## 7
### Portfolio Theory

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1. Introduction

Investment in the securities such as bonds, debentures and shares etc. is lucrative as well as exciting for the investors. Though investment in these securities may be rewarding, it is also fraught with risk. Therefore, investment in these securities requires a good amount of scientific and analytical skill. As per the famous principle of not putting all eggs in the same basket, an investor never invests his entire investable funds in one security. He invests in a well diversified portfolio of a number of securities which will optimize the overall risk-return profile. Investment in a portfolio can reduce risk without diluting the returns. An investor, who is expert in portfolio analysis, may be able to generate trading profits on a sustained basis.

Every investment is characterized by return and risk. The concept of risk is intuitively understood by investors. In general, it refers to the possibility of the rate of return from a security or a portfolio of securities deviating from the corresponding expected/average rate and can be measured by the standard deviation/variance of the rate of return.

1.1 Activities in Portfolio Management

The following three major activities are involved in the formation of an Optimal Portfolio suitable for any given investor:

(a) Selection of securities.

(b) Construction of all Feasible Portfolios with the help of the selected securities.

(c) Deciding the weights/proportions of the different constituent securities in the portfolio so that it is an Optimal Portfolio for the concerned investor.

The activities are directed to achieve an Optimal Portfolio of investments commensurate with the risk appetite of the investor.

1.2 Objectives of Portfolio Management

Some of the important objectives of portfolio management are:

(i) Security/Safety of Principal: Security not only involves keeping the principal sum intact but also its purchasing power.
(ii) **Stability of Income**: To facilitate planning more accurately and systematically the reinvestment or consumption of income.

(iii) **Capital Growth**: It can be attained by reinvesting in growth securities or through purchase of growth securities.

(iv) **Marketability i.e. the case with which a security can be bought or sold**: This is essential for providing flexibility to investment portfolio.

(v) **Liquidity i.e. nearness to money**: It is desirable for the investor so as to take advantage of attractive opportunities upcoming in the market.

(vi) **Diversification**: The basic objective of building a portfolio is to reduce the risk of loss of capital and/or income by investing in various types of securities and over a wide range of industries.

(vii) **Favourable Tax Status**: The effective yield an investor gets from his investment depends on tax to which it is subjected to. By minimising the tax burden, yield can be effectively improved.

2. **Phases of Portfolio Management**

Portfolio management is a process and broadly it involves following five phases and each phase is an integral part of the whole process and the success of portfolio management depends upon the efficiency in carrying out each of these phases.

2.1 **Security Analysis**: The securities available to an investor for investment are numerous in number and of various types. The securities are normally classified on the basis of ownership of securities such as equity shares, preference shares, debentures and bonds. In recent times a number of new securities with innovative features are available in the market e.g. Convertible Debentures, Deep Discount Bonds, Zero Coupon Bonds, Flexi Bonds, Floating Rate Bonds, Global Depository Receipts, Euro-currency Bonds, Green Bonds, Pro Bonds, Masala Bonds etc. are some examples of these new securities. Among this vast group of securities, an investor has to choose those ones which he considers worthwhile to be included in his investment portfolio. This requires a detailed analysis of all the securities available for making investment.

Security analysis constitutes the initial phase of the portfolio formation process and consists of examining the risk-return characteristics of individual securities and also the correlation among them. A simple strategy in securities investment is to buy underpriced securities and sell overpriced securities. But the basic problem is how to identify underpriced and overpriced securities and this is what security analysis is all about.

As discussed in the chapter of Security Analysis, there are two alternative approaches to analyse any security viz. fundamental analysis and technical analysis. They are based on different premises and follow different techniques. Fundamental analysis, the older of the two approaches, concentrates on the fundamental factors affecting the company such as

- the EPS of the company,
- the dividend pay-out ratio,
7.4 Strategic Financial Management

- the competition faced by the company,
- the market share, quality of management, etc.
- fundamental factors affecting the industry to which the company belongs.

The fundamental analyst compares this intrinsic value (true worth of a security based on its fundamentals) with the current market price. If the current market price is higher than the intrinsic value, the share is said to be overpriced and vice versa. This mispricing of securities gives an opportunity to the investor to acquire the share or sell off the share profitably. An intelligent investor would buy those securities which are underpriced and sell those securities which are overpriced. Thus, it can be said that fundamental analysis helps to identify fundamentally strong companies whose shares are worthy to be included in the investor's portfolio.

The second approach to security analysis is 'Technical Analysis'. As per this approach, the share price movements are systematic and exhibit certain consistent patterns. Therefore, properly studied past movements in the prices of shares help to identify trends and patterns in security prices and efforts are made to predict the future price movements by looking at the patterns of the immediate past. Thus, technical analyst concentrates more on price movements and ignores the fundamentals of the shares.

In order to construct well diversified portfolios, so that Unsystematic Risk can be eliminated or substantially mitigated, an investor will like to select securities across diverse industry sectors which should not have strong positive correlation among themselves.

The efficient market hypothesis holds that share price movements are random and not systematic. Consequently, neither fundamental analysis nor technical analysis is of value in generating trading gains on a sustained basis. The EMH thus does not subscribe to the belief that it is possible to book gains in the long term on a sustained basis from trading in the stock market. Markets, though becoming increasingly efficient everywhere with the passage of time, are never perfectly efficient. So, there are opportunities all the time although their durations are decreasing and only the smart investors can look forward to booking gains consistently out of stock market deals.

2.2 Portfolio Analysis: Once the securities for investment have been identified, the next step is to combine these to form a suitable portfolio. Each such portfolio has its own specific risk and return characteristics which are not just the aggregates of the characteristics of the individual securities constituting it. The return and risk of each portfolio can be computed mathematically based on the risk-return profiles for the constituent securities and the pair-wise correlations among them.

From any chosen set of securities, an indefinitely large number of portfolios can be constructed by varying the fractions of the total investable resources allocated to each one of them. All such portfolios that can be constructed out of the set of chosen securities are termed as Feasible Portfolios.

2.3 Portfolio Selection: The goal of a rational investor is to identify the Efficient Portfolios out of the whole set of Feasible Portfolios mentioned above and then 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. Harry Markowitz’s portfolio theory (Modern Portfolio Theory) outlines the methodology for locating the Optimal Portfolio for an investor (unlike the CAPM, the Optimal Portfolio as per Markowitz Theory is investor specific).

2.4 Portfolio Revision: Once an optimal portfolio has been constructed, it becomes necessary for the investor to constantly monitor the portfolio to ensure that it does not lose its optimality. Since the 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 with the passage of time. New securities with expectations of high returns and low risk may emerge. In light of these developments in the market, the investor now has to revise his portfolio. This revision leads to addition (purchase) of some new securities and deletion (sale) of some of the existing securities from the portfolio. The nature of securities and their proportion in the portfolio changes as a result of the revision.

This portfolio revision may also be necessitated by some investor-related changes such as availability of additional funds for investment, change in risk appetite, need of cash for other alternative use, etc.

