$11.38 = 8\ B_p$

$B_p = \frac{11.38}{8} = 1.42$

Portfolio Beta (1.46) is more than market implicit Beta (1.42) hence portfolio is Risky in Comparison to market.

(ii) Calculation of required Rate of Return

		Ke	ER		
I	= 11 + (19 – 11) 1.16	= 20.28%	19.50%	Ke>ER	Sell
II	= 11 + (19 – 11) 2.28	= 29.24%	24%	Ke>ER	Sell
III	= 11 + (19 – 11) 0.9	= 18.20%	17.50%	Ke>ER	Sell
IV	= 11 + (19 – 11) 1.50	= 23%	26%	Ke<ER	Buy

Question – 32

The following information are available with respect of Krishna Ltd.

Year	Krishna Ltd. Average share price	Dividend per Share	Average Market Index	Dividend Yield	Return on Govt. Bonds
	₹	₹			
2012	245	20	2013	4%	7%
2013	253	22	2130	5%	6%
2014	310	25	2350	6%	6%
2015	330	30	2580	7%	6%

Compute beta value of the Krishna Ltd. at the end of 2015 and state your observation.

(SM TYK – 08)

Solution:

(1) Annual Return of Krishna Ltd. (x)

$x = \frac{(P_1 - P_0) + D_1}{P_0} \times 100$

$$2013 = \frac{(253-245)+22}{245} \times 100 = 12.24\%$$

$$2014 = \frac{(310-253)+25}{253} \times 100 = 32.41\%$$

$$2015 = \frac{(330-310)+30}{310} \times 100 = 16.13\%$$

(2) Calculation of Rm (y)

$$2013 = \left(\frac{2{,}130-2{,}013}{2{,}013} \times 100\right) + 5 = 10.81\%$$

$$2014 = \left(\frac{2{,}350-2\,130}{2{,}130} \times 100\right) + 6 = 16.33\%$$

$$2015 = \left(\frac{2{,}580-2{,}350}{2{,}350} \times 100\right) + 7 = 16.79\%$$

$$Rf = \frac{6+6+6}{3} = 6\%$$

Calculation of Cov_{xy}

Year	x	$(x-\bar{x})$	y	$(y-\bar{y})$	$(y-\bar{y})^2$	$(x-\bar{x})(y-\bar{y})$
1	12.24	-8.02	10.81	-3.83	14.67	30.717
2	32.41	12.15	16.33	1.69	2.86	20.533
3	16.13	-4.13	16.79	2.15	4.62	-8.879
$\sum x =$	60.78	$\sum y =$	43.93	$\sum (y-\bar{y})^2 =$	22.15	$42.371(\%)^2$

$$\bar{x} = \frac{60.78}{3} = 20.26\%$$

$$\bar{y} = \frac{43.92}{3} = 14.64\%$$

$$\sigma_m^2 = \frac{22.15}{3} = 7.383(\%)^2$$

$$Cov_{xy} = \frac{42.371}{3} = 14.123(\%)^2$$

$\beta = \frac{Cov_{xy}}{o_m^2} = \frac{14.123}{7.383} = 1.91$

Ke $= R_f + \beta (R_m - R_f)$

$= 6 + 1.91(14.64 - 6) = 22.50\%$

Observation

2013 = Ke = 6 + (10.81 – 6) 1.91 = 15.19% > ER = 12.24 Sell

2014 = Ke = 6 + (16.33 – 6) 1.91 = 25.71% < ER = 32.41 Buy

2015 = Ke = 6 + (16.79 – 6) 1.91 = 26.61% > ER = 16.13 Sell

Question – 33

Expected returns on two stocks for particular market returns are given in the following table:

Market Return	Aggressive	Defensive
7%	4%	9%
25%	40%	18%

You are required to calculate:

(a) The Betas of the two stocks.

(b) Expected return of each stock, if the market return is equally likely to be 7% or 25%.

(c) The Security Market Line (SML), if the risk free rate is 7.5% and market return is equally likely to be 7% or 25%.

(d) The Alphas of the two stocks.

