

CHAPTER 7: PORTFOLIO ANALYSIS

This chapter deals with the risks and returns on investments in securities. Portfolio Management activities include:

- Selection of securities for investment;
- Construction of possible portfolios;
- Deciding the weights / proportions of different securities in the portfolio and arriving at an Optimal Portfolio for the concerned investor.

The main objective of a rational investor is to identify the Efficient Portfolios out of the different Feasible Portfolios and to zero in on the Optimal Portfolio suiting his risk appetite. ***An Efficient Portfolio has the highest return among all Feasible Portfolios having identical Risk and has the lowest Risk among all Feasible Portfolios having identical Return.***

The other **Objectives of Portfolio management** are:

- a. Security/Safety of Principal;
- b. Stability of Income;
- c. Capital Appreciation;
- d. Marketability & Liquidity;
- e. Minimisation of risk;
- f. Diversification;
- g. Suitable tax considerations.

All investments are to be looked in the above areas before taking a call on investment or continuing with the amount invested.

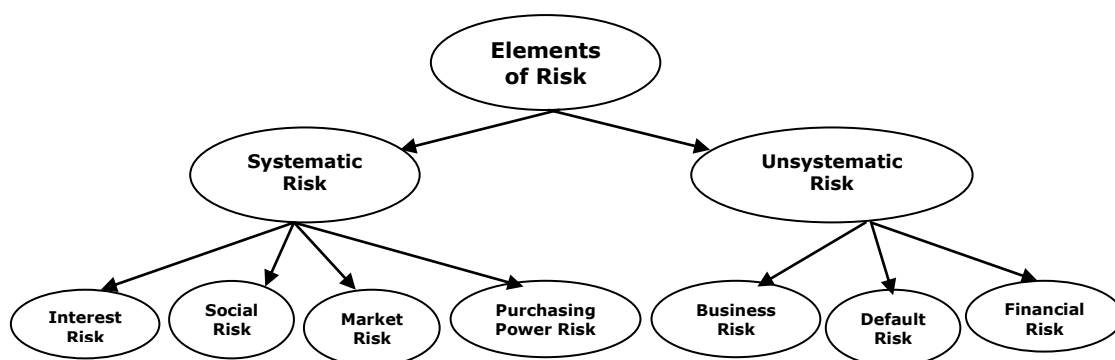
Investment management is a complex task, and requires special knowledge and skills to deal with the identification and form of Portfolio.

Phases of portfolio Management: The various phases are:

- a. **Security Analysis:** Securities are analysed under Fundamental Analysis (EPS of the Co., Dividend Payout ratio, Competition faced by the company, market share etc.) & Technical Analysis (Trends in share price movements etc.) As per Efficient Market Hypothesis, share price movements are random and not systematic. Consequently, neither fundamental analysis nor technical analysis is of value or of use in generating trading gains on a sustained basis.

- b. **Portfolio analysis:** After identifying the securities in which investments are to be made, next comes the formation of Portfolio. Portfolio is a combination of securities with different proportions of investments. Different feasible portfolios are constructed and the return and risk of each portfolio is ascertained. As per the risk appetite of the investor, and his preferences, appropriate portfolio is identified for investment.
- c. **Portfolio Revision:** Economy and financial markets are dynamic in nature, changes take place in these variables almost on a daily basis and securities which were once attractive may cease to be so and vice versa with the passage of time. Having made investments as per the risk appetite of investors, the portfolio is watched continuously and suitable changes to it are made as per changing market conditions and risk appetite of the investor.
- d. **Portfolio Evaluation:** Performance of the portfolio over a selected period of time in terms of return and risk is ascertained. It involves quantitative measurement of actual return realized and the risk borne by the portfolio over the period of investment. The objective of constructing a portfolio and revising it periodically is to maintain its optimal risk return characteristics. Various types of measures of performance evaluation have been developed for use by investors and portfolio managers.

Risk Analysis: The risk in an investment is the variation in its returns. This variation in returns is caused by a number of factors. The factors which produce variations in the returns from an investment are called the elements of risk which can be depicted by the following figure:



Total risk = Systematic risk + Unsystematic risk

Systematic risk refers to the variability of return on stocks or portfolio associated with changes in return on the market as a whole. Systematic Risk arises due to external factors that are macro in nature and usually out of control of the company. It arises due to risk factors that affect the overall market such as changes in the nations' economy, tax reform by the Government or a change in the world energy situation. These are risks that affect securities overall and, consequently, cannot be diversified away. This is the risk which is common to an entire class of assets or liabilities. The value of investments may decline over a given time period simply because of economic changes or other events that impact large portions of the market. Asset diversification can protect against systematic risk because different portions of the market tend to underperform at different times. This is also called market risk.

Systematic risk is further classified into:

- a. **Interest Rate Risk:** The change in the interest rate has a bearing on the welfare of the investors. As the interest rate goes up, the market price of existing fixed income securities falls and vice versa. This is because the buyer of a fixed income security would not buy it at its par value or face value if its fixed interest rate is lower than the prevailing interest rate on a similar security.
- b. **Social or Regulatory Risk:** The social or regulatory risk arises, where an otherwise profitable investment is impaired as a result of adverse legislation, harsh regulatory climate, or in extreme instance nationalization by a socialistic government. Eg. Latest Land acquisition Act.
- c. **Market risk:** At times prices of securities, equity shares in particular, tend to fluctuate. Major cause appears to be the changing psychology of the investors. The irrationality in the security markets may cause losses unrelated to the basic risks. These losses are the result of changes in the general tenor of the market and are called market risks.
- d. **Purchasing Power Risk:** Inflation or rise in prices lead to rise in costs of production, lower margins, wage rises and profit squeezing etc. The return expected by investors will change due to change in real value of returns.

Unsystematic risk refers to risk unique to a particular company or industry. This arises due to factors within the company and usually micro in

nature and is controllable to a great extent. This is the risk of price change due to the unique circumstances of a specific security as opposed to the overall market. This risk can be virtually eliminated from a portfolio through diversification.

Unsystematic risk is further classified into:

- a. **Business Risk:** As a holder of corporate securities (equity shares or debentures) one is exposed to the risk of poor business performance. This may be caused by a variety of factors like heightened competition, emergence of new technologies (SLR cameras to digital cameras), development of substitute products, shifts in consumer preferences, inadequate supply of essential inputs, changes in governmental policies and so on. Often of course, the principal factor may be inept and incompetent management.
- b. **Default Risk:** Default risk refers to the risk arising from the fact that a borrower may not pay interest and / or principal on time. Except in the case of highly risky debt instrument, investors seem to be more concerned with the perceived risk of default rather than the actual occurrence of default. Even though the actual default may be highly unlikely, they believe that a change in the perceived default risk of a bond would have an immediate impact on its market price.
- c. **Financial Risk:** This relates to the method of financing, adopted by the company, high leverage leading to larger debt servicing problem or short term liquidity problems due to bad debts, delayed receivables and fall in current assets or rise in current liabilities.