Portfolio revision is not a casual process to be taken lightly and needs to be carried out with care, scientifically and objectively so as to ensure the optimality of the revised portfolio. Hence, in the entire process of portfolio management, portfolio revision is as important as portfolio analysis and selection.

2.5 Portfolio Evaluation: This process is concerned with assessing the performance of the portfolio over a selected period of time in terms of return and risk and 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 alternative measures of performance evaluation have been developed for use by investors and portfolio managers.

This step provides a mechanism for identifying weaknesses in the investment process and for improving these deficient areas.

It should however be noted that the portfolio management process is an ongoing process. It starts with security analysis, proceeds to portfolio construction, and continues with portfolio revision and end with portfolio evaluation. Superior performance is achieved through continual refinement of portfolio management skill.

3. Portfolio Theories

Portfolio theory forms the basis for portfolio management. Portfolio management deals with the selection of securities and their continuous shifting in the portfolio to optimise returns to suit the objectives of an investor. This, however, requires financial expertise in selecting the right mix of securities in changing market conditions to get the best out of the stock market. In India as well as in a number of Western countries, portfolio management service has assumed the role of a specialised service and a number of professional investment bankers/fund
managers compete aggressively to provide the best options to high net-worth clients, who have little time to manage their own investments. The idea is catching on with the growth of the capital market and an increasing number of people want to earn profits by investing their hard-earned savings in a planned manner.

A portfolio theory guides investors about the method of selecting and combining securities that will provide the highest expected rate of return for any given degree of risk or that will expose the investor to the lowest degree of risk for a given expected rate of return. Portfolio theory can be discussed under the following heads:

3.1 **Traditional Approach**: The traditional approach to portfolio management concerns itself with the investor, definition of portfolio objectives, investment strategy, diversification and selection of individual investment as detailed below:

(i) Investor's study includes an insight into his – (a) age, health, responsibilities, other assets, portfolio needs; (b) need for income, capital maintenance, liquidity; (c) attitude towards risk; and (d) taxation status;

(ii) Portfolio objectives are defined with reference to maximising the investors' wealth which is subject to risk. The higher the level of risk borne, the more the expected returns.

(iii) Investment strategy covers examining a number of aspects including:

   (a) Balancing fixed interest securities against equities;
   (b) Balancing high dividend payout companies against high earning growth companies as required by investor;
   (c) Finding the income of the growth portfolio;
   (d) Balancing income tax payable against capital gains tax;
   (e) Balancing transaction cost against capital gains from rapid switching; and
   (f) Retaining some liquidity to seize upon bargains.

(iv) Diversification reduces volatility of returns and risks and thus adequate equity diversification is sought. Balancing of equities against fixed interest bearing securities is also sought.

(v) Selection of individual investments is made on the basis of the following principles:

   (a) Methods for selecting sound investments by calculating the true or intrinsic value of a share and comparing that value with the current market value (i.e. by following the fundamental analysis) or trying to predict future share prices from past price movements (i.e., following the technical analysis);
   (b) Expert advice is sought besides study of published accounts to predict intrinsic value;
   (c) Inside information is sought and relied upon to move to diversified growth companies, switch quickly to winners than loser companies;
   (d) Newspaper tipsters about good track record of companies are followed closely;
Companies with good asset backing, dividend growth, good earning record, high quality management with appropriate dividend paying policies and leverage policies are traced out constantly for making selection of portfolio holdings.

In India, most of the share and stock brokers follow the above traditional approach for selecting a portfolio for their clients.

3.2 Modern Approach (Markowitz Model or Risk-Return Optimization): Originally developed by Harry Markowitz in the early 1950's, Portfolio Theory - sometimes referred to as Modern Portfolio Theory - provides a logical/mathematical framework in which investors can optimize their risk and return. The central plank of the theory is that diversification through portfolio formation can reduce risk, and return is a function of expected risk.

Harry Markowitz is regarded as the father of Modern Portfolio Theory. According to him, investors are mainly concerned with two properties of an asset: risk and return. The essence matters is the contribution it makes to the investor’s overall risk. By turning his principle into a useful technique for selecting the right portfolio from a range of different assets, he developed the 'Mean Variance Analysis' in 1952.

We shall discuss this theory in greater detail later in this chapter.

4. Risk Analysis

Before proceeding further it will be better if the concept of risk and return is discussed. A person makes an investment in the expectation of getting some return in the future. But, the future is uncertain and so is the future expected return. It is this uncertainty associated with the returns from an investment that introduces risk for an investor.

It is important here to distinguish between the expected return and the realized return from an investment. The expected future return is what an investor expects to get from his investment and is uncertain. On the other hand, the realized return is what an investor actually obtains from his investment at the end of the investment period. The investor makes the investment decision based on the expected return from the investment. However, the actual return realized from the investment may not correspond to the expected return. This possible variation of the actual return from the expected return is termed as risk. If actual realizations correspond to expectations exactly, there would be no risk. Risk arises where there is a possibility of variation between expectations and realizations with regard to an investment.

Thus, risk arises from the variability in returns. An investment whose returns are fairly stable is considered to be a low-risk investment, whereas an investment whose returns fluctuate significantly is considered to be a highly risky investment. Government securities whose returns are fairly stable and which are free from default are considered to possess low risk whereas equity shares whose returns are likely to fluctuate widely around their mean are considered risky investments.

The essence of risk in an investment is the variation in its returns. This variation in returns is caused by a number of factors. These factors which produce variations in the returns from an investment constitute the elements of risk.
4.1 Elements of Risk: Let us consider the risk in holding securities, such as shares, debentures, etc. The elements of risk may be broadly classified into two groups as shown in the following diagram.

The first group i.e. systematic risk comprises factors that are external to a company (macro in nature) and affect a large number of securities simultaneously. These are mostly uncontrollable in nature. The second group i.e. unsystematic risk includes those factors which are internal to companies (micro in nature) and affect only those particular companies. These are controllable to a great extent.

The total variability in returns of a security is due to the total risk of that security. Hence,

Total risk = Systematic risk + Unsystematic risk

4.1.1 Systematic Risk: Due to dynamic nature of society, the changes occur in the economic, political and social systems constantly. These changes have an influence on the performance of companies and thereby on their stock prices but in varying degrees. For example, economic and political instability adversely affects all industries and companies. When an economy moves into recession, corporate profits will shift downwards and stock prices of most companies may decline. Thus, the impact of economic, political and social changes is system-wide and that portion of total variability in security returns caused by such system-wide factors is referred to as systematic risk. Systematic risk can be further subdivided into interest rate risk, market risk and purchasing power risk.

(i) Interest Rate Risk: This arises due to variability in the interest rates from time to time and particularly affects debts securities like bonds and debentures as they carry fixed coupon rate of interest. A change in the interest rates establishes an inverse relationship in the price of security i.e. price of securities tends to move inversely with change in rate of interest, long term securities show greater variability in the price with respect to interest rate changes than short term securities. While cash equivalents are less vulnerable to interest rate risk the long term bonds are more vulnerable to interest rate risk.

