{45.45} - \frac{1}{x} = 0.02 \times \frac{1}{45.45}$$

$$\begin{aligned} \text{or } \frac{1}{x} &= \left[\frac{1}{45.45} - 0.02 \times \frac{1}{45.45} \right] \\ &= 0.022 - 0.00044 \\ &= 0.02156 \end{aligned}$$

$$\text{or } x = 46.38$$

If the FII invested \$ 10 million in Indian security

$$\begin{aligned} \therefore \text{Amount invested in rupees} &= 10 \times 45.45 \\ &= \text{Rs. } 454.50 \end{aligned}$$

$$\begin{aligned} \text{The value of investment after one} &= 454.50(1.1270) \\ &= \text{Rs. } 512.2215 \text{ million} \end{aligned}$$

$$\begin{aligned} \therefore \text{value of investment in \$} &= \frac{512.2215}{46.38} \\ &= \$11.044 \text{ million} \end{aligned}$$

$$\begin{aligned} \therefore \$ \text{ return of investment} &= \frac{11.044 - 10.00}{10} \\ &= 10.44\% \end{aligned}$$

$$\therefore \text{Expected return to FII} = 10.44\%$$

$$\begin{aligned} \text{Variance of returns} &= \text{Var}(r_p) + \text{Var}(S\%) + 2 \text{Cov}(r_p, S\%) \\ &= (7)^2 + (10)^2 + 2 \times 0.50 \times 7 \times 10 \\ &= 219(\%)^2 \end{aligned}$$

$$\text{Total risk of investment} = 219 (\%)^2$$

20. The closing value of the Sensex for the month of October 2001 is given as below:

Date	Closing Sensex value
1/10/01	2795.30
3/10/01	2754.95
4/10/01	2788.97
5/10/01	2812.90
8/10/01	2765.37
9/10/01	2794.42
10/10/01	2896.60
11/10/01	2943.69
12/10/01	2953.39
15/10/01	2976.30
16/10/01	2992.46
17/10/01	3043.85
19/10/01	3016.84
22/10/01	3001.80
23/10/01	3061.91
24/10/01	3047.92
25/10/01	3022.16
29/10/01	3009.33
30/10/01	2957.45
31/10/01	2989.35

You are **required** to test the weak form of efficient market hypothesis by applying the “Run test” at 5% and 10% level of significance.

SOLUTION:

To test the independence of the prices, we require

Total number of runs : r

No. of positive runs : n_1

No. of negative runs : n_2

The mean and the standard error of the mean are calculated by the following formulas:

$$\mu_r = \frac{2n_1n_2}{n_1 + n_2} + 1$$

$$\text{and } \sigma_r = \sqrt{\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)}}$$

Date	Closing Sensex	Sign of Price Changes
1/10/01	2795.30	
3/10/01	2754.95	(-)
4/10/01	2788.97	(+)
5/10/01	2812.90	(+)
8/10/01	2765.37	(-)
9/10/01	2794.42	(+)
10/10/01	2896.60	(+)
11/10/01	2943.69	(+)
12/10/01	2959.39	(+)
15/10/01	2976.30	(+)
16/10/01	2992.44	(+)
17/10/01	3043.85	(+)
19/10/01	3016.84	(+)
22/10/01	3001.80	(-)
23/10/01	3061.91	(+)
24/10/01	3047.92	(-)
25/10/01	3022.16	(-)
29/10/01	3009.33	(-)
30/10/01	2957.45	(-)
31/10/01	2989.35	(+)

Total number of price changes, r = 8

No. of positive price changes, n_1 = 11

No. of negative price changes, n_2 = 8

$$\begin{aligned}\mu_r &= \frac{2 \times 11 \times 8}{11 + 8} + 1 \\ &= \frac{176}{19} + 1 = 10.26\end{aligned}$$

$$\begin{aligned}
 \hat{\sigma}_r &= \left(\frac{2n_1n_2(2n_1n_2 - n_1 - n_2)}{(n_1 + n_2)^2(n_1 + n_2 - 1)} \right)^{1/2} \\
 &= \left(\frac{(2 \times 11 \times 8)(2 \times 11 \times 8 - 11 - 8)}{(11 + 8)^2(11 + 8 - 1)} \right)^{1/2} \\
 &= \left(\frac{176 \times 157}{(19)^2(18)} \right)^{1/2} \\
 &= (4.252)^{1/2} = 2.06
 \end{aligned}$$

Since too few runs in this case would indicate that the movement of prices is not random, we employ a two-tailed test to test the randomness of prices.

Test at 5% significance level

At $\alpha = 0.05$, using t – table at 18 degrees of freedom

$$\text{The lower limit: } \mu_r - t \times \hat{\sigma}_r = 10.26 - 2.101 \times 2.06 = 5.932$$

$$\text{The upper limit: } \mu_r + t \times \hat{\sigma}_r = 10.26 + 2.101 \times 2.06 = 14.588$$

At 10% confidence interval we have:

$$\text{Lower limit} = 10.26 - 1.734 \times 2.06 = 6.688 \text{ and upper limit} = 10.26 + 1.734 \times 2.06 = 13.832$$

As observed r lies between these limits, hence, both confirms that Indian stock market exhibits the weak form of market efficiency.