Diversion of Risk: Each Security has two types of risks. Viz. Systematic Risk and Unsystematic Risk. Unsystematic risk can be minimised by increasing the size of the portfolio (say around 25 scrips.)

The following graph shows the relationship between the number of scrips and the risk of portfolio. As the number of scrips increases, unsystematic risk reduces (and thus total risk as well) and eventually gets minimised and we will be left with only systematic risk of the portfolio.

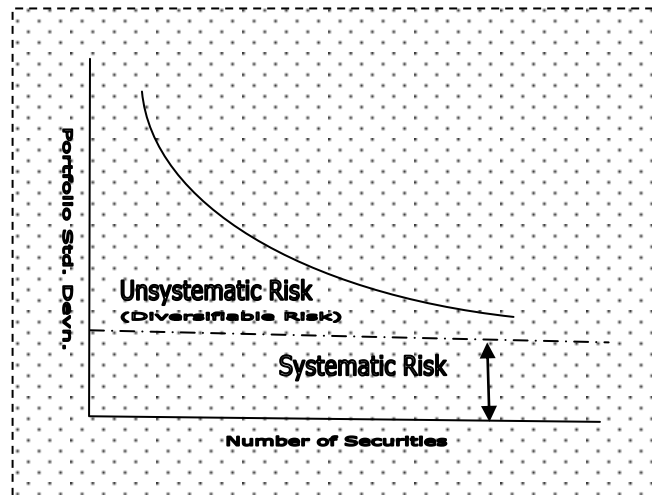
Risk is usually measured by calculating Variance or Standard Deviation of the returns of security / portfolio. Variance and standard deviation indicate the extent of variability of possible returns from the expected return.

$$\text{Variance (Sd}^2\text{)} = \sum_{i=1}^n [(X_i - X)^2 * P(X_i)] \text{ Where,}$$

X_i = Possible returns on security i ; X = Expected Value of security / Portfolio;

$P(X_i)$ = Probability.

Standard Deviation is the Square Root of Variance.



Variance and Standard Deviation indicate the total risk associated with security, i.e. Systematic risk + Unsystematic risk.

A rational risk-averse investor views the variance (or standard deviation) of her portfolio's return as the proper risk of her portfolio. If the investor holds only one security (or very few securities), the variance of that security's return becomes the variance of the portfolio's return. Hence, the variance of the security's return is the security's proper measure of risk.

An investor with diversified portfolio measures the beta of the security as a proper measure of risk for the security since for him unsystematic risk is minimised because of diversification. An investor who is evaluating the systematic element of risk, that is, extent of deviation of returns vis a vis the market, therefore considers beta as a proper measure of risk.

When risk is separated into systematic and unsystematic parts, the market generally does not reward for diversifiable risk (unsystematic risk) since the investor himself is expected to diversify the risk. However, if the investor does not diversify he cannot be considered to be an efficient investor. The market, therefore, rewards an investor only for the non-diversifiable (systematic) risk. Hence, the investor needs to know how much non-diversifiable risk he is taking. Non diversifiable risk is measured in terms of beta.

Further, an investor with varied diversified portfolio also considers variance and standard deviation of the security as measure of the risk for the security so far it impacts the variance and standard deviation of the portfolio. He will not be per se interested in the variance or standard deviation of each security, rather he is interested in their impact on the total portfolio.

Unsystematic risk is internal risk and is associated with the company. This can be minimised by having another security in the portfolio with opposite correlation and this process is known as diversification. A portfolio with around 25 securities in it will have minimum unsystematic risk due to diversification.

Measurement of Systematic Risk: Systematic risk relates to external environment and is uncontrollable. Different Securities returns are affected by different degrees due to changes in economy like inflation, interest rate, etc. The average effect of a change in the economy can be represented by the change in the stock market index. The systematic risk of a security can be measured by relating that security's variability vis-à-vis variability in the stock market index. A higher variability would indicate higher systematic risk and vice versa.

The systematic risk of a security is measured by a statistical measure called **Beta**. Input data required for the calculation of beta of any security are the historical data of returns of the individual security and corresponding return of a representative market return (stock market index). There are two statistical methods i.e. **correlation method and the regression method**, which can be used for the calculation of Beta.

Correlation Method: Formula used for calculation of Beta is:

$$\beta = \frac{Cov_{im}}{sd_m^2} = \frac{r_{im}sd_i sd_m}{sd_m^2} = \frac{r_{im}sd_i}{sd_m} = \frac{r_{pm}sd_p}{sd_m} \quad \text{Where,}$$

r_{im} = coefficient of correlation between scrip i and the market index m;

r_{pm} = coefficient of correlation between portfolio p and the market index m

sd_i = standard deviation of returns of stock i;

sd_m = standard deviation of returns of market index,

sd_m^2 = the variance of market returns; and

sd_p = standard deviation of returns of portfolio.

Regression method: The general form of regression equation is:

$$\alpha = Y - \beta X \quad \text{Where,}$$

X = independent variable (market);
Y = dependent variable (security), and
 α, β are constants.

Alpha indicates excess of return over expected return and **Beta** indicates return of security vis a vis market return. **Alpha** indicates absolute figure whereas **Beta** indicates relative figure.

Beta is calculated by the formula:

$$\beta = \frac{n \sum XY - (\sum X)(\sum Y)}{n \sum X^2 - (\sum X)^2} \quad \text{where,}$$

n = number of items;
X = Independent variable (market);
Y = Dependent variable (security);
XY = product of dependent and independent variable;

Alternative Formula:

$$\beta = \frac{\sum XY - n \bar{X} \bar{Y}}{\sum X^2 - n \bar{X}^2} = \frac{\sum XY - (\sum X) \bar{Y}}{\sum X^2 - (\sum X) \bar{X}}$$

$\bar{X}$ & $\bar{Y}$ are respective arithmetic means and rest of Notations have same meaning as in above earlier formula.

To calculate return of individual security, following CAPM formula is used:

$$R_a = \alpha + \beta R_m \quad \text{where,}$$

R_a = Return of individual security,

R_m = Return on market index or Risk Premium

α = Return of the security when market is stationary

β = Change in return of individual security for unit change in return of market index.