(SM TYK – 13)

Solution:

(a) Beta

$\text{Beta} = \frac{\text{Change in Stock Return}}{\text{Change in Market Return}}$

$A = \frac{40 - 4}{25 - 7} = 2$

$$D = \frac{18-9}{25-7} = 0.5$$

(b) Expected Return

A = (4 × 0.5) + (40 × 0.5) = 22%

= (9 × 0.5) + (18 × 0.5) = 13.5%

(c) Security Market Line

R_m = (7 × 0.5) + (25 × 0.5)

= 16%

SML = R_f + MRP β

= 7.5 + (16 – 7.5) β

= 7.5 + 8.5 β

(d) Alpha

Y = α + bx

Security A

22 = α + 2 × 16

α = -10

Security B

13.5 = α + 0.5 × 16

α = 5.5

Question – 34

A Ltd. has an expected return of 22% and Standard deviation of 40%. B Ltd. has an expected return of 24% and Standard deviation of 38%. A Ltd. has a beta of 0.86 and B Ltd. a beta of 1.24. The correlation coefficient between the return of A Ltd. and B Ltd. is 0.72. The Standard deviation of the market return is 20%. Suggest:

(i) Is investing in B Ltd. better than investing in A Ltd.?

(ii) If you invest 30% in B Ltd. and 70% in A Ltd., what is your expected rate of return and portfolio Standard deviation?

(iii) What is the market portfolios expected rate of return and how much is the risk-free rate?

(iv) What is the beta of Portfolio if A Ltd.'s weight is 70% and B Ltd.'s weight is 30%?

(SM TYK – 21)

Solution:

	A	B
ER	22%	24%
SD	40%	38%
Beta	0.86	1.24

r_{AB} = 0.72

σ_m = 20%

(I) Yes Investment in B Ltd is better than A Ltd due to higher return & lower standard deviation.

(II) ER_p & $S.D_p$ W_A = 0.70 W_B = 0.30

$ER_p = (22 \times 0.7) + (24 \times 0.3) = 22.60\%$

$$\sigma_p = \sqrt{\sigma_A^2 W_A^2 + \sigma_B^2 W_B^2 + 2 \times \sigma_A \times W_A \times \sigma_B \times r_{AB}}$$

$$= \sqrt{40^2 \times 0.7^2 + 38^2 \times 0.3^2 + 2 \times 40 \times 0.7 \times 38 \times 0.3 \times 0.72}$$

= 37.06%

(III) R_m & R_f

It is assumed that both securities are correctly priced

ER $= R_f + MRPB$

22 $= R_f + 0.86$ MRP ..... (i)

$$24 = R_f + 1.24\ MRP \quad \ldots\ldots\ (ii)$$

$$-2 = -0.38\ MRP$$

$$MRP = \frac{2}{0.38} = 5.26\%$$

Put MRP in equation (i)

$22 = R_f + 0.86 \times 5.26$

$R_f = 17.46$

$MRP = R_m - R_f$

$5.26 = R_m - 17.46$

$R_m = 22.72\%$

(IV) B_p

$B_p = (0.7 \times 0.86) + (0.3 \times 1.24)$

$= 0.974$

ASSET PRICING

Question – 35

Amal Ltd. has been maintaining a growth rate of 12% in dividends. The company has paid dividend @ ₹ 3 per share. The rate of return on market portfolio is 15% and the risk-free rate of return in the market has been observed as10%. The beta co-efficient of the company's share is 1.2.

You are required to calculate the expected rate of return on the company's shares as per CAPM model and the equilibrium price per share by dividend growth model.

(SM TYK – 18)

Solution:

Capital Asset Pricing Model (CAPM) formula for calculation of expected rate of return is

$ER = R_f + \beta\ (R_m - R_f)$

ER = Expected Return

β = Beta of Security

R_m = Market Return

R_f = Risk free Rate

= 10 + [1.2 (15 – 10)]

= 10 + 1.2 (5)

= 10 + 6 = 16% or 0.16

Applying dividend growth mode for the calculation of per share equilibrium price:-

$$ER = \frac{D_1}{P_0} + g$$

$$\text{or } 0.16 = \frac{3(1.12)}{P_0} + 0.12 \quad \text{or} \quad 0.16 - 0.12 = \frac{3.36}{P_0}$$

$$\text{or } 0.04\ P_0 = 3.36 \quad \text{or} \quad P_0 = \frac{3.36}{0.04} \text{ ₹ } 84$$

Therefore, equilibrium price per share will be ₹ 84.