21. The current stock price of Telesoftek Ltd. is quoting at Rs.75. The standard deviation of continuously compounded annual rate of return from the stock is 25%. The risk-free rate in the economy is 8%.

You are **required** to

- Calculate the value of a call option with strike price Rs.100 and time to expiration 6 months using Black Schole's option valuation model.
- Calculate the value of a put option with strike price Rs.100 and time to expiration 6 months.

SOLUTION:

a. Value of a call option $C = S N(d_1) - X e^{-rt} N(d_2)$

Where, $S = \text{Rs. } 75$
 $X = \text{Rs. } 100$
 $r = 0.08$
 $t = 0.50 \text{ years}$
 $\sigma = 0.25$

$$\text{and } d_1 = \frac{\ln(S/X) + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

$$= \frac{\ln(75/100) + \left(0.08 + \frac{0.25^2}{2}\right)0.5}{0.25\sqrt{0.50}}$$

$$= \frac{-0.2877 + 0.05563}{0.17678}$$

$$= -1.3128$$

$$\begin{aligned} d_2 &= d_1 - \sigma\sqrt{t} \\ &= -1.3128 - 0.25\sqrt{0.5} \\ &= -1.3128 - 0.17678 \\ &= -1.4896 \end{aligned}$$

$$\begin{aligned} \therefore N(d_1) &= N(-1.3128) \\ &= 0.50 - 0.4049 = 0.0951 \end{aligned}$$

$$\begin{aligned} \text{and, } N(d_2) &= N(-1.4896) \\ &= 0.50 - 0.4319 = 0.0681 \end{aligned}$$

$$\begin{aligned} \therefore C &= S N(d_1) - X e^{-rt} N(d_2) \\ &= 75 \times 0.0951 - 100 \times e^{-0.08 \times 0.50} \times 0.0681 \\ &= 7.1325 - 100 \times 0.9608 \times 0.0681 \\ &= 7.1325 - 6.5430 \\ &= \text{Rs. } 0.59 \end{aligned}$$

b. Value of put option, $P = X e^{-rt} N(-d_2) - S N(-d_1)$

$$N(-d_1) = N(1.3128) = 0.50 + 0.4049 = 0.9049$$

$$N(-d_2) = N(1.4896) = 0.50 + 0.4319 = 0.9319$$

$$\begin{aligned} \therefore P &= 100 \times e^{-0.08 \times 0.50} \times 0.9319 - 75 \times 0.9049 \\ &= 100 \times 0.9608 \times 0.9319 - 67.8675 \\ &= 89.5370 - 67.8675 \\ &= \text{Rs. } 21.67 \end{aligned}$$

22. The following options are quoted at the market:

Option	Expiration	Strike price	Premium
Call	1 month	Rs.48.50/\$	Rs.0.30
Put	1 month	Rs.48.50/\$	Rs.0.05

A trader is looking at the above options and planning to adopt long strip or long strap strategy to make profit from the rupee – dollar exchange rate volatility.

You are **required** to

a. Show the pay-off profile and indicate break-even points for strip and strap strategies in a price range of Rs.47 – Rs.50 for a dollar.

b. Comment on the desirability of the above two option strategies.

SOLUTION:

a. Strip Strategy

Buy one call at 48.50

Buy two puts at 48.50

Total initial outflow = $0.30 + 2 \times 0.05 = \text{Rs.}0.40$

Spot price	Exercised		Profit from		Initial outflow	Net inflow
	Call	Puts	Call	Puts		
47.00	No	Yes	–	3.00	0.40	2.60
47.50	No	Yes	–	2.00	0.40	1.60
48.00	No	Yes	–	1.00	0.40	0.60
48.10	No	Yes	–	0.80	0.40	0.40
48.30	No	Yes	–	0.40	0.40	0
48.50	No	No	–	–	0.40	– 0.40
48.75	Yes	No	0.25	–	0.40	–0.15
48.90	Yes	No	0.40	–	0.40	0
49.00	Yes	No	0.50	–	0.40	0.10
49.50	Yes	No	1.00	–	0.40	0.60
50.00	Yes	No	1.50	–	0.40	1.10

Break-even points are 48.30 and 48.90.

Strap Strategy

Buy two calls at 48.50

Buy one put at 48.50

Total initial outflow = $2 \times 0.30 + 0.05 = \text{Rs.}0.65$.