Significance of Beta: Beta measures the volatility of a security's returns relative to the market, the larger the beta, the more volatile the security. A beta of 1.0 indicates a security of average risk. A stock with beta greater than 1.0 has above average risk i.e. its returns would be more volatile than the market returns. For example, when market returns move up by 6%, a

stock with beta of 2 would find its returns moving up by 12% (i.e. 6% x 2). Similarly, decline in market returns by 6% would produce a decline of 12% (i.e. 6% x 2) in the return of that security.

Positive beta of security: it indicates that return on security is dependent on market return and will be in the same direction as that of market;

Negative beta of security: it indicates that return on security is dependent on market return and will be in the opposite direction as that of market;

Zero beta: it indicates return on security is independent of market return.

Portfolio Beta: Systematic risk can be measured by using Beta (β). The beta for the market is equal to 1.0. Beta explains the systematic relationship between the return on a security and the return on the market by using a simple linear regression equation. The return on a security is taken as a dependent variable and the return on market is taken as independent variable then,

$$R_i = R_f + \beta (R_m - R_f) \quad \text{where,}$$

R_i = Return on security;

R_f = Risk free return on security;

R_m = Return on market

B = Responsive of security returns to market returns.

The beta parameter (β) in the above equation represents the slope of the above regression relationship. The portfolio beta is merely the weighted average of the betas of individual securities included in the portfolio.

Portfolio beta, $\beta = \Sigma \text{proportion of security} \times \text{beta for security}$.

Beta is calculated from historical data on the presumption that future will replicate history which may not always be correct.

Portfolio Analysis: Expected return of a portfolio is the sum of the weighted average return of individual securities comprising the portfolio. The weights to be applied for calculation of the portfolio return are the fractions of the portfolio invested in respective securities. Formula is:

$$r_p = \sum_{i=1}^n x_i r_i \quad \text{where}$$

r_p = expected return of portfolio;

x_i = proportion of funds invested in each security;

r_i = expected return on securities; and

n = number of securities.

Covariance (a statistical measure) between two securities or two portfolios or a security and a portfolio indicates how the rates of return for the two concerned entities behave relative to each other. Covariance is calculated by the formula;

$$\mathbf{Cov_{AB}} = \frac{\sum(R_A - \bar{R}_A)(R_B - \bar{R}_B)}{N} \quad \text{where}$$

R_A = Return on security A;

$\bar{R}_A$ = Expected or mean return of Security A;

R_B = Return on security B;

$\bar{R}_B$ = Expected or mean return of Security B.

Covariance of 2 securities is +ve if the returns consistently move in same direction.

Covariance of 2 securities is -ve if the returns consistently move in opposite direction.

Covariance of 2 securities is zero, if their returns are independent of each other.

Coefficient of correlation is expressed by the formula:

$$\mathbf{r_{AB}} = \frac{Cov_{AB}}{Sd_A Sd_B} \quad \text{where}$$

r_{AB} = Coefficient of correlation between A & B;

Cov_{AB} = Covariance between securities A & B

Sd_A = Standard deviation of security A.

Sd_B = Standard deviation of security B

Correlation coefficients may range from -1 to 1.

A value of +1 indicates a perfect positive correlation between the two securities returns

A value of -1 indicates perfect negative correlation between the two securities returns, and

A value of zero indicates that the returns are independent.

Further, covariance can be expressed as the product of coefficient of correlation between the securities and the standard deviation of each of the securities as shown below:

$$Cov_{AB} = r_{AB} Sd_A Sd_B$$

Covariance between two securities may also be calculated by multiplying respective betas and the variance of market.

$$Cov_{AB} = \beta_A \beta_B sd_m^2$$

The **Variance of a Portfolio** consists of 2 components (unlike the return of a portfolio where weighted average of individual securities is taken):

- Aggregate of the weighted variances of the constituent securities and
- Weighted covariances among different pairs of securities.

Calculation of risk In case of only 2 securities, A & B are there in portfolio, then Variance of portfolio is given by the formula

$$Sd_p^2 = [X_A^2 Sd_A^2 + X_B^2 Sd_B^2] + 2 [X_A X_B (r_{AB} Sd_A Sd_B)]$$

Sd_p^2 = Variance of the portfolio;

X_A = Proportion of funds invested in security A;

X_B = Proportion of funds invested in security B;

Sd_A^2 = Variance of security A;

Sd_B^2 = Variance of security B;

Sd_A = Standard deviation of security A;

Sd_B = Standard deviation of security B, and

r_{AB} = Correlation coefficient between the returns of A & B securities.

In case of perfect +ve correlation, coefficient of correlation, $r_{AB} = 1$. So, the variance of portfolio becomes:

$$Sd_p = X_A Sd_A + X_B Sd_B$$

In case of perfect -ve correlation, coefficient of correlation, $r_{AB} = -1$. So, the variance of portfolio becomes:

$$Sd_p = X_A Sd_A - X_B Sd_B$$

In case of perfect no correlation, $r_{AB} = 0$. So, the variance of portfolio becomes:

$$Sd_p^2 = X_A^2 Sd_A^2 + X_B^2 Sd_B^2 \text{ and}$$

$$Sd_p = [X_A^2 Sd_A^2 + X_B^2 Sd_B^2]^{1/2}$$

Portfolio Variance can also be calculated by the formula:

$$Sd_p^2 = [(\sum_{i=1}^n X_i \beta_i)^2 Sd_m^2] + [\sum_{i=1}^n X_i^2 USR^2] \quad \text{Where,}$$

Sd_p^2 = Variance of portfolio;

X_i = Proportion of the Stock in portfolio;

β_i = Beta of the stock i in portfolio;

Sd_m^2 = Variance of the index;

USR = Unsystematic Risk

First component is weighted average of systematic risk and second component is weighted average of unsystematic risk and sum of these is total risk.

Optimum proportion of investment in case of 2 securities: Formula for Optimum proportion of investment in case of 2 securities i & j is calculated by the formula:

$$X_i = \frac{Sd_j^2 - r_{ij} Sd_i Sd_j}{Sd_i^2 + Sd_j^2 - 2r_{ij} Sd_i Sd_j} = \frac{Sd_j^2 - Cov_{ij}}{Sd_i^2 + Sd_j^2 - 2Cov_{ij}}$$

Where, X_i is the proportion of investment in security i. Proportion of investment in security j will be (1 – j).