(ii) Purchasing Power Risk: It is also known as inflation risk, as it also emanates from the very fact that inflation affects the purchasing power adversely. Nominal return contains both the real return component and an inflation premium in a transaction involving risk of the above
type to compensate for inflation over an investment holding period. Inflation rates vary over time and investors are caught unaware when rate of inflation changes unexpectedly causing erosion in the value of realised rate of return and expected return.

Purchasing power risk is more in inflationary conditions especially in respect of bonds and fixed income securities. It is not desirable to invest in such securities during inflationary periods. Purchasing power risk is however, less in flexible income securities like equity shares or common stock where rise in dividend income off-sets increase in the rate of inflation and provides advantage of capital gains.

(iii) Market risk: This is a type of systematic risk that affects prices of any particular share move up or down consistently for some time periods in line with other shares in the market. A general rise in share prices is referred to as a bullish trend, whereas a general fall in share prices is referred to as a bearish trend. In other words, the share market moves between the bullish phase and the bearish phase. The market movements can be easily seen in the movement of share price indices such as the BSE Sensitive Index, BSE National Index, NSE Index etc.

4.1.2 Unsystematic Risk: Sometimes the return from a security of any company may vary because of certain factors particular to this company. Variability in returns of the security on account of these factors (micro in nature), it is known as unsystematic risk. It should be noted that this risk is in addition to the systematic risk affecting all the companies. Unsystematic risk can be further subdivided into business risk and financial risk.

(i) Business Risk: Business risk emanates from sale and purchase of securities affected by business cycles, technological changes etc. Business cycles affect all types of securities viz. there is cheerful movement in boom due to bullish trend in stock prices whereas bearish trend in depression brings down fall in the prices of all types of securities. Flexible income securities are more affected than fixed rate securities during depression due to decline in their market price.

(ii) Financial Risk: It arises due to changes in the capital structure of the company. It is also known as leveraged risk and expressed in terms of debt-equity ratio. Excess of debt vis-à-vis equity in the capital structure indicates that the company is highly geared. Although a leveraged company's earnings per share are more but dependence on borrowings exposes it to the risk of winding-up for its inability to honour its commitments towards lenders/creditors. This risk is known as leveraged or financial risk of which investors should be aware of and portfolio managers should be very careful.

4.2 Diversion of Risk: As discussed above the total risk of an individual security consists of two risks systematic risk and unsystematic risk. It should be noted that by combining many securities in a portfolio the unsystematic risk can be avoided or cancelled out which is attached to any particular security. The following diagram depicts how the risk can be reduced with the increase in the number of securities.
From the above diagram it can be seen that total risk is reducing with the increase in the number of securities in the portfolio. However, ultimately when the size of the portfolio reaches certain limit, it will contain only the systematic risk of securities included in the portfolio.

4.3 Risk & Return: It is very common that an intelligent investor would attempt to anticipate the kind of risk that he/she is likely to face and would also attempt to estimate the extent of risk associated with different investment proposals. In other words an attempt is made by him/her to measure or quantify the risk of each investment under consideration before making the final selection. Thus quantification of risk is necessary for analysis of any investment.

As risk is attached with return its risk cannot be measured without reference to return. The return, in turn, depends on the cash inflows to be received from the investment. Let us take an example of purchase of a share. With an investment in an equity share, an investor expects to receive future dividends declared by the company. In addition, he expects to receive capital gain in the form of difference between the selling price and purchase price, when the share is finally sold.

Suppose a share of X Ltd. is currently selling at ₹ 12.00. An investor who is interested in the share anticipates that the company will pay a dividend of ₹ 0.50 in the next year. Moreover, he expects to sell the share at ₹ 17.50 after one year. The expected return from the investment in share will be as follows:

\[
R = \frac{\text{Forecasted dividend} + \text{Forecasted end of the period stock price}}{\text{Initial investment}} - 1
\]

\[
R = \frac{₹ 0.50 + ₹ 17.50}{₹ 12.00} - 1 = 0.5 \text{ or } 50 \text{ per cent}
\]
It is important to note that here the investor expects to get a return of 50 per cent in the future, which is uncertain. It might be possible that the dividend declared by the company may turn out to be either more or less than the figure anticipated by the investor. Similarly, the selling price of the share may be less than the price expected by the investor at the time of investment. It may sometimes be even more. Hence, there is a possibility that the future return may be more than 50 per cent or less than 50 per cent. Since the future is uncertain the investor has to consider the probability of several other possible returns. The expected returns may be 20 per cent, 30 per cent, 50 per cent, 60 per cent or 70 per cent. The investor now has to assign the probability of occurrence of these possible alternative returns as given below:

<table>
<thead>
<tr>
<th>Possible returns (in per cent)</th>
<th>Probability of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_i$</td>
<td>$p(X_i)$</td>
</tr>
<tr>
<td>20</td>
<td>0.20</td>
</tr>
<tr>
<td>30</td>
<td>0.20</td>
</tr>
<tr>
<td>50</td>
<td>0.40</td>
</tr>
<tr>
<td>60</td>
<td>0.10</td>
</tr>
<tr>
<td>70</td>
<td>0.10</td>
</tr>
</tbody>
</table>

The above table gives the probability distribution of possible returns from an investment in shares. Such distribution can be developed by the investor with the help of analysis of past data and modifying it appropriately for the changes he expects to occur in a future period of time.

With the help of available probability distribution two statistical measures one expected return and the other risk of the investment can be calculated.

**4.3.1 Expected Return:** The expected return of the investment is the probability weighted average of all the possible returns. If the possible returns are denoted by $X_i$ and the related probabilities are $p(X_i)$ the expected return may be represented as $\bar{X}$ and can be calculated as:

$$\bar{X} = \sum_{i=1}^{n} X_i p(X_i)$$

It is the sum of the products of possible returns with their respective probabilities.

The expected return of the share in the example given above can be calculated as shown below:

**Calculation of Expected Return**

<table>
<thead>
<tr>
<th>Possible returns(%)</th>
<th>Probability $p(X_i)$</th>
<th>$X_i p(X_i)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.20</td>
<td>4.00</td>
</tr>
<tr>
<td>30</td>
<td>0.20</td>
<td>6.00</td>
</tr>
<tr>
<td>40</td>
<td>0.40</td>
<td>16.00</td>
</tr>
</tbody>
</table>
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\[
\begin{array}{c|c|c}
\text{50} & 0.10 & 5.00 \\
\text{60} & 0.10 & 6.00 \\
\hline
\sum_{i=1}^{n} x_i p(X_i) & & 37.00 \\
\end{array}
\]

Hence the expected return is 37 per cent

4.3.2 Risk: As risk is attached with every return hence calculation of only expected return is not sufficient for decision making. Therefore risk aspect should also be considered along with the expected return. The most popular measure of risk is the variance or standard deviation of the probability distribution of possible returns.