Spot price	Exercised		Profit from		Initial outflow	Net inflow
	Calls	Put	Calls	Put		
47.00	No	Yes	–	1.50	0.65	0.85
47.50	No	Yes	–	1.00	0.65	0.35
47.85	No	Yes	–	0.65	0.65	0
48.00	No	Yes	–	0.50	0.65	– 0.15
48.50	No	No	–	–	0.65	– 0.65
48.825	Yes	No	0.65	–	0.65	0
49.00	Yes	No	1.00	–	0.65	0.35
49.15	Yes	No	1.30	–	0.65	0.65
49.50	Yes	No	2.00	–	0.65	1.35
50.00	Yes	No	3.00	–	0.65	2.35

Break-even points are 47.85 and 48.825.

b. The buyer of strip and strap expects there will be a significant movement in the spot price. Strip strategy is more desirable if the spot price is more likely to fall than to rise and strap strategy is desirable if spot price more likely to rise. Strip will give profit if spot price falls below 48.30 or rises above 48.90. Strip will give profit if price falls below 47.85 or rises above 48.825. So, the trader will buy strip if he expects rupee to appreciate and will buy strap if he expects rupee to depreciate significantly.

23. Vikash Ltd. is evaluating a capital project requiring an outlay of Rs.120 lakhs. It is expected to generate a net cash inflow of Rs.28.5 lakhs for 7 years. The opportunity cost of capital is 15%. Vikash Ltd. is planning to raise Rs.60 lakhs from term loan. The term loan carries an interest rate of 12% and would be repayable in 12 equal half yearly installments, the first installment falling due at the end of first-half of second year. The balance amount required for the project can be raised by issuing external equity. The issue cost is expected to be 5%. The tax rate for the company is 30%.

You are **required** to find out

- Base case NPV
- Adjusted NPV

SOLUTION:

$$\begin{aligned}
 &\text{a. Base case NPV} \\
 &= -120 + 28.5 \times \text{PVIFA}(15,7) \\
 &= -120 + 28.5 \times 4.160 \\
 &= -1.44
 \end{aligned}$$

Base case NPV of capital project of Vikash Ltd. is Rs.–1.44 lakhs.

b. The company raises Rs.60 lakhs from debt @12%. The interest and payments and loan re will be as follows:

Year	Half	Debt outstanding at the beginning	Interest	Tax shield	Present value of Tax shield	Repayment
1	1	60	3.60	1.08	1.02	0
	2	60	3.60	1.08	0.96	0
2	1	60	3.60	1.08	0.91	5
	2	55	3.30	0.99	0.78	5
3	1	50	3.00	0.90	0.67	5
	2	45	2.70	0.81	0.57	5
4	1	40	2.40	0.72	0.48	5
	2	35	2.10	0.63	0.39	5
5	1	30	1.80	0.54	0.32	5
	2	25	1.50	0.45	0.25	5
6	1	20	1.20	0.36	0.19	5
	2	15	0.90	0.27	0.13	5
7	1	10	0.60	0.18	0.08	5
	2	05	0.30	0.09	0.04	5

Total value of the tax shield = Rs.6.79 lakhs.

The company raises Rs.60 lakhs from equity.

As the issue cost is 5%, so to receive Rs.60 lakhs from equity the company has to issue equity of $(60 / 0.95)$ or, value Rs.63.16 lakhs.

Cost of issue = $63.16 - 60.00 = \text{Rs.}3.16$ lakhs.

Adjusted NPV = $-1.44 - 3.16 + 6.79 = \text{Rs.}2.19$ lakhs

24.

Consider the following prices of the stock of Kataria Motors Ltd. and the corresponding value of the Market Index:

End of Month	Kataria Motors (Rs.)	Closing Value of Market Index
October 2005	514.30	2312.30
November 2005	529.90	2384.65
December 2005	531.60	2601.40
January 2006	538.95	2370.95
February 2006	587.90	2652.25
March 2006	585.85	2836.55
April 2006	598.80	3001.10
May 2006	620.30	3074.70
June 2006	730.50	3402.55
July 2006	788.90	3557.60

You are **required** to calculate:

- The characteristic line for stock of Kataria Motors.
- The proportions of systematic risk and unsystematic risk in the total risk of the stock of Kataria Motors

SOLUTION:

The returns on Kataria Motors and market index are as follows:

Month	Return on the stock of Kataria Motors (y) %	$(y - \bar{y})$	$(y - \bar{y})^2$	Return on Market index (x)%	$(x - \bar{x})$	$(x - \bar{x})^2$	xy	x^2
October 2005								
November 2005	3.03	-1.97	3.88	3.13	-1.94	3.76	9.49	9.80
December 2005	0.32	-4.68	21.90	9.09	4.02	16.16	2.92	82.63
January 2006	1.38	-3.62	13.10	-8.86	-13.93	194.04	-12.25	78.50
February 2006	9.08	4.08	16.65	11.86	6.79	46.10	107.76	140.66
March 2006	-0.35	-5.35	28.62	6.95	1.88	3.53	-2.42	48.30
April 2006	2.21	-2.79	7.78	5.80	0.73	0.53	12.82	33.64
May 2006	3.59	-1.41	1.99	2.45	-2.62	6.86	8.81	6.00
June 2006	17.77	12.76	162.82	10.66	5.59	31.25	189.43	113.64
July 2006	7.99	2.99	8.94	4.56	-0.51	0.26	36.43	20.79
	$\bar{y} = 45.03/9 = 5.00$		$\sum (y - \bar{y})^2 = 265.68$	$45.65 \bar{x} = 5.07$		$\sum (x - \bar{x})^2 = 302.49$	$\sum xy = 352.99$	533.96