Reduction or dilution of Portfolio Risk through Diversification: The process of combining more than one security in to a portfolio is known as diversification. The main purpose of this diversification is to reduce the total risk by substantially mitigating the unsystematic risk, without sacrificing portfolio return. Unsystematic Risk keeps reducing as more and more shares are added to the portfolio say upto around 25 securities. Beyond this there will not be any significant change in the unsystematic risk, despite addition of securities to portfolio. Standard deviation of the portfolio keeps reducing for the initial addition of around 25 securities. This happens in all cases except when the shares are +vely correlated.

Portfolio with more than two securities: The total risk of an individual security comprises two components; the market related risk called systematic risk and the unique risk of that particular security called

unsystematic risk. By combining securities into a portfolio the unsystematic risk specific to different securities is cancelled out. Consequently, the risk of the portfolio as a whole is reduced as the size of the portfolio increases. Ultimately when the size of the portfolio reaches a certain limit, it will contain only the systematic risk of securities included in the portfolio. The systematic risk, however, cannot be eliminated. Thus, a fairly large portfolio has only systematic risk and has relatively little unsystematic risk. That is why there is no gain in adding securities to a portfolio beyond a certain portfolio size.

Calculation of Risk of Portfolio with more than two securities: The portfolio variance and standard deviation depend on the proportion of investment in each security as also the variance and covariance of each security included in the portfolio. The formula for portfolio variance of a portfolio with more than two securities is as follows:

$$Sd_p^2 = \sum_{i=1}^n \sum_{j=1}^n X_i X_j Cov_{ij} = \sum_{i=1}^n \sum_{j=1}^n X_i X_j r_{ij} Sd_i Sd_j \quad \text{where,}$$

Sd_p^2 = Variance of Portfolio;

X_i = Proportion of funds invested in security i (the first of a pair of securities).

X_j = Proportion of funds invested in security j (the second of a pair of securities).

Cov_{ij} = The Covariance between the pair of securities i and j;

r_{ij} = Correlation Coefficient between securities i and j;

Sd_i = Standard deviation of Security i;

Sd_j = Standard deviation of Security j;

n = Total number of securities in the portfolio.

From a given set of 'n' securities, any number of portfolios can be created. These portfolios may comprise of two securities, three securities, all the way up to 'n' securities. A portfolio may contain the same securities as another portfolio but with different weights. A new portfolio can be created either by changing the securities in the portfolio or by changing the proportion of investment in the existing securities.

Portfolio Analysis is Determination of expected return and risk (variance or standard deviation) of each portfolio that can be used to create a set of selected securities for portfolio management.

Markowitz Model: This model is used to choose a particular portfolio among alternative portfolios. Following are the assumptions:

- a. The return on an investment summarises the outcome of the investment.
- b. The investors can visualise a probability distribution of rates of return.
- c. The investors' risk estimates are proportional to the variance of return they perceive for a security or portfolio.
- d. Investors base their investment decisions on two criteria i.e. expected return and variance of return.
- e. All investors are risk averse. For a given expected return he prefers to take minimum risk, for a given level of risk the investor prefers to get maximum expected return.
- f. Investors are assumed to be rational in so far as they would prefer greater returns to lesser ones given equal or smaller risk and are risk averse.
- g. Return could be any suitable measure of monetary inflows like NPV but yield has been the most commonly used measure of return, so that where the standard deviation of returns is referred to it is meant the standard deviation of yield about its expected value.

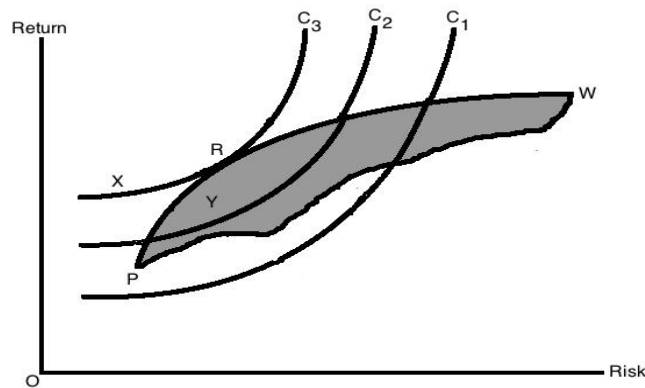
Markowitz has developed the concept of Efficient Frontier based on risk return relationship. He says that a portfolio is not efficient if there exists another portfolio with:

- a. A higher expected value of return and a lower standard deviation (risk).
- b. A higher expected value of return and the same standard deviation (risk)
- c. The same expected value but a lower standard deviation (risk)

He says that if the portfolio of an investor is not efficient, then the investor will:

- a. Increase the expected value of return without increasing the risk.
- b. Decrease the risk without decreasing the expected value of return, or
- c. Obtain some combination of increase of expected return and decrease risk.

He does this by switching his investment over the efficient frontier.



He says that all investments are to be plotted on a risk return graph and Efficient Frontier is to be marked containing all efficient portfolios. the shaded portion represents all feasible solutions. An efficient portfolio has the highest return among all portfolios with identical risk and the lowest risk among all portfolios with identical return. In the above diagram, P Y R W are on efficient frontier.

Lines c_1 , c_2 , and c_3 are indifference curves for different customers with regard to risks and associated returns of different portfolios. The investor has to select a portfolio from the set of efficient portfolios lying on the efficient frontier. This will depend upon his risk-return appetite. As different investors have different preferences, the optimal portfolio of securities will vary from one investor to another. Optimal portfolio to an investor will be the point where the indifference curve meets the efficient frontier. For c_3 customer, optimal portfolio will be at point R. At Point w, returns and risk are at peak. Since this is not customer preference line, it is ignored.

Capital Asset Pricing Model (CAPM): CAPM provides a conceptual framework for evaluating any investment decision where capital is committed with a goal of producing future returns. The Capital Asset Pricing Model was developed by Sharpe, Mossin and Linter in 1960. The model explains the relationship between the expected return, non diversifiable risk and the valuation of securities. It considers the required rate of return of a security on the basis of its contribution to the total risk. It is based on the premises that the diversifiable risk of a security is eliminated when more and more securities are added to the portfolio. However, the systematic risk cannot be diversified and is related with that of the market portfolio. All securities do

not have same level of systematic risk. The systematic risk can be measured by beta. β under CAPM, the expected return from a security can be expressed as:

$$\text{Expected return on security} = R_f + \text{Beta} (R_m - R_f)$$

The model shows that the expected return of a security consists of the risk-free rate of interest and the risk premium. The CAPM, when plotted on the graph paper is known as the **Security Market Line (SML)**. Usually Beta is plotted on X Axis and required return on Y Axis. Security market line measures the relation between systematic risk and return. Formula for Security Line is:

$$y = \beta x + \alpha$$

where, x is independent variable and y dependant variable.