Variance is generally denoted by \( \sigma^2 \) and is calculated by using the following formula:

\[
\sum_{i=1}^{n} [(X_i - \bar{X})^2 \cdot p(X_i)]
\]

Continuing our earlier example the following table provides calculations required to calculate the risk i.e. Variance or Standard Deviation (SD).

<table>
<thead>
<tr>
<th>Possible returns ( X_i ) (%)</th>
<th>Probability ( p(X_i) )</th>
<th>Deviation ( (X_i - \bar{X}) )</th>
<th>Deviation squared ( (X_i - \bar{X})^2 )</th>
<th>Product ( (X_i - \bar{X})^2 \cdot p(X_i) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.20</td>
<td>-17.00</td>
<td>289.00</td>
<td>57.80</td>
</tr>
<tr>
<td>30</td>
<td>0.20</td>
<td>-7.00</td>
<td>49.00</td>
<td>9.80</td>
</tr>
<tr>
<td>40</td>
<td>0.40</td>
<td>3.00</td>
<td>9.00</td>
<td>3.60</td>
</tr>
<tr>
<td>50</td>
<td>0.10</td>
<td>13.00</td>
<td>169.00</td>
<td>16.90</td>
</tr>
<tr>
<td>60</td>
<td>0.10</td>
<td>23.00</td>
<td>529.00</td>
<td>52.90</td>
</tr>
</tbody>
</table>

Variance = 141 per cent

Standard Deviation of the return will be the positive square root of the variance and is generally represented by \( \sigma \). Accordingly, the standard deviation of return in the above example will be \( \sqrt{141} = 11.87\% \).

The basic purpose to calculate the variance and standard deviation is to measure the extent of variability of possible returns from the expected return. Several other measures such as range, semi-variance and mean absolute deviation can also be used to measure risk, but standard deviation has been the most popularly accepted measure.

The method described above is widely used for assessing risk and is also known as the mean variance approach.

The standard deviation or variance, however, provides a measure of the total risk associated with a security. As we know, the total risk comprises two components, namely systematic risk and unsystematic risk. Unsystematic risk is the risk specific or unique to a company.
Unsystematic risk associated with the security of a particular company can be eliminated/reduced by combining it with another security having negative correlation. This process is known as diversification of unsystematic risk. As a means of diversification the investment is spread over a group of securities with different characteristics. This collection of diverse securities is called a portfolio.

As unsystematic risk can be reduced or eliminated through diversification, it is not very important for an investor to consider. The risk that is relevant in investment decisions is the systematic risk because it is not diversifiable. Hence, the main interest of the investor lies in the measurement of systematic risk of a security.

4.3.3 Measurement of Systematic Risk: As discussed earlier, systematic risk is the variability in security returns caused by changes in the economy or the market and all securities are affected by such changes to some extent. Some securities exhibit greater variability in response to market changes and some may exhibit less response. Securities that are more sensitive to changes in factors are said to have higher systematic risk. 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 which is called Beta. The main 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.

4.3.3.1 Correlation Method: Using this method beta (β) can be calculated from the historical data of returns by the following formula:

$$\beta_i = \frac{r_{im}\sigma_i\sigma_m}{\sigma_m^2}$$

Where

- $r_{im}$ = Correlation coefficient between the returns of the stock $i$ and the returns of the market index.
- $\sigma_i$ = Standard deviation of returns of stock $i$
- $\sigma_m$ = Standard deviation of returns of the market index.
- $\sigma_m^2$ = Variance of the market returns

4.3.3.2 Regression Method: The regression model is based on the postulation that there exists a linear relationship between a dependent variable and an independent variable. The model helps to calculate the values of two constants, namely alfa ($\alpha$) and beta (β). $\beta$ measures the change in the dependent variable in response to unit change in the independent variable,
while $\alpha$ measures the value of the dependent variable even when the independent variable has zero value. The formula of the regression equation is as follows:

$$Y = \alpha + \beta X$$

where

- $Y =$ Dependent variable
- $X =$ Independent variable
- $\alpha$ and $\beta$ are constants.

$$\alpha = Y - \beta X$$

The formula used for the calculation of $\alpha$ and $\beta$ are given below.

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

where

- $n =$ Number of items.
- $Y =$ Dependent variable scores.
- $X =$ Independent variable scores.

For the purpose of calculation of $\beta$, the return of the individual security is taken as the dependent variable and the return of the market index is taken as the independent variable. The regression equation is represented as follows:

$$R_i = \alpha + \beta_i R_m$$

where

- $R_i =$ Return of the individual security.
- $R_m =$ Return of the market index.
- $\alpha =$ Estimated return of the security when the market is stationary.
- $\beta_i =$ Change in the return of the individual security in response to unit change in the return of the market index. It is, thus, the measure of systematic risk of a security.

Here it is very important to note that a security can have betas that are positive, negative or zero.

- **Positive Beta** - indicates that security’s return is dependent on the market return and moves in the direction in which market moves.
- **Negative Beta** - indicates that security’s return is dependent on the market return but moves in the opposite direction in which market moves.
- **Zero Beta** - indicates that security’s return is independent of the market return.

Further as 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.

A stock with beta less than 1.0 would have below average risk. Variability in its returns would be less than the market variability.

Beta is calculated from historical data of returns to measure the systematic risk of a security. It is a historical measure of systematic risk. In using this beta for investment decision making, the investor is assuming that the relationship between the security variability and market variability will continue to remain the same in future also.

4.4 Portfolio Analysis

Till now we have discussed the risk and return of a single security. Let us now discuss the return and risk of a portfolio of securities.

4.4.1 Portfolio Return: For a portfolio analysis an investor first needs to specify the list of securities eligible for selection or inclusion in the portfolio. Then he has to generate the risk-return expectations for these securities. The expected return for the portfolio is expressed as the mean of its rates of return over the time horizon under consideration and risk for the portfolio is the variance or standard deviation of these rates of return around the mean return.

The expected return of a portfolio of assets is simply the weighted average of the returns of the individual securities constituting the portfolio. The weights to be applied for calculation of the portfolio return are the fractions of the portfolio invested in such securities.

Let us consider a portfolio of two equity shares A and B with expected returns of 16 per cent and 22 per cent respectively.

The formula for the calculation of expected portfolio return may be expressed as shown below:

$$\bar{r}_p = \sum_{i=1}^{n} x_i \bar{r}_i$$

$\bar{r}_p =$ Expected return of the portfolio.

$x_i =$ Proportion of funds invested in security

$\bar{r}_i =$ Expected return of security i.

$n =$ Number of securities in the portfolio.