The regression equation between the two can be determined as follows:

$$\beta = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} = \frac{9 \times 352.99 - (45.65)(45.03)}{9 \times 533.96 - (45.65)^2} = 0.41$$

$$\alpha = \frac{(\sum y - \beta \sum x)}{n} = \frac{1}{9} [(45.03) - 0.41 \times (45.65)] = 2.92$$

Mean return on market = 5.07

Characteristic line: $R_i = 2.92 + 0.41R_m$

Where R_i is the return on Kataria Motors and R_m is the return on the market.

$$\text{Variance of returns from Kataria Motors } \sigma_s^2 = \frac{\sum (y - \bar{y})^2}{n-1} = \frac{265.68}{8} = 33.21$$

$$\text{Standard deviation of returns on Kataria Motors } \sigma_s = \sqrt{\sigma_s^2} = \sqrt{33.21} = 6.15$$

$$\text{Variance of market return } \sigma_m^2 = \frac{\sum(x - \bar{x})^2}{n-1} = \frac{302.49}{8} = 37.81$$

$$\text{Standard deviation of market return } \sigma_m = \sqrt{37.81} = 6.15$$

$$\text{Explained variance} = \beta^2 \sigma_m^2 = 0.41^2 \times 37.81 = 6.35$$

$$\text{Proportion of explained variance} = \frac{6.35}{33.21} = 19.12\%$$

$$\text{Unexplained variance} = 1 - 0.1912 = 0.8088 = 80.88\%$$

25. Mr. Jain has zeroed in on the following stocks with the parameters given below:

Stock	Return (%)	Systematic risk (%) ²	Residual return (%) to residual risk (%)
Premier Ltd.	16	180	0.80
Quality Pharmaceuticals	15	110	0.80
Reliance Industries	19	362	1.60
Sonata Software	13	256	1.75
Tata Tea	14	220	2.10

The standard deviation of returns on market is 14%. Market risk premium is 7.5%. 364 day T-bills are trading at Rs.94.44 in the market. You are **required** to construct an optimum portfolio using the Sharpe's optimization method.

SOLUTION:

Stock	Return (%)	Systematic Risk (%) ²	$\beta^2 =$ (Systematic Risk/ Market Variance)	β	Required Return (%) = $R_f + \beta(R_m - R_f)$	Alpha (%) (Residual Return) = Return - Required Return	Residual Risk (%)	Residual Risk ² (%) ²	Excess Return to Beta
Premier	16	180	0.92	0.96	13.1	2.9	3.625	13.14	10.52
Quality	15	110	0.56	0.75	11.525	3.475	4.34375	18.87	12.13
Reliance	19	362	1.847	1.36	16.1	2.9	1.8125	3.285	9.63
Sonata	13	256	1.306	1.14	14.45	-1.45	0.8286	0.6866	6.23
Tata tea	14	220	1.122	1.06	13.85	0.15	0.07	0.005	7.64

Yield on 364 day T-bills = $[(100/94.44) - 1] \times 365/364 \times 100 = 5.9\%$.

Stock	$(R_i - R_f)/\beta$	$(R_i - R_f) \times \beta$	$[(R_i - R_f) \times \beta]/\sigma_{ei}^2$	β^2/σ_{ei}^2	$\frac{(R_i - R_f)\beta_i}{\sum \sigma_{ei}^2}$	$\frac{\beta_i^2}{\sum \sigma_{ei}^2}$	$C_i = \frac{\sigma_m^2 \sum \frac{(R_i - R_f)\beta}{\sigma_{ei}^2}}{1 + \sigma_m^2 \sum \frac{\beta_i^2}{\sigma_{ei}^2}}$
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Quality	12.13	6.825	0.362	0.03	0.362	0.03	10.31
Premier	10.52	9.696	0.738	0.07	1.1	0.10	10.47
Reliance	9.63	17.82	5.425	0.56	6.525	0.66	9.81
Tata tea	7.64	8.59	1718	224.4	1724.525	225.06	7.66
Sonata	6.23	8.09	11.783	1.90	1736.308	226.96	7.65

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2} \left(\frac{R_i - R_f}{\beta_i} - C^* \right)$$

$$Z_Q = \frac{0.75}{18.87} (12.13 - 10.47) = 0.065978$$

$$Z_P = \frac{0.96}{13.14} (10.52 - 10.47) = 0.003653$$

$$Z_i = 0.065978 + 0.003653 = 0.069631$$

$$\% \text{ Quality} = \frac{0.065978}{0.069631} = 0.9475 = 94.75\%$$

$$\% \text{ Premier} = \frac{0.003653}{0.069631} = 0.0525 = 5.25\%$$

26. Brain Ltd. is considering whether to set up a division in order to manufacture a new product, the Agni. The following statement has been prepared, showing the projected “profitability” per unit of the new product:

Selling price		Rs.22
Material(3kg @ Rs.1.5/kg)	Rs. 4.50	
Labor (2 hours @ Rs.2.5/hour)	Rs. 5.00	
Overheads	<u>Rs. 11.50</u>	<u>Rs.21</u>
Profit/unit		Rs.1

A feasibility study, recently undertaken at a cost of Rs.50,000, suggests that a selling price of Rs.22/unit should be set. At this, price it is expected that 10000 units would be sold each year. Demand for the product is expected to cease after 5 years. Direct labor and materials cost would be incurred only for the duration of the product life.