Slope of security line indicates **BETA**. major implication of CAPM is that not only every security but all portfolios too must be plotted on SML. This implies that in an efficient market, all securities expected returns are commensurate with their riskiness, measured by β .

CAPM is based on following assumptions:

- a. The investor's objective is to maximise the utility of terminal wealth;
- b. Investors make choices on the basis of risk and return;
- c. Investors have identical time horizon;
- d. Investors have homogeneous expectations of risk and return;
- e. Information is freely and simultaneously available to investors;
- f. There is risk-free asset, and investor can borrow and lend unlimited amounts at the risk-free rate;
- g. There are no taxes, transaction costs, restrictions on short rates or other market imperfections;
- h. Total asset quantity is fixed, and all assets are marketable and divisible.

CAPM Advantages:

Risk Adjusted Return: CAPM provides a basis for estimating the required return on an investment which has risk built into it. Hence it can be used as Risk Adjusted Discount Rate in Capital Budgeting.

No Dividend Company: It is useful in computing the cost of equity of a company which does not declare dividend.

CAPM has also some limitations:

- a. **Reliability of Beta:** Statistically reliable Beta might not exist for shares of many firms. It may not be possible to determine the cost of equity of all firms using CAPM. All shortcomings that apply to Beta value apply to CAPM too.
- b. **Other Risks:** It emphasises only systematic risk while unsystematic risks are also important to share holders who do not possess a diversified portfolio.
- c. **Information Available:** It is extremely difficult to obtain important information on risk-free interest rate and expected return on market portfolio as there are multiple risk-free rates for one while for another, markets being volatile it varies over time period.

Under Valued and Over Valued Stocks:

The CAPM model can be used to buy, sell or hold stocks. CAPM provides the required rate of return on a stock after considering the risk involved in an investment. Based on current market price one can identify as to what would be the expected return over a period of time. By comparing the required return with the expected return the following investment decisions can be made: If:

On Return Basis:

Expected Return < CAPM Return; Sell, since stock is overvalued.

Expected Return > CAPM Return; Buy, since stock is undervalued

Expected Return = CAPM Return; Hold.

On Price Basis:

Actual Market Price < CAPM price, stock is undervalued; so Buy

Actual market Price > CAPM price, stock is overvalued; so, sell.

Actual market Price = CAPM price, stock is correctly valued.;

Point of indifference.

Characteristic Line: Characteristic line represents the relationship between the returns of two securities or a security and market return over a period of time. The differences between Security Market Line and Characteristic Line are as below:

Sl. #	Aspect	Security Market Line	Characteristic Line
1	Scheme	Represents relationship between return and risk measured in terms of systematic risk of a security or portfolio.	Represents the relationship between the returns of two securities or a security and market return over a period of time.
2	Nature of Graph	Security Market Line is a Cross Sectional Graph.	Characteristic Line is a Time Series Graph.
3	Comparison	Beta Vs. Expected Return are Plotted.	Security Returns Vs. Index Returns are Plotted.
4	Utility	Used to estimate the expected return of a security vis-a-vis its Beta.	Used to estimate Beta and also to determine how a security return correlates to a market index return.

Beta in case of Leverage: The risk of a company changes with change in the debt equity ratio. A company with no debt funds will be less risky than a company with debts which has the commitments of interest and principal repayments. A leveraged company will have the risk of an unleveraged company and in addition to this it will also have risk related to the leverage. To ascertain Beta for leveraged companies formula is:

$$\beta_l = \beta_{ul} [1 + (1 - T) D / E] = \beta_{ul} + \beta_{ul} (1 - T) D / E \text{ Where,}$$

β_l = Leveraged β

β_{ul} = Unleveraged β

D = Debt; E = Equity, and T = Rate of Tax

Arbitrage Pricing Theory Model: CAPM is single factor model, as against Arbitrage Pricing Theory Model which uses 4 factors Viz., Inflation and money supply, Interest Rate, Industrial Production, and personal consumption. Under this method, expected return on investment is:

$$E(R_i) = R_f + \lambda_1 \beta_{i1} + \lambda_2 \beta_{i2} + \lambda_3 \beta_{i3} + \lambda_4 \beta_{i4} \quad \text{where,}$$

$E(R_i)$ = Expected return on equity;

$\lambda_1, \lambda_2, \lambda_3, \lambda_4$ are average risk premium ($R_m - R_f$) for each of the four factors in the model and $\beta_{i1}, \beta_{i2}, \beta_{i3}, \beta_{i4}$ are measures of sensitivity of the particular security i to each of the four factors.

Sharpe Index Model: This model assumes that co-movement between stocks is due to change or movement in the market index. Casual observation of the stock prices over a period of time reveals that most of the stock prices move with the market index. As per this model, expected return on security i, is calculated by the formula;

$$R_i = \alpha_i + \beta_i R_m + \epsilon_i \text{ where,}$$

R_i = expected return on security i

α_i = intercept of the straight line or alpha co-efficient

β_i = slope of straight line or beta co-efficient

R_m = the rate of return on market index

ϵ_i = error term.

Alpha of a stock can be found by the above formula or alternatively by fitting a straight line with coordinates (x_1, y_1) and (x_2, y_2) where x_1, x_2 and y_1, y_2 are the expected returns of the market and the security in any 2 periods. Alpha is the value of intercept on Y Axis. Equation of the line in 2 point form is given by the formula:

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$$

According to Sharpe, the return of stock can be divided into 2 components:

- Return due to market changes (systematic risk) and
- Return independent of market changes (unsystematic risk).

Beta indicates the sensitiveness of the stock returns to changes in the market return.

The Variance of the security has 2 components:

- Systematic or market risk, and
- Unsystematic or unique risk.

So, the variance explained by the market index (i.e. Beta) is called systematic risk and the variance not explained by market index is unsystematic risk.

$$\text{Total variance } (Sd_i^2) = \text{Systematic risk } (\beta_i^2 \times Sd_m^2) + \text{Unsystematic risk}$$

Unsystematic risk will be the balancing figure.