Question – 36

An investor is holding 1,000 shares of Fatlass Company. Presently the rate of dividend being paid by the company is ₹ 2 per share and the share is being sold at ₹ 25 per share in the market. However, several factors are likely to be changed during the course of the year as indicated below:

	Existing	Revised
Risk free rate	12%	10%
Market risk premium	6%	4%
Beta value	1.4	1.25
Expected growth rate	5%	9%

In view of the above factors whether the investor should buy, hold or sell the shares? And why?

(SM TYK – 29)

Solution:

On the basis of existing and revised factors, rate of return and price of share is to be calculated.

Existing rate of return

= R_f + Beta (Rm – R_f) = 12% + 1.4 (6%) = 20.4%

Revised rate of return

= 10% + 1.25 (4%) = 15%

Price of share (original)

$$Po = \frac{D(1+g)}{K_e - g} = \frac{2(1.05)}{.204 - .05} = \frac{2.10}{.154} = ₹\ 13.63$$

Price of share (Revised)

$$Po = \frac{2(1.09)}{.15-.09} = \frac{2.18}{.06} = ₹\ 36.33$$

In case of existing market price of ₹ 25 per share, rate of return (20.4%) and possible equilibrium price of share at ₹ 13.63, this share needs to be sold because the share is overpriced (₹ 25 – 13.63) by ₹ 11.37. However, under the changed scenario where growth of dividend has been revised at 9% and the return though decreased at 15% but the possible price of share is to be at ₹ 36.33 and therefore, in order to expect price appreciation to ₹ 36.33 the investor should hold the shares, if other things remain the same.

Question – 37

An investor is holding 5,000 shares of X Ltd. Current year dividend rate is ₹ 3/ share. Market price of the share is ₹ 40 each. The investor is concerned about several factors which are likely to change during the next financial year as indicated below:

	Current Year	Next Year
Dividend paid/anticipated per share (₹)	3	2.5
Risk free rate	12%	10%
Market Risk Premium	5%	4%
Beta Value	1.3	1.4
Expected growth	9%	7%

In view of the above, advise whether the investor should buy, hold or sell the shares.

(SM TYK – 30)

Solution:

$K_e = 12 + 5 \times 1.4 = 18.5\%$

$P_0 = \frac{3\,(1.09)}{0.185 - 0.09} = ₹\ 34.42$

As per existing situation, share is overpriced, hence investor should sell the shares.

Revised Situation

$K_e = \ 10 + 4 \times 1.25 = 15.6\%$

$p_0 = \frac{2.5(1.07)}{0.156 - 0.07} = ₹\ 31.10$

In revised situation share is also overpriced, hence the investor should sell the share.

SYSTEMATIC & UNSYSTEMATIC RISK

Question – 38

A has portfolio having following features:

Security	β	Random Error σ_{ei}	Weight
L	1.60	7	0.25
M	1.15	11	0.30
N	1.40	3	0.25
K	1.00	9	0.20

You are required to find out the risk of the portfolio if the standard deviation of the market index (σ_m) is 18%.

(SM TYK – 37)

Solution:

$\beta_p = (1.60 \times 0.25) + (1.15 \times 0.30) + (1.40 \times 0.25) + (1.00 \times 0.20)$

$= 1.295$

$SR_p = \sigma_P^2 \times \sigma_M^2$

$= 1.295^2 \times 324$

$= 543.36(\%)^2$

$\sigma ep^2 = \sigma e_A{}^2 W_A{}^2 + \sigma e_B{}^2 \times W_B{}^2 + \sigma e_C{}^2 W_C{}^2 + \sigma e_D{}^2 \times W_D{}^2$

$= 49 \times 0.25^2 + 121 \times 0.30^2 + 9 \times 0.25^2 + 81 \times 0.20^2$

$= 17.755$

TR $= 543.36 + 17.755$

$= 561.115 \quad = 23.69\%$

Question – 39

A study by a Mutual fund has revealed the following data in respect of three securities:

Security	σ(%)	Correlation with Index, Pm
A	20	0.60
B	18	0.95
C	12	0.75

The standard deviation of market portfolio (BSE Sensex) is observed to be 15%.

(i) What is the sensitivity of returns of each stock with respect to the market?