Overheads per unit have been calculated as follows:	Rs.
Variable Overheads	2.50
Rent (see a note below)	0.80

Manager's Salary(See note b)	0.70
Depreciation (See note c)	5.00
Head Office (See note d)	<u>2.50</u>
	<u>11.50</u>

Notes:

- Agni would be manufactured in a factory rented specially for the purpose. Annual rental be Rs. 8000 payable only for as long as the factory was occupied.
- A manager would be employed to supervise production of Agnis at a salary of rs. 7000 p.a. The manager is at present employed by the company but is due to retire in the near future on an annual pension of Rs. 2000. If he continued to be employed his pension would not be paid during the period of employment. His subsequent pension rights would not be affected.
- Manufacture of the Agni would require a specialized machine costing Rs. 2,50,000. The machine would be capable of producing Agni for an indefinite period, although due to its specialized nature it would not have any resale value or scrap value when the production of Agni ceased. It is the policy of Brain Ltd. to provide depreciation on all fixed assets using the straight line method. The annual charge of Rs. 50000 for the new machine is based on a life of 5 years, equal to the period during which Agnis are expected to be produced.
- Brain Ltd. allocates its head office fixed costs to all products at the rate of Rs. 1.25/direct labour hour. Total head office fixed costs would not be affected by the introduction of the Agni to the company's range of products.

The required return of Brain Ltd. for all new projects is estimated at 5% p.a. in real terms, and you may assume that all costs and prices given above will remain constant in real terms. All cash flows would arise at the end of each year and are certain, with the exception of those relating to product life, annual sales volume and material cost per Agni. Required:

- Prepare NPV calculations, based on the estimates provided, to show whether Brain Ltd. should proceed with manufacture of the Agni?
- Prepare a statement showing how sensitive the NPV of manufacturing Agnis is to errors of estimation in each of the three factors:
Product life, Annual sales volume, and Material cost per Agni?

SOLUTION:

- | | |
|--------------------|----------------|
| Selling price | = Rs. 22 |
| Variable cost | = <u>Rs.12</u> |
| (Mat, Lab & V.O/H) | |

Costs/unit	= Rs. 10
Annual dd	=10000
Annual contn	=100,000
Incremental Relevant Fixed Cost	= 8000 + 5000
	= 13000

Annual C.F	=87000
Life	= 5 yrs
Disc. Rate	= 5 %
PVIFA (5% ,5)	=4.3295
I.Inv.	= 250000
Expected NPV	= 87000 * 4.3295 - 250000
	= 126664.

- The NPV model is given by -

$$NPV = [(14.5 - M)Q - 13000] PVIFA (5\%, n) - 250000$$

Sensitivity of NPV w.r.t M

$$Q = 10000 \text{ and } n = 5 \text{ yrs.}$$

$$NPV = [(14.5 - M)10000 - 13000] 4.3295 - 250000 = 0$$

$$M = 7.43$$

as compared to the expected value of 4.50.

$$\text{So, Margin of safety} = \frac{7.43 - 4.50}{4.50} * 100 = 65.11\%$$

Sensitivity of NPV w.r.t Q

$$M = 4.50 \text{ and } n = 5 \text{ yrs.}$$

$$NPV = [(14.50 - 4.50)Q - 13000] * 4.3295 - 250000 = 0$$

$$Q = 7074 \text{ units}$$

as compared to the expected value of 10000 units .

$$MOS = \frac{10000 - 7074}{10000} * 100 = 29.26\%$$

Sensitivity of NPV w.r.t n

$$M = 4.50 \text{ and } Q = 10000 \text{ units.}$$

$$NPV = 87000 * PVIFA (5\%, n) - 250000 = 0$$

$$PVIFA (5\%, n) = 2.8736$$

$$\frac{PVIFA (on LHS)}{3} = \frac{2.7232}{4 - 3} = \frac{3.5460}{4 - 3}$$

$$n = 3.18 \text{ yrs}$$

as compared to the expected life of 5 yrs.

$$\text{So, MOS} = \frac{5 - 3.18}{5} * 100 = 36.40\%$$

Hence, the sensitivity Analysis Report is shown below :

Factor MOS

Q	29.26%
n	36.40%
M	65.11%

27. XYZ Ltd. manufactures a special chemical for sale at Rs. 30 per kg. The variable cost of manufacture is Rs. 15 per kg. Fixed cost excluding depreciation is Rs. 2,50,000. XYZ Ltd. is currently operating at 50% capacity. It can produce a maximum of 1,00,000 kgs at full capacity.

The Production Manager suggests that if the existing machines are fully replaced the company can achieve maximum capacity in the next five years gradually increasing the production by 10% per year.