Formula for systematic risk is:

$$\text{systematic risk} = \beta_i^2 \times \text{Variance of market index} = \beta_i^2 \times Sd_m^2$$

Unsystematic risk = Total Variance – systematic risk

$$\text{i.e. Unsystematic risk} = Sd_i^2 - \beta_i^2 \times Sd_m^2$$

(Sd_m = Standard deviation of Market index; β_i = Beta of security i; Sd_i = Standard deviation of security i)

When USR is given, Portfolio Variance is calculated by the formula:

$$Sd_p^2 = [(\sum_{i=1}^n X_i \beta_i)^2 Sd_m^2] + [\sum_{i=1}^n X_i^2 USR^2] \quad \text{Where,}$$

Sd_p^2 = Variance of portfolio;

X_i = Proportion of the Stock in portfolio;

β_i = Beta of the stock i in portfolio;

Sd_m^2 = Variance of the index;

USR = Unsystematic Risk

First component is weighted average of systematic risk and second component is weighted average of unsystematic risk and sum of these is total risk.

Coefficient of Determination (r^2): Coefficient of determination (r^2) gives the percentage of variation in the security's return that is explained by the variation of the market index return

Systematic and Unsystematic risk can also be found by the formulas:

$$\text{Systematic risk } (\beta) = \text{variance of security} \times r^2 = Sd_i^2 \times r^2$$

$$\text{Unsystematic risk} = \text{variance of security} (1 - r^2) = Sd_i^2 (1 - r^2)$$

r^2 = Coefficient of Determination.

Sharpe and Treynor ratios: These two ratios measure the Risk Premium per unit of Risk for a security or a portfolio of securities and provide the tools for comparing the performance of diverse securities and portfolios.

$$\text{Sharpe Ratio} = (R_i - R_f) / Sd_i \quad \text{and}$$

$$\text{Treynor Ratio} = (R_i - R_f) / \beta_i \quad \text{Where,}$$

R_i = Expected return on stock i

R_f = Return on a risk less asset

Sd_i = Standard Deviation of the rates of return for the ith Security

β_i = Expected change in the rate of return on stock i associated with one unit change in the market return

Higher the Risk Premium generated by a security or portfolio per unit of risk, the better and these ratios provide a useful tool for comparing securities and portfolios with diverse risk return profiles. While the Sharpe Ratio uses the standard deviation (i.e. total risk) as the measure of risk, the Treynor Ratio uses the beta (i.e. systematic risk) as the measure of risk.

Sharpe's Optimal Portfolio: The steps for finding out the stocks to be included in the optimal portfolio are as below:

- Find out the "excess return to beta" ratio for each stock under consideration.
- Rank them from the highest to the lowest.
- Calculate C_i for all the stocks/portfolios according to the ranked order using the following formula:

$$C_i = \frac{Sd_m^2 \sum_{i=1}^n \frac{(R_i - R_f) \beta_i}{USR^2}}{1 + Sd_m^2 \sum_{i=1}^n \frac{\beta_i^2}{USR^2}} \quad \text{Where,}$$

Sd_m^2 = Variance of the index;

R_i = Expected return on stock i

R_f = Return on a risk less asset

β_i = Expected change in the rate of return on stock i associated with one unit change in the market return

USR = Unsystematic Risk i.e., variance of stock movement not related to index movement.

- Compute the cut-off point which is the highest value of C_i and is taken as C^* . The stock whose excess-return to risk ratio is above the cut-off ratio are selected and all whose ratios are below are rejected. The main reason for this selection is that since securities are ranked from highest excess return to Beta to lowest, and if particular security belongs to optimal portfolio all higher ranked securities also belong to optimal portfolio.
- Calculate the percent to be invested in each security by using the following formula:

$$\% \text{ to be invested} = \frac{Z_i}{\sum_{i=1}^n Z_i} \text{ Where,}$$

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

Formulation of Portfolio Strategy: There are 2 main strategies of portfolio, viz.

- a. Active Portfolio Strategy and
- b. Passive Portfolio Strategy.

Active Portfolio Strategy: Most of the investment professionals follow this strategy. "Active" fund managers try to identify and invest in stocks of those companies that they think will produce better returns and beat the overall market (or Index). Principles involved in this strategy are:

- a. Market Timing
- b. Sector Rotation
- c. Security Selection
- d. Use of Specialised Investment Concept

Passive Portfolio Strategy: Passive strategy, is based on the principle that capital market is fairly efficient with respect to the available information. Hence they search for superior return. Basically, passive strategy involves adhering to two guidelines.

- a. Create a well diversified portfolio at a predetermined level of risk.
- b. Hold the portfolio relatively unchanged over time unless it became adequately diversified or inconsistent with the investor risk return preference.

Funds which are passively managed are called index funds.

Portfolio Balancing: Balancing of portfolio comprises of 2 issues. Viz., one Balancing the value of the portfolio and another Balancing the composition of the portfolio. Balancing is done by following the below policies:

- A. Buy and Hold Policy:** This is a **Do Nothing** policy where shares and bonds are bought in a predetermined ratio and retained as such.
- a. Gives rise to a straight line pay off.
 - b. Provides a definite downside protection.
 - c. Performance between Constant mix policy and CPPI policy.

B. Constant Mix Policy: This is a **Do Something** policy where shares and bonds are bought at predetermined ratio and reviewed when significant changes take place and the portfolio is reset to predetermined ratio by taking appropriate action.

- a. Gives rise to concave pay off drive.
- b. Doesn't provide much downward protection and tends to do relatively poor in the up market
- c. Tends to do very well in flat but fluctuating market.

C. CPPI Policy: This is Constant Proportion Portfolio Insurance Policy, where the portfolio is frequently reviewed to ensure the investments in shares is maintained as per the following formula:

$$\text{Investment in shares} = m * (\text{Portfolio value} - \text{Floor Value})$$

Floor Value is the value which market expects at end of the period of investment and m is a constant factor.

- a. Gives rise to a convex pay off drive.
- b. Provides good downside protection and performs well in up market.
- c. Tends to do very poorly in flat but in fluctuating market.
- d. As market increases more funds will be diverted to market and vice versa.

Hedge Funds: Hedge Fund is an aggressively managed portfolio of investments that uses advanced investment strategies such as leverage, long, short and derivative positions in both domestic and international markets with the goal of generating high returns (either in an absolute sense or over a specified market benchmark). Investments in hedge funds are illiquid as they often require investors to keep their money in the fund for a minimum period of at least one year. Hedge funds (unlike mutual funds) are mostly unregulated because they cater to sophisticated investors.