If 40 per cent of the total funds is invested in share A and the remaining 60 per cent in share B, then the expected portfolio return will be:

$$(0.40 \times 16) + (0.60 \times 22) = 19.6 \text{ per cent}$$

4.4.2 Portfolio Risk: As discussed earlier, the variance of return and standard deviation of return are statistical measures that are used for measuring risk in investment. The variance of a portfolio can be written down as the sum of 2 terms, one containing the aggregate of the
weighted variances of the constituent securities and the other containing the weighted co-variances among different pairs 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.

The covariance between two securities A and B may be calculated using the following formula:

$$\text{COV}_{AB} = \frac{\sum (R_A - \overline{R_A})(R_B - \overline{R_B})}{N}$$

At the beginning please add the summation sign in the numerator

where

$\text{COV}_{AB}$ = Covariance between $x$ and $y$.

$R_A$ = Return of security $x$.

$R_B$ = Return of security $y$.

$\overline{R_A}$ = Expected or mean return of security $x$.

$\overline{R_B}$ = Expected or mean return of security $y$.

$N$ = Number of observations.

The calculation of covariance can be understood with the help of following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>$R_x$</th>
<th>Deviation $R_x - \overline{R_x}$</th>
<th>$R_y$</th>
<th>Deviation $R_y - \overline{R_y}$</th>
<th>$[R_x - \overline{R_x}][R_y - \overline{R_y}]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>-4</td>
<td>18</td>
<td>5</td>
<td>-20</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>-2</td>
<td>14</td>
<td>1</td>
<td>-2</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>2</td>
<td>11</td>
<td>-2</td>
<td>-4</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>4</td>
<td>9</td>
<td>-4</td>
<td>-16</td>
</tr>
</tbody>
</table>

$$\overline{R_x} = 15 \quad \overline{R_y} = 13$$

$$\text{Cov}_{xy} = \frac{\sum_{i=1}^{n} [R_x - \overline{R_x}][R_y - \overline{R_y}]}{n} = \frac{-42}{4} = -10.5$$

From the above table it can be seen that the covariance is a measure of how returns of two securities move together. In case the returns of the two securities move in the same direction consistently the covariance is said to be positive (+). Contrarily, if the returns of the two securities move in opposite directions consistently the covariance would be negative (-). If the movements of returns are independent of each other, covariance would be close to zero (0).
The coefficient of correlation is expressed as:

\[ r_{AB} = \frac{\text{Cov}_{AB}}{\sigma_A \sigma_B} \]

where

- \( r_{AB} \) = Coefficient of correlation between \( x \) and \( y \).
- \( \text{Cov}_{AB} \) = Covariance between \( A \) and \( B \).
- \( \sigma_A \) = Standard deviation of \( A \).
- \( \sigma_B \) = Standard deviation of \( B \).

It may be noted on the basis of above formula the covariance can be expressed as the product of correlation between the securities and the standard deviation of each of the securities as shown below:

\[ \text{Cov}_{AB} = \sigma_A \sigma_B r_{AB} \]

It is very important to note that the correlation coefficients may range from -1 to 1. A value of -1 indicates perfect negative correlation between the two securities' returns, while a value of +1 indicates a perfect positive correlation between them. A value of zero indicates that the returns are independent.

The calculation of the variance (or risk) of a portfolio is not simply a weighted average of the variances of the individual securities in the portfolio as in the calculation of the return of portfolio. The variance of a portfolio with only two securities in it can be calculated with the following formula.

\[ \sigma_p^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2x_1x_2(r_{12} \sigma_1 \sigma_2) \]

where

- \( \sigma_p^2 \) = Portfolio variance.
- \( x_1 \) = Proportion of funds invested in the first security.
- \( x_2 \) = Proportion of funds invested in the second security (\( x_1 + x_2 = 1 \)).
- \( \sigma_1^2 \) = Variance of first security.
- \( \sigma_2^2 \) = Variance of second security.
- \( \sigma_1 \) = Standard deviation of first security.
- \( \sigma_2 \) = Standard deviation of second security.
- \( r_{12} \) = Correlation coefficient between the returns of the first and second securities.

As the standard deviation is the square root of the variance the portfolio standard deviation can be obtained by taking the square root of portfolio variance.

Let us take an example to understand the calculation of portfolio variance and portfolio standard deviation. Two securities A and B generate the following sets of expected returns, standard deviations and correlation coefficient:
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<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>(r)</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>(\sigma)</td>
<td>50%</td>
<td>30%</td>
</tr>
<tr>
<td>(r_{ab})</td>
<td>-0.60</td>
<td>-0.60</td>
</tr>
</tbody>
</table>

Now suppose a portfolio is constructed with 40 per cent of funds invested in A and the remaining 60 per cent of funds in B (i.e. \(P = 0.4A + 0.6B\)).

Using the formula of portfolio return the expected return of the portfolio will be:

\[ R_p = (0.40 \times 20) + (0.60 \times 25) = 23\% \]

And the Variance and Standard Deviation of the portfolio will be:

\[ \text{Variance} \]

\[ \sigma_p^2 = (0.40)^2 \times (50)^2 + (0.60)^2 \times (30)^2 + 2(0.40)(0.60)(-0.60)(50)(30) = 400 + 324 - 432 = 292 \]

\[ \text{Standard deviation} \]

\[ \sigma_p = \sqrt{292} = 17.09 \text{ per cent} \]

The return and risk of a portfolio depends on following two sets of factors:

(a) Returns and risks of individual securities and the covariance between securities forming the portfolio

(b) Proportion of investment in each of securities.

As the first set of factors is parametric in nature for the investor in the sense that he has no control over the returns, risks and co-variances of individual securities. The second set of factors is choice factor or variable for the investors in the sense that they can choose the proportions of each security in the portfolio.

4.4.3 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 eliminating or substantially mitigating the unsystematic risk, without sacrificing portfolio return. As shown in the example mentioned above, diversification has helped to reduce risk. The portfolio standard deviation of 17.09 is lower than the standard deviation of either of the two securities taken separately which were 50 and 30 respectively. Incidentally, such risk reduction is possible even when the two constituent securities are uncorrelated. In case, however, these have the maximum positive correlation between them, no reduction of risk can be achieved.

In order to understand the mechanism and power of diversification, it is necessary to consider the impact of covariance or correlation on portfolio risk more closely. We shall discuss following three cases taking two securities in the portfolio:

(a) Securities' returns are perfectly positively correlated,

(b) Securities' returns are perfectly negatively correlated, and
Securities’ returns are not correlated i.e. they are independent.

**4.4.3.1 Perfectly Positively Correlated**: In case two securities returns are perfectly positively correlated the correlation coefficient between these securities will be +1 and the returns of these securities then move up or down together.

The variance of such portfolio can be calculated by using the following formula:

\[
\sigma_p^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2x_1 x_2 r_{12} \sigma_1 \sigma_2
\]

As \( r_{12} = 1 \), this may be rewritten as:

\[
\sigma_p^2 = x_1^2 \sigma_1^2 + x_2^2 \sigma_2^2 + 2x_1 x_2 \sigma_1 \sigma_2
\]

or

\[
\sigma_p^2 = (x_1 \sigma_1 + x_2 \sigma_2)^2
\]

Hence Standard Deviation will become

\[
\sigma_p = x_1 \sigma_1 + x_2 \sigma_2
\]

In other words this is simply the weighted average of the standard deviations of the individual securities.