The Finance Manager estimates that for each 10% increase in capacity, the additional increase in fixed cost will be Rs. 50,000. The existing machines with a current book value of Rs. 10,00,000 can be disposed of for Rs. 5,00,000. The manager (finance) is willing to replace the existing machines provided the NPV on replacement is about Rs. 4,53,000 at 15% cost of capital after tax.

(i) You are required to compute the total value of machines necessary for replacement.

For your exercise you may assume the following:

- (a) The company follows the block assets concept and all the assets are in the same block. Depreciation will be on straight-line basis and the same basis is allowed for tax purposes.
- (b) There will be no salvage value for the machines newly purchased. The entire cost of the assets will be depreciated over five year period.
- (c) Tax rate is at 40%.
- (d) Cash inflows will arise at the end of the year.
- (e) Replacement outflow will be at the beginning of the year (year 0).
- (f)
- | Year | 0 | 1 | 2 | 3 | 4 | 5 |
|------------------------|---|------|------|------|------|------|
| Discount Factor at 15% | 1 | 0.87 | 0.76 | 0.66 | 0.57 | 0.49 |

- (ii) On the basis of data given above, the managing director feels that the replacement, if carried out, would at least yield post tax return of 15% in the three years provided the capacity build up is 60%, 80% and 100% respectively. Do you agree?

SOLUTION:

- (i) Computation of the total replacement value of machine. (Assuming that existing machines also have valid life for 5 years.)

Step 1 : Incremental Cash Inflows

Year	1	2	3	4	5
Incremental Capacity	10%	20%	30%	40%	50%
Incremental production and sales (Kgs.)	10,000	20,000	30,000	40,000	50,000
	Rs.	Rs.	Rs.	Rs.	Rs.
Incremental contribution	1,50,000	3,00,000	4,50,000	6,00,000	7,50,000
Incremental Fixed cost	50,000	1,00,000	1,50,000	2,00,000	2,50,000
Incremental PBTD	1,00,000	2,00,000	3,00,000	4,00,000	5,00,000
Tax at 40%	40,000	80,000	1,20,000	1,60,000	2,00,000
Incremental PAT BD	60,000	1,20,000	1,80,000	2,40,000	3,00,000
Discount factors	0.87	0.76	0.66	0.57	0.49
Discounted value of PAT BD	52,200	91,200	1,18,800	1,36,800	1,47,000
Total for 5 years	5,46,000				

Step 2 : Incremental Cash outflow

Let the total cost of replacement	X	
Disposal value of existing machines	5,00,000	
Incremental cash outflow	(X	—
	5,00,000)	

Step 3 : Tax savings on depreciation

(Incremental block/5) × Tax rate × (Annuity factor of 15% for 5 years)

$$[(X - 5,00,000/5) \times 40\% \times 3.35 = 0.268 \times -1,34,000$$

Step 4 : Total Discounted cash inflows

$$\begin{aligned} \text{Total incremental discounted cash inflows} &: 5,46,000 + .268X - 1,34,000 \\ &= 4,12,000 + .268 X \end{aligned}$$

Step 5 : Equation

NPV = Sum of discounted cash inflows – Sum of the discounted cash outflows

$$4,53,000 = (4,12,000 + .268 X) - (X - 5,00,000)$$

$$4,53,000 = 4,12,000 + .268 X - X + 5,00,000$$

$$4,53,000 - 4,12,000 - 5,00,000 = .268 X - X$$

$$- 4,59,000 = -0.732 X$$

$$\text{Or } 0.732 X = 4,59,000$$

$$\text{Or } X = 4,59,000/0.732 = \text{Rs. } 6,27,049$$

(ii) Evaluation whether replacement would yield post tax return of 15% in 3 years.

	1	2	3
Incremental capacity	10%	30%	50%
Incremental PBTD	1,00,000	3,00,000	5,00,000
Depreciation $(6,27,049 - 5,00,000)/5$	25,410	25,410	25,410
Incremental PBT	74,590	2,74,590	4,74,590
Tax at 40%	29,836	1,09,836	1,89,836
Incremental PAT	44,754	1,64,754	2,84,754
PAT + Depreciation	70,164	1,90,164	3,10,164
Discount factors	0.87	0.76	0.66
Discounted cash inflows	61,043	1,44,525	2,04,708
Total discounted cash inflow	4,10,276		
Discounted incremental cash outflow	1,27,049		
NPV	2,83,227		

Conclusion: As the net present value is positive the view of the manager (finance) is correct.

28. K Ltd. is considering acquiring N Ltd. the following information is available:

Company	Profit after tax	Number of Equity shares	Market value per share
K Ltd.	50,00,000	10,00,000	200.00
N Ltd.	15,00,000	2,50,000	160.00

Exchange of equity shares for acquisition is based on current market value as above.

There is no synergy advantage available:

Find the earning per share for company K Ltd. after merger.

Find the exchange ratio so that shareholders of N Ltd. would not be at a loss.