Features of Hedge Funds:

- a. Utilize a variety of financial instruments to reduce risk, enhance returns
- b. Hedge funds vary enormously in terms of investment returns, volatility and risk. Many, but not all, hedge fund strategies tend to hedge against downturns in the markets being traded.
- c. Hedge funds have the ability to deliver non-market correlated returns.

- d. Many hedge funds have as an objective consistency of returns and capital preservation rather than magnitude of returns.
- e. Hedge funds are managed by experienced investment professionals who are generally disciplined and diligent.
- f. Pension funds, endowments, insurance companies, private banks and high net worth individuals and families invest in hedge funds.
- g. Most hedge fund managers are highly specialized and trade only within their area of expertise and competitive advantage.
- h. Hedge funds benefit by heavily weighting hedge fund managers' remuneration towards performance incentives, thus attracting the best brains in the investment business.

Hedging Strategies:

- a. Selling Short
- b. Using Arbitrage
- c. Trading Options or Derivatives
- d. Investing in Anticipation of a Specific Event
- e. Investing in Deeply Discounted Securities
- f. Many of the strategies used by hedge funds benefit from being non-correlated to the direction of equity markets.

Styles of Hedge Funds:

- a. Aggressive Growth
- b. Distressed Securities
- c. Emerging Markets
- d. Funds of Hedge Funds: : Mix and match hedge funds and other pooled investment vehicles
- e. Income
- f. Macro: Participates in all major markets - equities, bonds, currencies and commodities - though not always at the same time.
- g. Market Neutral: Off sets positions.
- h. Market Timing
- i. Opportunistic
- j. Multi Strategy
- k. Short Selling
- l. Special Situations

- m. Value: Invests in securities perceived to be selling at deep discounts to their intrinsic or potential worth.

Random Walk Theory: Many investment managers and stock market analysts believe that stock market prices can never be predicted because they are not a result of any underlying factors but are mere statistical ups and downs. This hypothesis is known as Random Walk hypothesis which states that the behaviour of stock market prices is unpredictable and that there is no relationship between the present prices of the shares and their future prices. Proponents of this hypothesis argue that stock market prices are independent. A British statistician, M. G. Kendall, found that changes in security prices behave nearly as if they are generated by a suitably designed roulette wheel for which each outcome is statistically independent of the past history. The fact that there are peaks and troughs in stock exchange prices is a mere statistical happening – successive peaks and troughs are unconnected. In the layman's language it may be said that prices on the stock exchange behave exactly the way a drunkard would behave while walking in a blind lane, i.e., up and down, with an unsteady way going in any direction he likes, bending on the side once and on the other side the second time etc. Views of supporters of this theory are as below:

- a. Prices of shares in stock market can never be predicted.
- b. The reason is that the price trends are not the result of any underlying factors, but that they represent a statistical expression of past data.
- c. There may be periodical ups or downs in share prices, but no connection can be established between two successive peaks (high price of stocks) and troughs (low price of stocks)

Factors Affecting Investment Decision In Portfolio: Objectives of investment Decision are varied:

- a. Growth oriented or income oriented
- b. Duration of investment
- c. Risk appetite of investor
- d. Whether investment is being made to hedge.
- e. To invest in Bonds or Stocks; etc.

Impact of Government Policies on Securities:

- a. Licensing Policy
- b. Restrictions on commodity and stock trading in exchanges

- c. Changes in FDI and FII rules.
- d. Export and import restrictions
- e. Restrictions on shareholding in different industry sectors
- f. Changes in tax laws and corporate and Securities laws.

Efficient Market Theory: This theory states that at any given time, all available information is fully reflected in securities' prices. Thus this theory implies that no investor can consistently outperform the market as every stock is appropriately priced based on available information. Thus it is impossible to either purchase undervalued stocks or sell stocks for inflated prices as stocks are always traded at their fair value on stock exchanges. Hence the only way to outperform market is through expert stock selection or market timing and that is the way an investor can possibly obtain higher returns by purchasing riskier investments.

Several researchers like Kendall, Roberts, Oshorne etc. have conducted several tests on price behaviour of stocks and all the results indicated that stock price movements are like the movement of a drunkard in an open area. No predictions can be made. The reason for this is efficient and perfect markets due to which any special information of a stock will find its way into market and accordingly the shares get repriced. Following are the Reasons for random movement of stock prices:

- a. Information is freely and instantaneously available to all market participants.
- b. Price change is only response to new information that is unrelated to previous information and therefore unpredictable.
- c. Keen competition among the market participants ensures that market will reflect intrinsic values since participants fully impound all available information.

Misconception about Efficient Market Theory: Efficient Market Theory signifies that prices impound all available information and so it implies that market does not possess perfect forecasting abilities.

Although prices tend to fluctuate they cannot reflect fair value. This is because the future is uncertain and the market springs surprises continually as fluctuations in prices reflect the surprises.

The random movement of stock prices suggests that stock market is irrational.

Inability of institutional portfolio managers to achieve superior investment performance implies that they lack competence in an efficient market. It is not possible to achieve superior investment performance since all portfolio managers do their job well in a competitive setting.

Three forms of Efficient Market Hypothesis: The Efficient Market Theory lays stress on the speed of information that affects the prices of securities. As per research studies, it was observed that if information is slowly incorporated in the price, it provides an opportunity to earn excess profit. However, once the information is incorporated then investor cannot earn this excess profit. There are 3 levels of market efficiency:

- a. **Weak form efficiency:** Prices reflect all information found in the record of past prices and volumes.
- b. **Semi – Strong efficiency:** Prices reflect not only all information found in the records of past prices and volumes but also all other publicly available information.
- c. **Strong form efficiency:** Prices reflect all available information public as well as private.

Proof of weak form of efficiency: According to the Weak form Efficient Market Theory current price of a stock reflects all information found in the record of past prices and volumes. This means that there is relationship between the past and future price movements. This is affirmed through 3 tests:

- a. **Serial Correlation Test:** In this test, price changes in one period are correlated with price changes in another period. Price changes are considered to be serially independent. Serial correlation studies employing different stocks, at different time lags and different time periods have been conducted to detect serial correlation but no significant serial correlation could be discovered. These studies were carried on short term trends viz. daily, weekly, fortnightly and monthly and not in long term trends in stock prices as in such cases, Stock prices tend to move upwards.
- b. **Run Test:** Given a series of stock price changes each price change is designated + if it represents an increase and – if it represents a decrease. The resulting series may be -, +, +, +, -, -, -, +, +.

A run occurs when there is no difference between the sign of two changes. When the sign of change differs, the run ends and new run begins.