(ii) What are the covariance's among the various stocks?

(iii) What would be the risk of portfolio consisting of all the three stocks equally?

(iv) What is the beta of the portfolio consisting of equal investment in each stock?

(v) What is the total, systematic and unsystematic risk of the portfolio in (iv)?

(SM TYK – 14)

Solution:

(i) Sensitivity

$$\beta = \frac{\sigma x}{\sigma m} \times rxm$$

$$A = \frac{20}{15} \times 0.60 = 0.80$$

$$B = \frac{18}{15} \times 0.95 = 1.14$$

$$C = \frac{12}{15} \times 0.75 = 0.60$$

(ii) Covariance

$$COV_{AB} = B_A \times B_B \sigma_m^2$$

$$COV_{AB} = 0.8 \times 1.14 \times 15^2 = 205.20\ (\%)^2$$

$$COV_{AC} = 0.8 \times 0.6 \times 15^2 = 108\ (\%)^2$$

$$COV_{BC} = 1.14 \times 0.6 \times 15^2 = 153.90\ (\%)^2$$

(iii) Risk of Portfolio (Sharpe)

$$\sigma p^2 = \sigma_A{}^2 W_A{}^2 + \sigma_B{}^2 \times W_B{}^2 + \sigma_C{}^2 \times W_C{}^2 + 2 \times W_A \times W_B \times Cov_{AB} + 2 \times W_A \times W_C \times Cov_{AC} + 2 \times W_B \times W_C \times Cov_{BC}$$

$$= 20^2 \left(\frac{1}{3}\right)^2 + 18^2 \times \left(\frac{1}{3}\right)^2 + 12^2 \times \left(\frac{1}{3}\right)^2 + 2 \times \frac{1}{3} \times \frac{1}{3} \times 205.20 + 2 \times \frac{1}{3} \times \frac{1}{3} \times 108 + 2 \times \frac{1}{3} \times \frac{1}{3} \times 153.90$$

$$= 200.24\ (\%)^2$$

$$\sigma_p = \sqrt{200.24} = 14.15\%$$

(iv) Beta of Portfolio

$$\sigma_p = \frac{0.80 + 1.14 + 0.60}{3}$$

= 0.8467

(v) TR, SR & UR of Portfolio

(i) $SR_p = \beta_p^2 \times \sigma_M^2$

$= 0.8467^2 \times 15^2$

$= 161.30\ (\%)^2$

(ii) $TR_p = 200.24\ (\%)^2$

(iii) $UR_p = TR_P - 8R_P$

$= 200.24 - 161.30$

$= 38.94\ (\%)^2$

Question – 40

Following are the details of a portfolio consisting of three shares:

Share	Portfolio Weight	Beta	Expected Return in %	Total Variance
A	0.20	0.40	14	0.015
B	0.50	0.50	15	0.025
C	0.30	1.10	21	0.100

Standard Deviation of Market Portfolio Returns = 10%

You are given the following additional data:

Covariance (A, B) = 0.030

Covariance (A, C) = 0.020

Covariance (B, C) = 0.040

Calculate the following:

(i) The Portfolio Beta

(ii) Residual variance of each of the three shares

(iii) Portfolio variance using Sharpe Index Model

(iv) Portfolio variance (on the basis of modern portfolio theory given by Markowitz)

(SM TYK – 34, MTP Aug – 2018)

Solution:

(I) Portfolio Beta

$B_p = (0.4 \times 0.2) + (0.5 \times 0.5) + (1.10 \times 0.30)$

$= 0.66$

$\sigma_m = 10\%$

$\sigma_m = 0.10$

$\sigma_m^2 = (0.10)^2$

$= 0.010$

(II) Residual Variance

(i) $SR = \beta_p^2 \times \sigma_M^2$

A $= 0.40^2 \times 0.010 = 0.0016$

B $= 0.50^2 \times 0.010 = 0.0025$

C $= 1.10^2 \times 0.010 = 0.0121$

(ii) $UR = TR - SR$

A $= 0.015 - 0.0016 = 0.0134$

B $= 0.025 - 0.0025 = 0.0225$

C $= 0.100 - 0.0121 = 0.0879$

(III) Portfolio Variance [Sharpe]