Taking the above example we shall now calculate the portfolio standard deviation when correlation coefficient is +1.

Standard deviation of security A = 40

Standard deviation of security B = 25

Proportion of investment in A = 0.4

Proportion of investment in B = 0.6

Correlation coefficient = +1.0

Portfolio standard deviation maybe calculated as:

\[
\sigma_p = (0.4) (40) + (0.6) (25) = 31
\]

Thus it can be seen that the portfolio standard deviation will lie between the standard deviations of the two individual securities. It will vary between 40 and 25 as the proportion of investment in each security changes.

Now suppose, if the proportion of investment in A and B are changed to 0.75 and 0.25 respectively; portfolio standard deviation of the portfolio will become:

\[
\sigma_p = (0.75) (40) + (0.25) (25) = 36.25
\]

It is important to note that when the security returns are perfectly positively correlated, diversification provides only risk averaging and no risk reduction because the portfolio risk cannot be reduced below the individual security risk. Hence, reduction of risk is not achieved when the constituent securities’ returns are perfectly positively correlated.
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4.4.3.2 Perfectly Negatively Correlated: When two securities’ returns are perfectly negatively correlated, two returns always move in exactly opposite directions and correlation coefficient between them becomes -1. The variance of such negatively correlated portfolio may be calculated as:

$$\sigma_p^2 = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 - 2x_1x_2(r_{12}\sigma_1\sigma_2)$$

As $r_{12} = -1$, this may be rewritten as:

$$\sigma_p^2 = (x_1\sigma_1 - x_2\sigma_2)^2$$

Hence Standard Deviation will become

$$\sigma_p = x_1\sigma_1 - x_2\sigma_2$$

Taking the above example, we shall now calculate the portfolio standard deviation when correlation coefficient is -1.

$$\sigma_p = (0.4)(40) - (0.6)(25) = 1$$

Thus, from above it can be seen that the portfolio risk has become very low in comparison of risk of individual securities. By changing the weights it can even be reduced to zero. For example, if the proportion of investment in A and B are 0.3846 and 0.6154 respectively, portfolio standard deviation becomes:

$$\sigma_p = (0.3846)(40) - (0.6154)(25) = 0$$

Although in above example the portfolio contains two risky assets, the portfolio has no risk at all. Thus, the portfolio may become entirely risk-free when security returns are perfectly negatively correlated. Therefore, diversification can substantially reduce or even eliminate risk when securities are perfectly negatively correlated. However, in real life it is very rare to find securities that are perfectly negatively correlated.

4.4.3.3 Returns are uncorrelated or independent: When the returns of two securities are entirely uncorrelated, the coefficient of correlation of these two securities would be zero and the formula for portfolio variance will be as follows:

$$\sigma_p^2 = x_1^2\sigma_1^2 + x_2^2\sigma_2^2 + 2x_1x_2r_{12}\sigma_1\sigma_2$$

As $r_{12} = 0$, this may be rewritten as:

$$\sigma_p^2 = x_1^2\sigma_1^2 + x_2^2\sigma_2^2$$

Hence Standard Deviation will become

$$\sigma_p = \sqrt{x_1^2\sigma_1^2 + x_2^2\sigma_2^2}$$

Taking the above example, we shall now calculate the portfolio standard deviation when correlation coefficient is 0.
Thus it can be observed that the portfolio standard deviation is less than the standard deviations of individual securities in the portfolio. Therefore, when security returns are uncorrelated, diversification can reduce risk.

We may now tabulate the portfolio standard deviations of our illustrative portfolio having two securities A and B, for different values of correlation coefficients between them. The proportion of investments in A and B are 0.4 and 0.6 respectively. The individual standard deviations of A and B are 40 and 25 respectively.

<table>
<thead>
<tr>
<th>Correlation coefficient</th>
<th>Portfolio Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>31</td>
</tr>
<tr>
<td>0.60</td>
<td>27.73</td>
</tr>
<tr>
<td>0</td>
<td>21.93</td>
</tr>
<tr>
<td>-0.60</td>
<td>13.89</td>
</tr>
<tr>
<td>-1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Summarily it can be concluded that diversification reduces risk in all cases except when the security returns are perfectly positively correlated. With the decline of correlation coefficient from +1 to -1, the portfolio standard deviation also declines. But the risk reduction is greater when the security returns are negatively correlated.

4.4.4 Portfolio with more than two securities: So far we have considered a portfolio with only two securities. The benefits from diversification increase as more and more securities with less than perfectly positively correlated returns are included in the portfolio. As the number of securities added to a portfolio increases, the standard deviation of the portfolio becomes smaller and smaller. Hence, an investor can make the portfolio risk arbitrarily small by including a large number of securities with negative or zero correlation in the portfolio.

But, in reality, no securities show negative or even zero correlation. Typically, securities show some positive correlation, that is above zero but less than the perfectly positive value (+1). As a result, diversification (that is, adding securities to a portfolio) results in some reduction in total portfolio risk but not in complete elimination of risk. Moreover, the effects of diversification are exhausted fairly rapidly. That is, most of the reduction in portfolio standard deviation occurs by the time the portfolio size increases to 25 or 30 securities. Adding securities beyond this size brings about only marginal reduction in portfolio standard deviation.

Adding securities to a portfolio reduces risk because securities are not perfectly positively correlated. But the effects of diversification are exhausted rapidly because the securities are...
still positively correlated to each other though not perfectly correlated. Had they been negatively correlated, the portfolio risk would have continued to decline as portfolio size increased. Thus, in practice, the benefits of diversification are limited.

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. Following figure depicts the diversification of risk in a portfolio.

![Diversification of Risk in a Portfolio](image)

The figure shows the portfolio risk declining as the number of securities in the portfolio increases, but the risk reduction ceases when the unsystematic risk is eliminated.