Price Incr. / Decr.	+,+,+,-,-,+,+,-,-,+,+,+,-,+,+,+,+															
Run	1	2	3	4	5	6	7	8	9							

To test a series of price change for independence, the number of runs in that series is compared with a number of runs in a purely random series of the same size to determine whether it is statistically different. The results of these studies strongly support the Random Walk Model.

Calculation: To test efficiency, following procedure is adopted:

First, number of runs **r** is calculated.

Secondly, N_+ & N_- are calculated. These are the number of +ve & -ve signs in the sample.

Thirdly, N is calculated. **$N = N_+ + N_- = \text{Total observations} - 1$**

Fourthly, As per Null hypothesis, the number of runs in a sequence of N elements as random variable whose conditional distribution is given by observations of N_+ and N_- is approximately normal with Mean μ which is calculated as

$$\mu = \frac{2 N_+ N_-}{N} + 1$$

Fifthly, Standard deviation, σ is calculated by the formula:

$$\sigma = \frac{(\mu - 1)(\mu - 2)}{N - 1}$$

Sixthly, If the sample size is N , then it will have $(N - 1)$ degrees of freedom. For this particular degrees of freedom, and the given level of significance, using the value '**t**' from t-table, Upper and Lower limits are found by the formula:

Upper / Lower Limit = $\mu \pm t * \sigma$

Lastly, If the value of **r** falls within the upper and lower limits, it is called weak form of efficiency, and if it falls outside the limits, it is called strong form of efficiency.

c. Filter Test: Under this test, if the price of a stock increases by at least $N\%$ buy and hold it until its price decreases by at least $N\%$ from

a subsequent high. When the price decreases at least N% or more, sell it. If the behaviour of stock price changes is random, filter rules should not be applied and in such case a buy and hold strategy is to be adopted. Studies suggest that filter rules do not outperform a single buy and hold strategy particularly after considering commission on transaction.

Proof of Semi Strong Efficiency: According to Semi-strong form efficient market theory stock prices adjust rapidly to all publicly available information. By using publicly available information, investors will not be able to earn above normal rates of return after considering the risk factor. To test semi-strong form efficient market theory, a number of studies were conducted to answer the following queries:

- Whether it is possible to earn the above normal rate of return after adjustment for risk, using only publicly available information? and
- How rapidly prices adjust to public announcement with regard to earnings, dividends, mergers, acquisitions, stock splits?

Several studies have been made on the above issues and it is observed that, the prices of stocks moved up significantly before announcements than after announcements. The studies have also brought out following observations:

- Stock price adjust gradually not rapidly to announcements of unanticipated changes in quarterly earnings.
- Small firms' portfolio seemed to outperform large firms' portfolio.
- Monday's return is lower than return for the other days of the week.

Thus it is affirmed that random movement of stock prices holds good.

Proof of Strong Efficiency: According to Strong form efficient market theory stock prices adjust rapidly to all publicly and privately available information.

To test this theory, the researchers analysed returns earned by certain groups viz. Corporate insiders, specialists on stock exchanges, mutual fund managers who have access to internal information (not publicly available), or posses greater resource or ability to intensively analyse information in the public domain. They suggested that corporate insiders (having access to internal information) and stock exchange specialists (having monopolistic exposure) earn superior rate of return after adjustment of risk.

Mutual Fund managers do not on an average earn a superior rate of return. No scientific evidence has been formulated to indicate that investment performance of professionally managed portfolios as a group is better than that of randomly selected portfolios.

This indicates that persons who are privy to certain information earn more than others who are not privy to such information.

Challenges of Efficient Market Theory: Information is not freely available and even if available, the authenticity cannot always be vouched. At times corporates deliberately allow wrong information to get propagated. Other challenges are:

- a. Limited information processing capabilities:** Human information processing capabilities are sharply limited. Every human organism lives in an environment which generates millions of new bits of information every second but the bottle necks of the perceptual apparatus does not admit more than thousand bits per second or possibly much less.
Further, under conditions of anxiety and uncertainty, with a vast interacting information grid, the market can become a giant.
- b. Irrational Behaviour:** It is generally believed that investors' rationality will ensure a close correspondence between market prices and intrinsic values. But in practice this is not true. All sorts of considerations enter into the market valuation which is in no way relevant to the prospective yield. This was confirmed by L. C. Gupta who found that the market evaluation processes work haphazardly almost like a blind man firing a gun. The market seems to function largely on hit or miss tactics rather than on the basis of informed beliefs about the long term prospects of individual enterprises.
- c. Monopolistic Influence:** A market is regarded as highly competitive. No single buyer or seller is supposed to have undue influence over prices. In practice, powerful institutions and big operators wield great influence over the market. The monopolistic power enjoyed by them diminishes the competitiveness of the market. Due to monopolistic powers, prices are rigged for gains.

Statutory Warning: *Investing all Liquid assets, and / or converting all fixed assets into liquid assets and investing in Stock Market will be injurious to your wealth.*

Questions:

- a. Briefly explain the objectives of "Portfolio Management".
- b. Distinguish between 'Systematic risk' and 'Unsystematic risk'.
- c. Discuss the various kinds of Systematic and Unsystematic risk?
- d. What sort of investor normally views the variance (or Standard Deviation) of an individual security's return as the security's proper measure of risk?
- e. What sort of investor rationally views the beta of a security as the security's proper measure of risk? In answering the question, explain the concept of beta.
- f. Write short note on Factors affecting investment decisions in portfolio management.
- g. Explain the Efficient Market Theory and what are major misconceptions about this theory?
- h. Explain the different levels or forms of Efficient Market Theory and what are various empirical evidence for these forms?
- i. Explain the three form of Efficient Market Hypothesis.
- j. Explain different challenges to Efficient Market Theory.
- k. Discuss the Capital Asset Pricing Model (CAPM) and its relevant assumptions.
- l. Discuss the Random Walk Theory.
- m. Discuss how the risk associated with securities is affected by Government policy.

Correlation: Correlation indicates the strength of relationship between two variables.

Covariance (a statistical measure) between two securities or two portfolios or a security and a portfolio indicating how the rates of return for the two concerned behave relative to each other. Covariance between 2 securities can be +ve, -ve or zero.

Coefficient of Correlation: Coefficient of Correlation is a statistical measure which indicates the degree to which changes to the value of a variable indicates the change in the value of the other variable. In positively correlated variables, the value of the variable increases or decreases in tandem with the value of another variable and the change depends on the degree of coefficient. In negatively correlated variables, the change will be vice versa.