$SR_P = \beta_p^2 \times \sigma_M^2$

$= 0.66^2 \times 0.010 = 0.004356$

$\sigma ep^2 = \sigma e_A{}^2 W_A{}^2 + \sigma e_B{}^2 \times W_B{}^2 + \sigma_{eC}{}^2 \times W_C{}^2$

$= 0.0134 \times 0.20^2 + 0.0225 \times 0.50^2 + 0.0879 \times 0.30^2$

$= 0.014072$

TR_P, SR_p & UR_P

$= 0.004356 + 0.014072$

$= 0.018428$

(IV) Portfolio Variance (Markowitz)

$\sigma p^2 = \sigma_A{}^2 W_A{}^2 + \sigma_B{}^2 \times W_B{}^2 + \sigma_C{}^2 \times W_C{}^2 + 2 \times W_A \times W_B \times Cov_{AB} + 2 \times W_A \times W_C \times Cov_{AC} + 2 \times W_B \times W_C \times Cov_{BC}$

$= 0.015 \times 0.20^2 + 0.025 \times 0.50^2 + 0.100 \times 0.30^2 + 2 \times 0.20 \times 0.50 \times 0.030 + 2 \times 0.20 \times 0.30 \times 0.020 + 2 \times 0.50 \times 0.30 \times 0.040$

$= 0.03625$

Question – 41

Following are risk and return estimates for two stocks :

Stock	Expected returns (%)	Beta	Specific SD of expected return (%)
A	14	0.8	35
B	18	1.2	45

The market index has a Standard Deviation (SD) of 25% and risk free rate on Treasury Bills is 6%.

You are required to calculate :

(i) The standard deviation of expected returns on A and B.

(ii) Suppose a portfolio is to be constructed with the proportions of 25%, 40% and 35% in stock A, B and Treasury Bills respectively, what would be the expected return, standard deviation of expected return of the portfolio?

(Exam November – 2019) (8 Marks)

Solution:

(I) Standard Deviation

SR $= \beta^2 \times \sigma_M^2$

A $= 0.8^2 \times 25^2 = 400(\%)^2$

B $= 1.2^2 \times 25^2 = 900(\%)^2$

UR

A $= 1225(\%)^2$

B $= 2025(\%)^2$

TR = SR + UR

A $= 1225 + 400 = 1625$

B $= 2025 + 900 = 2925$

$\sigma_A = \sqrt{1625} = 40.31\%$

$\sigma_B = \sqrt{2925} = 54.08\%$

(II) Expected return & σ_p

$ER_p = (14 \times 0.25) + (18 \times 0.40) + (6 \times 0.35)$

$= 12.8\%$

$\sigma p^2 = \sigma_A^2 W_A^2 + \sigma_B^2 W_B^2 + 2 \times W_A \times W_B \times Cov_{AB} + 2 \times W_A \times W_C \times Cov_{AC} + 2 \times W_B \times W_C \times Cov_{BC}$

$= 1625 \times 0.25^2 + 2925 \times 0.40^2 + 2 \times 0.25 \times 0.40 \times 0.8 \times 1.2 \times 0.25^2$

$= 689.59\ (\%)^2$

$= \sqrt{689.59} = 26.26\%$

Question – 42

Mr. Abhishek is interested in investing ₹ 2,00,000 for which he is considering following three alternatives:

(i) Invest ₹ 2,00,000 in Mutual Fund X (MFX)

(ii) Invest ₹ 2,00,000 in Mutual Fund Y (MFY)

(iii) Invest ₹ 1,20,000 in Mutual Fund X (MFX) and ₹ 80,000 in Mutual Fund Y (MFY)

Average annual return earned by MFX and MFY is 15% and 14% respectively. Risk free rate of return is 10% and market rate of return is 12%.