SOLUTION:

No synergy advantage available i.e. we have to mean no synergy in earning

$$(i) \quad r = \frac{P_B}{P_A} = 160/200 = 0.8$$

$$EPS_{AB} = \frac{PAT_A + PAT_B}{NA + rNB} = \frac{50 + 15}{10 + 0.8 \times 2.5} = 5.42$$

(ii) Minimum exchange ratio (β) which the shareholders of B wants would be such that

$$\beta \cdot P_{AB} = P_B = 160$$

$$\beta \times P/E \times EPS_{AB} = 160$$

$$\beta \times P/E \times \frac{PAT_A + PAT_B}{NA + \beta \cdot NB} = 160 \dots\dots\dots(i)$$

Assuming boot strap effect P/E ratio remaining same after merger, i.e. $EPS_A = 50L/10L = 5$

$$P/E = \frac{P_A}{EPS_A} = 200/5 = 40$$

= Putting in equation (i)

$$\beta \times 40 \times \frac{50+15}{10+\beta \times 2.5} = 160$$

$$\beta = 0.73$$

29.

Following are the estimates of the net cash flows and probability of a new project of M/s X Ltd.:

	Year	P=0.3	P=0.5	P=0.2
Initial investment	0	4,00,000	4,00,000	4,00,000
Estimated net after tax cash inflows per year	1 to 5	1,00,000	1,10,000	1,20,000
Estimated salvage value (after tax)	5	20,000	50,000	60,000

Required rate of return from the project is 10%. Find:

- (i) *the expected NPV of the project.*
- (ii) *the best case and the worst case NPVs.*
- (iii) *the probability of occurrence of the worst case if the cash flows are*
 - (a) *perfectly dependent overtime*
 - (b) *independent overtime.*
- (iv) *Standard deviation and coefficient of variation assuming that there are only three streams of cash flow, which are represented by each column of the table with the given probabilities.*
- (v) *Coefficient of variation of X Ltd. on its average project which is in the range of 0.95 to 1.0. If the coefficient of variation of the project is found to be less riskier than average, 100 basis points are deducted from the Company's cost of Capital*

Should the project be accepted by X Ltd ?

SOLUTION:**(i) Expected cash flows:-**

<i>Year</i>		<i>Net cash flows</i>	<i>P.V.</i>	<i>PV. @ 10%</i>
0	$(4,00,000 \times 1)$	= (-)4,00,000	1.000	(-)4,00,000
1 to 4	$(1,00,000 \times 0.3 + 1,10,000 \times 0.5 + 1,20,000 \times 0.2)$	= 1,09,000	3.169	3,45,421
5	$[1,09,000 + (20,000 \times 0.3 + 50,000 \times 0.5 + 60,000 \times 0.2)]$	= 1,52,000	0.621	94,392
NPV=				<u>39,813</u>

(ii) ENPV of the worst case

$1,00,000 \times 3.790 = \text{Rs.} 3,79,000$ (Students may have 3.791 also the values will change accordingly)

$20,000 \times 0.621 = \text{Rs.} 12,420/-$

$\text{ENPV} = (-)4,00,000 + 3,79,000 + 12,420 = (-)\text{Rs.} 8,580/-$

ENPV of the best case

$\text{ENPV} = (-)4,00,000 + 1,20,000 \times 3.79 + 60,000 \times 0.621 = \text{Rs.} 92,060/-$

(iii) (a) Required probability = 0.3

(b) Required probability = $(0.3)^5 = 0.00243$

(iv) The base case NPV = $(-)4,00,000 + (1,10,000 \times 3.79) + (50,000 \times 0.621)$
 $= \text{Rs.} 47,950/-$

$\text{ENPV} = 0.30 \times (-) 8580 + 0.5 \times 47950 + 92060 \times 0.20$
 $= \text{Rs.} 39,813/-$ Therefore,

$$\sigma \text{ENPV} = \sqrt{0.3(-8580 - 39,813)^2 + 0.5(47950 - 39,813)^2 + 0.2(92,060 - 39,813)^2}$$

$= \text{Rs.} 35,800/-$

Therefore, $\text{CV} = 35,800/39,813 = 0.90$

(v) Risk adjusted cost of capital of X Ltd. = $10\% - 1\% = 9\%$.

NPV

Year	Expected net cash flow	PV @ 9%	
0	(-) 4,00,000	1.000	(-)4,00,000
1 to 4	1,09,000	3.239	3,53,051
5	1,52,000	0.650	<u>98,800</u>
		ENPV =	<u>51,851</u>

Therefore, the project should be accepted.

30.

Engineers Ltd. is in the business of manufacturing nut bolts. Some more product lines are being planned to be added to the existing system. The machinery required may be bought or may be taken on lease. The cost of machine is Rs. 20,00,000 having a useful life of 5 years with the salvage value of Rs. 4,00,000 (consider short term capital loss/gain for the Income tax). The full purchase value of machine can be financed by bank loan at the rate of 20% interest repayable in five equal instalments falling due at the end of each year. Alternatively, the machine can be procured on a 5 years lease, year-end lease rentals being Rs. 6,00,000 per annum. The Company follows the written down value method of depreciation at the rate of 25 per cent. Company's tax rate is 35 per cent and cost of capital is 14 per cent.