### 4.4.5 Calculation of Return and Risk of Portfolio with more than two securities:

The expected return of a portfolio is the weighted average of the returns of individual securities in the portfolio, the weights being the proportion of investment in each security. The formula for calculation of expected portfolio return is the same for a portfolio with two securities and for portfolios with more than two securities. The formula is:

$$
\bar{r}_p = \sum_{i=1}^{n} x_i \bar{r}_i
$$

Where

- $\bar{r}_p = \text{Expected return of portfolio.}$
- $x_i = \text{Proportion of funds invested in each security.}$
- $\bar{r}_i = \text{Expected return of each security.}$
- $n = \text{Number of securities in the portfolio.}$
Let us consider a portfolio with four securities having the following characteristics:

<table>
<thead>
<tr>
<th>Security</th>
<th>Returns (per cent)</th>
<th>Proportion of investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>11</td>
<td>0.3</td>
</tr>
<tr>
<td>Q</td>
<td>16</td>
<td>0.2</td>
</tr>
<tr>
<td>R</td>
<td>22</td>
<td>0.1</td>
</tr>
<tr>
<td>S</td>
<td>20</td>
<td>0.4</td>
</tr>
</tbody>
</table>

The expected return of this portfolio may be calculated using the formula:

\[ \bar{r}_p = (0.3)(11) + (0.2)(16) + (0.1)(22) + (0.4)(20) \]

\[ = 16.7 \text{ per cent} \]

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:

\[ \sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \sigma_{ij} \]

where

\[ \sigma_p^2 = \text{Portfolio variance.} \]

\[ x_i = \text{Proportion of funds invested in security } i \text{ (the first of a pair of securities).} \]

\[ x_j = \text{Proportion of funds invested in security } j \text{ (the second of a pair of securities).} \]

\[ \sigma_{ij} = \text{The covariance between the pair of securities } i \text{ and } j \]

\[ n = \text{Total number of securities in the portfolio.} \]

or

\[ \sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \sigma_i \sigma_j \rho_{ij} \]

where

\[ \sigma_p^2 = \text{Portfolio variance.} \]

\[ \sigma_i = \text{Standard Deviation of security } i \]

\[ \sigma_j = \text{Standard Deviation of security } j \]

\[ \rho_{ij} = \text{The co-efficient of correlation between the pair of securities } i \text{ and } j \]

Let us take the following example to understand how we can compute the risk of multiple asset portfolio.
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<table>
<thead>
<tr>
<th>Security</th>
<th>$x_i$</th>
<th>$\sigma_i$</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>0.25</td>
<td>16</td>
<td>X and Y = 0.7</td>
</tr>
<tr>
<td>Y</td>
<td>0.35</td>
<td>7</td>
<td>X and Z = 0.3</td>
</tr>
<tr>
<td>Z</td>
<td>0.40</td>
<td>9</td>
<td>Y and Z = 0.4</td>
</tr>
</tbody>
</table>

It may be noted that correlation coefficient between X and X, Y and Y, Z and Z is 1.

A convenient way to obtain the result is to set up the data required for calculation in the form of a variance-covariance matrix.

As per data given in the example, the first cell in the first row of the matrix represents X and X the second cell in the first row represents securities X and Y, and so on. The variance or covariance in each cell has to be multiplied by the weights of the respective securities represented by that cell. These weights are available in the matrix at the left side of the row and the top of the column containing the cell.

This process may be started from the first cell in the first row and continued for all the cells till the last cell of the last row is reached as shown below:

<table>
<thead>
<tr>
<th>Weights</th>
<th>0.25</th>
<th>0.35</th>
<th>0.40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$X$</td>
<td>$Y$</td>
<td>$Z$</td>
</tr>
<tr>
<td>0.25</td>
<td>1 x 16 x 16</td>
<td>0.7 x 16 x 7</td>
<td>0.3 x 16 x 9</td>
</tr>
<tr>
<td>0.35</td>
<td>0.7 x 7 x 16</td>
<td>1 x 7 x 7</td>
<td>0.4 x 7 x 9</td>
</tr>
<tr>
<td>0.40</td>
<td>0.3 x 9 x 16</td>
<td>0.4 x 9 x 7</td>
<td>1 x 9 x 9</td>
</tr>
</tbody>
</table>

Once the variance-covariance matrix is set up, the computation of portfolio variance is a comparatively simple operation. Each cell in the matrix represents a pair of two securities.

When all these products are summed up, the resulting figure is the portfolio variance. The square root of this figure gives the portfolio standard deviation.

Thus the variance of the portfolio given in the example above can now be calculated.

\[
\sigma_p^2 = (0.25 \times 0.25 \times 1 \times 16 \times 16) + (0.25 \times 0.35 \times 0.7 \times 16 \times 7) + (0.25 \times 0.40 \times 0.3 \times 16 \times 9) +
(0.35 \times 0.25 \times 0.7 \times 7 \times 16) + (0.35 \times 0.35 \times 1 \times 7 \times 7) + (0.35 \times 0.40 \times 0.4 \times 7 \times 9) +
(0.40 \times 0.25 \times 0.3 \times 9 \times 16) + (0.40 \times 0.35 \times 0.4 \times 9 \times 7) + (0.40 \times 0.40 \times 1 \times 9 \times 9)
\]

\[
= 16+6.86+6.86+6.0025+6.0025+3.528+3.528+3.528+3.528+12.96 = 64.3785
\]

The portfolio standard deviation is:

\[
\sigma_p = \sqrt{64.3785} = 8.0236
\]

Hence, the formula for computing portfolio variance may also be stated as follows:

\[
\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \cdot \sigma_i \cdot \sigma_j
\]
Thus, from above discussion it can be said that a portfolio is a combination of assets. 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 portfolios can be created either by changing the securities in the portfolio or by changing the proportion of investment in the existing securities.

Thus, summarily it can be concluded that each portfolio is characterized by its expected return and risk. Determination of expected return and risk (variance or standard deviation) of each portfolio can be used to create a set of selected securities which is the first step in portfolio management and called portfolio analysis.

5. Markowitz Model of Risk-return Optimization

The portfolio selection problem can be divided into two stages, (1) finding the mean-variance efficient portfolios and (2) selecting one such portfolio. Investors do not like risk and the greater the riskiness of returns on an investment, the greater will be the returns expected by investors. There is a tradeoff between risk and return which must be reflected in the required rates of return on investment opportunities. The standard deviation (or variance) of return measures the total risk of an investment. It is not necessary for an investor to accept the total risk of an individual security. Investors can and do diversify to reduce risk. As number of holdings approach larger, a good deal of total risk is removed by diversification.

5.1 Assumptions of the Model

It is a common phenomenon that the diversification of investments in the portfolio leads to reduction in variance of the return, even for the same level of expected return. This model has taken into account risks associated with investments - using variance or standard deviation of the return. This model is based on the following assumptions: :

(i) The return on an investment adequately summarises the outcome of the investment.
(ii) The investors can visualise a probability distribution of rates of return.
(iii) The investors' risk estimates are proportional to the variance of return they perceive for a security or portfolio.
(iv) Investors base their investment decisions on two criteria i.e. expected return and variance of return.
(v) 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.
(vi) 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. Risk aversion in this context means merely that, as between two investments with equal expected returns, the investment with the smaller risk would be preferred.
(vii) ‘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.
5.2 Efficient Frontier

Markowitz has formalised the risk return relationship and developed the concept of efficient frontier. For selection of a portfolio, comparison between combinations of portfolios is essential. As a rule, a portfolio is not efficient if there is 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)

Markowitz has defined the diversification as the process of combining assets that are less than perfectly positively correlated in order to reduce portfolio risk without sacrificing any portfolio returns. If an investors’ portfolio is not efficient he may:

(i) Increase the expected value of return without increasing the risk.
(ii) Decrease the risk without decreasing the expected value of return, or
(iii) Obtain some combination of increase of expected return and decrease risk.