Covariance of returns of MFX, MFY and market portfolio Mix are as follow:

	MFX	**MFY**	**Mix**
MFX	4.800	4.300	3.370
MFY	4.300	4.250	2.800
Mix	3.370	2.800	3.100

You are required to calculate:

(i) Variance of return from MFX, MFY and market return,

(ii) Portfolio return, beta, portfolio variance and portfolio standard deviation,

(iii) Expected return, systematic risk and unsystematic risk; and

(iv) Sharpe ratio, Treynor ratio and Alpha of MFX, MFY and Portfolio Mix

(SM TYK – 17)

Solution:

(i) Variance of X, Y & Market

Variance of X

(r between x & x is 1)

$$r_{x\,x} = \frac{Cov_{xx}}{\sigma_x \times \sigma_x}$$

$$1 = \frac{4.800}{\sigma_x^2}$$

$$\sigma_x^2 = 4.800$$

$$\sigma_y^2 = 4.250$$

$$\sigma_m^2 = 3.100$$

(ii) ER_p , β, σ_p^2 , & σ_p

$ER_p = (15 \times 0.6) + (14 \times 0.4) = 14.6\%$

Beta of Portfolio

$$\beta_x = \frac{COV_{xm}}{\sigma_m^2} = \frac{3.370}{3.100} = 1.087$$

$$\beta_y = \frac{COV_{xm}}{\sigma_m^2} = \frac{2.800}{3.100} = 0.903$$

$\beta_p = (1.087 \times 0.6) + (0.903 \times 0.4) = 1.0134$

$\sigma_p^2 = \sigma_x^2 \times w_x + \sigma_y^2 \times w_y + 2 \times w_x \times w_y \times Cov_{xy}$

$= (4.800 \times (0.6)^2 + (4.250 \times (0.4)^2) + 2 \times 0.6 \times 0.4 \times 4.300$

$= 4.472\ (\%)^2$

$\sigma_p = 2.1147\%$

(iii) ER as per CAPM, SR & UR:

$ER = R_f + (R_m - R_f)\ \beta$

X $= 10 + (12 - 10)\ 1.087 = 12.17\%$

Y $= 10 + (12 - 10)\ 0.903 = 11.806\%$

$ER_P = 10 + (12 - 10)\ 1.0134 = 12.027\%$

$SR = B^2\sigma_m^2$

X = $(1.087)^2 \times 3.100$ = $3.6628\ (\%)^2$

Y = $(0.903)^2 \times 3.100$ = $2.5278(\%)^2$

SR_p = $(1.0134)^2 \times 3.100$ = $3.1836\ (\%)^2$

UR = TR – SR

X = 4.800 – 3.6628 = $1.1372\ (\%)^2$

Y = 4.250- 2.5278 = $1.7222\ (\%)^2$

Z = 4.472 – 3.1836 = $1.289\ (\%)^2$

(iv) (a) Sharpe Ratio $= \frac{ER - RF}{S.D.}$

X $= \frac{15 - 10}{2.19} = 2.28$

Y $= \frac{14 - 10}{2.06} = 1.94$

Portfolio $= \frac{14.6 - 10}{2.11} = 2.18$

(b) Treynor Ratio $= \frac{ER - R_f}{\beta}$

X $= \frac{15 - 10}{1.087} = 4.60$

Y $= \frac{14 - 10}{0.903} = 4.43$

Portfolio $= \frac{14.6 - 10}{1.0134} = 4.54$

Alpha $= ER - K_e$

X = 15 – 12.174 = 2.826%

Y = 14 – 11.806 = 2.194%

Portfolio = 14.6 – 12.027 = 2.573%

Question – 43

The returns on stock A and market portfolio for a period of 6 years are as follows:

Year	Return on A (%)	Return on market portfolio (%)
1	12	8
2	15	12
3	11	11
4	2	-4
5	10	9.5
6	-12	-2

You are required to determine:

(i) Characteristic line for stock A

(ii) The systematic and unsystematic risk of stock A.

(SM TYK – 11)

Solution:

Characteristic line is given by

$\alpha + \beta_{Rm}$

$\beta i = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n(x)^2}$

$\alpha i = \bar{y} - \beta \bar{x}$

Return on A (Y)	Return of market (X)	xy	x^2	$(x - \bar{x})$	$(x - \bar{x})^2$	$(y - \bar{y})$	$(y - \bar{y})^2$
12	8	96	64	2.25	5.06	5.67	32.15
15	12	180	144	6.25	39.06	8.67	75.17
11	11	121	121	5.25	27.56	4.67	21.81
2	-4	-8	16	-9.75	95.06	-4.33	18.75
10	9.5	95	90.25	3.75	14.06	3.67	13.47
-12	-2	24	4	-7.75	60.06	-18.33	335.99
38	34.5	508	439.25		240.86		497.34