- (i) Advise the company which option it should choose – lease or borrow.
- (ii) Assess the proposal from the lessor's point of view examining whether leasing the machine is financially viable at 14 per cent cost of capital.

Detailed working notes should be given.

SOLUTION:

(a) Discounting Factor:

Cost of finance 20% - Tax 35% = 13%.

- (i) PV of cash outflows under leasing alternative

Year-end	Lease rent after taxes P.A.	PVIFA at 13%	Total P.V.
1 – 5	Rs. 3,90,000	3.517	Rs. 13,71,630

PV of cash outflows under buying alternative

Year end	Loan Instalment	Tax advantage on Interest	Tax advantage on Depreciation	Net Cash Outflow	PVIF at 13%	Total PV
1	6,68,673	1,40,000	1,75,000	3,53,673	0.885	3,13,001
2	6,68,673	1,21,193	1,31,250	4,16,230	0.783	3,25,908
3	6,68,673	98,624	98,438	4,71,611	0.693	3,26,826
4	6,68,673	71,542	73,828	5,23,303	0.613	3,20,785
5	6,68,673	38,819	55,371	5,74,483	0.543	3,11,944
Total PV outflows						15,98,464
Less: PV of Salvage Value (Rs. 4,00,000 * 0.543)						2,17,200
						13,81,264
Less: PV of tax saving on short term capital loss (4,74,609 – 4,00,000) * 35% * .543						14,179
NPV of Cash outflow						13,67,085

Working Notes:

(1) Schedule of Debt Payment

<i>Year-end</i>	<i>Opening balance</i>	<i>Interest @ 20%</i>	<i>Repayment</i>	<i>Closing Balance</i>	<i>Principal Amount</i>
1	20,00,000	4,00,000	6,68,673	17,31,327	2,68,673
2	17,31,327	3,46,265	6,68,673	14,08,919	3,22,408
3	14,08,919	2,81,784	6,68,673	10,22,030	3,86,889
4	10,22,030	2,04,406	6,68,673	5,57,763	4,64,267
5	5,57,763	1,10,910*	6,68,673	0	5,57,763

*Balancing Figure

(2) Schedule of Depreciation

Year	Opening WDV	Depreciation	Closing WDV
1	20,00,000	5,00,000	15,00,000
2	15,00,000	3,75,000	11,25,000
3	11,25,000	2,81,250	8,43,750
4	8,43,750	2,10,938	6,32,812
5	6,32,812	1,58,203	4,74,609

(3) $EMI = Rs.20,00,000 / \text{Annuity for 5 years @ } 20\% = \text{i.e. } Rs.20,00,000 / 2.991$
 $= Rs. 6,68,673.$

Advice: Company is advised to borrow and buy not to go for leasing as NPV of cash outflows is lower in case of buying alternative.

Note: Students may note that the cost of capital of the company given in the question is 14% at which cash flows may also be discounted, the question is however, silent whether this cost of capital is pre-tax or post tax. If it is assumed that this is after tax cost and the cash flows are discounted at this rate there is no change in the advice to the company i.e. borrow and buy. However, if it is assumed that the cost of capital is pre-tax and the same is adjusted with the tax rate to discount the cash flows, the advice to the company changes to leasing.

(ii) Evaluation from Lessor's Point of View

	(1)	(2)	(3)	(4)	(5)
Lease Rent	6,00,000	6,00,000	6,00,000	6,00,000	6,00,000
Less: Depreciation	5,00,000	3,75,000	2,81,250	2,10,938	1,58,203
EBT	1,00,000	2,25,000	3,18,750	3,89,062	4,41,797
Less: Tax @ 35%	35,000	78,750	1,11,563	1,36,172	1,54,629
EAT	65,000	1,46,250	2,07,187	2,52,890	2,87,168
Add: Depreciation	5,00,000	3,75,000	2,81,250	2,10,938	1,58,203
Cash Inflows	5,65,000	5,21,250	4,88,437	4,63,828	4,45,371
PV factor @ 14%	0.877	0.769	0.675	0.592	0.519
PV of inflows	4,95,505	4,00,841	3,29,695	2,74,586	2,31,148

Evaluation:

Aggregate PV of cash inflows	17,31,775
Add: PV of salvage value $(4,00,000 \times 0.519)$	2,07,600
Add: Tax shelter on short-term capital loss $(4,74,609 - 4,00,000) \times 0.35 \times 0.519$	<u>13,553</u>

PV of all cash inflows	19,52,928
Cost of the machine	20,00,000
NPV	−47,072

Hence, leasing at this rate is not feasible.

Working Note: Depreciation @ 25% WDV.

Cost = Rs. 20,00,000

			(Amount in Rs.)
		<i>Depreciation</i>	<i>Balance</i>
1	20,00,000	5,00,000	15,00,000
2	15,00,000	3,75,000	11,25,000
3	11,25,000	2,81,250	8,43,750
4	8,43,750	2,10,938	6,32,812
5	6,32,812	1,58,203	4,74,609