

(III)  $R_m$  &  $R_f$

It is assumed that both securities are correctly priced

$$ER = R_f + MRPB$$

$$22 = R_f + 0.86 MRP \dots\dots (i)$$

$$24 = R_f + 1.24 MRP \dots\dots (ii)$$

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$$-2 = -0.38 MRP$$


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

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 as 10%. 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

$\beta$  = Beta of Security

$R_m$  = Market Return

$R_f$  = Risk free Rate

$$\begin{aligned} &= 10 + [1.2 (15 - 10)] \\ &= 10 + 1.2 (5) \\ &= 10 + 6 = 16\% \text{ or } 0.16 \end{aligned}$$

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

$$= R_f + \text{Beta} (R_m - R_f) = 12\% + 1.4 (6\%) = 20.4\%$$

Revised rate of return

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

Price of share (original)

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

Price of share (Revised)

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

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 Underpriced, Hence the Investor should hold the share.

**SYSTEMATIC & UNSYSTEMATIC RISK**

**Question – 38**

A has portfolio having following features:

Security	$\beta$	Random Error $\sigma_{ei}$	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 ( $\sigma_m$ ) is 18%.

**Solution:**

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

$$= 1.295$$

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

$$= 1.295^2 \times 324$$

$$= 543.36(\%)^2$$

$$\sigma_{ep}^2 = \sigma_{eA}^2 W_A^2 + \sigma_{eB}^2 \times W_B^2 + \sigma_{eA}^2 W_A^2 + \sigma_{eC}^2 \times W_C^2 + \sigma_{eA}^2 W_A^2 + \sigma_{eD}^2 \times W_D^2 + \sigma_{eB}^2 W_B^2 + \sigma_{eC}^2 W_C^2 + \sigma_{eB}^2 \times W_B^2 + \sigma_{eD}^2 W_D^2 + \sigma_{eC}^2 \times W_C^2 + \sigma_{eD}^2 W_D^2$$

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

$$= 17.755$$

$$TR = 543.36 + 17.755$$

$$= 561.115 = 23.69\%$$

**Question – 39**

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

Security	$\sigma(\%)$	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**

$$\beta = \frac{\sigma_x}{\sigma_m} \times r_{xm}$$
$$A = \frac{20}{15} \times 0.60 = 0.80$$
$$B = \frac{18}{15} \times 0.95 = 1.14$$
$$C = \frac{12}{15} \times 0.75 = 0.60$$

**(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)**

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

$$\begin{aligned}
 &= 20^2 \left(\frac{1}{3}\right)^2 + 18^2 \times \left(\frac{1}{3}\right)^2 + 12^2 \times \left(\frac{1}{3}\right)^2 + 2 \times \frac{1}{3} \times \frac{1}{3} \times 205.20 + 2 \\
 &\times \frac{1}{3} \times \frac{1}{3} \times 108 + 2 \times \frac{1}{3} \times \frac{1}{3} \times 153.90 \\
 &= 200.24 (\%)^2
 \end{aligned}$$

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

**(iv) Beta of Portfolio**

$$\begin{aligned}
 \sigma_p &= \frac{0.80 + 1.14 + 0.60}{3} \\
 &= 0.8467
 \end{aligned}$$

**(v) TR, SR & UR of Portfolio**

$$\begin{aligned}
 \text{(i)} \quad \text{SR}_p &= \beta_p^2 \times \sigma_M^2 \\
 &= 0.8467^2 \times 15^2 \\
 &= 161.30 (\%)^2
 \end{aligned}$$

$$\text{(ii)} \quad \text{TR}_p = 200.24 (\%)^2$$

$$\begin{aligned}
 \text{(iii)} \quad \text{UR}_p &= \text{TR}_p - \text{SR}_p \\
 &= 200.24 - 161.30 \\
 &= 38.94 (\%)^2
 \end{aligned}$$

**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**

$$\begin{aligned} B_p &= (0.4 \times 0.2) + (0.5 \times 0.5) + (1.10 \times 0.30) \\ &= 0.66 \end{aligned}$$

$$\sigma_m = 10\%$$

$$\sigma_m = 0.10$$

$$\begin{aligned} \sigma_m^2 &= (0.10)^2 \\ &= 0.010 \end{aligned}$$

**(II) Residual Variance**

$$\begin{aligned} \text{(i) SR} &= \beta_p^2 \times \sigma_m^2 \\ A &= 0.40^2 \times 0.010 = 0.0016 \\ B &= 0.50^2 \times 0.010 = 0.0025 \\ C &= 1.10^2 \times 0.010 = 0.0121 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) UR} &= \text{TR} - \text{SR} \\
 \text{A} &= 0.015 - 0.0016 = 0.0134 \\
 \text{B} &= 0.025 - 0.0025 = 0.0225 \\
 \text{C} &= 0.100 - 0.0121 = 0.0879
 \end{aligned}$$

**(III) Portfolio Variance [Sharpe]**

$$\begin{aligned}
 \text{SR}_P &= \beta_p^2 \times \sigma_M^2 \\
 &= 0.66^2 \times 0.010 = 0.004356 \\
 \sigma_{ep}^2 &= \sigma_{eA}^2 W_A^2 + \sigma_{eB}^2 \times W_B^2 + \sigma_{eC}^2 \times W_C^2 \\
 &= 0.0134 \times 0.20^2 + 0.0225 \times 0.50^2 + 0.0879 \times 0.30^2 \\
 &= 0.014072
 \end{aligned}$$

**TR<sub>P</sub>, SR<sub>P</sub> & UR<sub>P</sub>**

$$\begin{aligned}
 &= 0.004356 + 0.014072 \\
 &= 0.018428
 \end{aligned}$$

**(IV) Portfolio Variance (Markowitz)**

$$\begin{aligned}
 \sigma_p^2 &= \sigma_A^2 W_A^2 + \sigma_B^2 \times W_B^2 + \sigma_C^2 \times W_C^2 + 2 \times W_A \times W_B \times \text{Cov}_{AB} + 2 \times \\
 &W_A \times W_C \times \text{Cov}_{AC} + 2 \times W_B \times W_C \times \text{Cov}_{BC} \\
 &= 0.015 \times 0.20^2 + 0.025 \times 0.50^2 + 0.100 \times 0.30^2 + 2 \times 0.20 \times \\
 &0.50 \times 0.030 + 2 \times 0.20 \times 0.30 \times 0.020 + 2 \times 0.50 \times 0.30 \times 0.040 \\
 &= 0.03625
 \end{aligned}$$

**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)**

**Solution:**

**(I) Standard Deviation**

$$\begin{aligned} SR &= \beta^2 \times \sigma_M^2 \\ A &= 0.8^2 \times 25^2 = 400(\%)^2 \\ B &= 1.2^2 \times 25^2 = 900(\%)^2 \\ UR & \\ A &= 1225(\%)^2 \\ B &= 2025(\%)^2 \\ TR &= SR + UR \\ A &= 1225 + 400 = 1625 \\ B &= 2025 + 900 = 2925 \\ \sigma_A &= \sqrt{1625} = 40.31\% \\ \sigma_B &= \sqrt{2925} = 54.08\% \end{aligned}$$

**(II) Expected return &  $\sigma_p$**

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