This is possible by switching to a portfolio on the efficient frontier.

If all the investments are plotted on the risk-return space, individual securities would be dominated by portfolios, and the efficient frontier would be containing all Efficient Portfolios (An Efficient Portfolio has the highest return among all portfolios with identical risk and the lowest risk among all portfolios with identical return). Fig – 1 depicts the boundary of possible investments in securities, A, B, C, D, E and F; and B, C, D, are lying on the efficient frontier.

The best combination of expected value of return and risk (standard deviation) depends upon the investors’ utility function. The individual investor will want to hold that portfolio of securities which places him on the highest indifference curve, choosing from the set of available portfolios. The dark line at the top of the set is the line of efficient combinations, or the efficient frontier. The optimal portfolio for an investor lies at the point where the indifference curve for the concerned investor touches the efficient frontier. This point reflects the risk level acceptable to the investor in order to achieve a desired return and provide maximum return for the bearable level of risk. The concept of efficient frontier and the location of the optimal portfolio are explained with help of Fig -2.
Fig. 2 : Optimal Investment under Markowitz Model

In Fig-2 A, B, C, D, E and F define the boundary of all possible investments out of which investments in B, C and D are the efficient portfolios lying on the efficient frontier. The attractiveness of the investment proposals lying on the efficient frontier depends on the investors' attitude to risk. At point B, the level of risk and return is at optimum level. The returns are highest at point D, but simultaneously it carries higher risk than any other investment.

Fig. 3 : Selection of Portfolios

The shaded area represents all attainable or feasible portfolios, that is all the combinations of risk and expected return which may be achieved with the available securities. The efficient frontier contains all possible efficient portfolios and any point on the frontier dominates any point to the right of it or below it.

Consider the portfolios represented by points B and E. B and E promise the same expected return $E(R_1)$ but the risk associated with B is $\sigma (R_1)$ whereas the associated with E is $\sigma (R_2)$. Investors, therefore, prefer portfolios on the efficient frontier rather than interior portfolios given the assumption of risk aversion; obviously, point A on the frontier represents the portfolio with the least possible risk, whilst D represents the portfolio with the highest possible rate of return with highest risk.
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 preference. As different investors have different preferences, the optimal portfolio of securities will vary from one investor to another.

6. Capital Asset Pricing Model (CAPM)

The CAPM distinguishes between risk of holding a single asset and holding a portfolio of assets. There is a trade off between risk and return. Modern portfolio theory concentrates on risk and stresses on risk management rather than on return management. Risk may be security risk involving danger of loss of return from an investment in a single financial or capital asset. Security risk differs from portfolio risk, which is the probability of loss from investment in a portfolio of assets. Portfolio risk is comprised of unsystematic risk and systematic risk. Unsystematic risks can be averted through diversification and is related to random variables. Systematic risk is market related component of portfolio risk. It is commonly measured by regression coefficient Beta or the Beta coefficient. Low Beta reflects low risk and high Beta reflects high risk.

As the unsystematic risk can be diversified by building a portfolio, the relevant risk is the non-diversifiable component of the total risk. As mentioned earlier, it can be measured by using Beta (β) a statistical parameter which measures the market sensitivity of returns. 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 \( R_i = R_f + \beta (R_m - R_f) \). The beta parameter \( \beta \) in this William Sharpe model represents the slope of the above regression relationship and measures the sensitivity or responsiveness of the security returns to the general market returns. The portfolio beta is merely the weighted average of the betas of individual securities included in the portfolio.

\[
\text{Portfolio beta } \beta = \sum \text{ proportion of security } \times \beta \text{ for security.}
\]

CAPM provides a conceptual framework for evaluating any investment decision where capital is committed with a goal of producing future returns. CAPM is based on certain assumptions to provide conceptual framework for evaluating risk and return. Some of the important assumptions are discussed below:

(i) **Efficient market**: It is the first assumption of CAPM. Efficient market refers to the existence of competitive market where financial securities and capital assets are bought and sold with full information of risk and return available to all participants. In an efficient market, the price of individual assets will reflect a real or intrinsic value of a share as the market prices will adjust quickly to any new situation, John J. Hampton has remarked in “Financial decision making” that although efficient capital market is not much relevant to capital budgeting decisions, but CAPM would be useful to evaluate capital budgeting proposal because the company can compare risk and return to be obtained by investment in machinery with risk and return from investment in securities.

(ii) **Rational investment goals**: Investors desire higher return for any acceptable level of risk or the lowest risk for any desired level of return. Such a rational choice is made on logical and consistent ranking of proposals in order of preference for higher good to
lower good and this is the scale of the marginal efficiency of capital. Besides, transactive preferences and certainty equivalents are other parameters of rational choice.

(iii) Risk aversion in efficient market is adhered to although at times risk seeking behaviour is adopted for gains.

(iv) CAPM assumes that all assets are divisible and liquid assets.

(v) Investors are able to borrow freely at a risk less rate of interest i.e. borrowings can fetch equal return by investing in safe Government securities.

(vi) Securities can be exchanged without payment of brokerage, commissions or taxes and without any transaction cost.

(vii) Securities or capital assets face no bankruptcy or insolvency.

Based on above assumptions the CAPM is developed with the main goal to formulate the return required by investors from a single investment or a portfolio of assets. The required rate of return is defined as the minimum expected return needed so that investors will purchase and hold an asset.

Risk and return relationship in this model stipulates higher return for higher level of risk and vice versa. However, there may be exception to this general rule where markets are not efficient.

Three aspects are worth consideration:

(a) Stock market is not concerned with diversifiable risk
(b) It is not concerned with an investor having a diversified portfolio
(c) Compensation paid is restricted to non-diversifiable risk.

Thus, an investor has to look into the non-diversifiable portion of risk on one side and returns on the other side. To establish a link between the two, the required return one expects to get for a given level of risk has been mandated by the Capital Asset Pricing Model.

If the risk-free investment \( R_f \) is 5%, an investor can earn this return of 5% by investing in risk free investment. Again, if the stock market earns a rate of return \( R_m \) which is 15% then an investor investing in stocks constituting the stock market index will earn also 15%. Thus the excess return earned over and above the risk free return is called the risk premium \( (R_m - R_f) \) ie \((15\% - 5\%) = 10\%\) which is the reward for undertaking risk, So, if an investment is as risky as the stock market, the risk premium to be earned is 10%.

If an investment is 30% riskier than the stock market, it would carry risk premium i.e. 30% more than the risk premium of the stock market i.e. 10% + 30% of 10% = 10% + 3% = 13%. \( \beta \) identifies how much more risky is an investment with reference to the stock market. Hence the risk premium that a stock should earn is \( \beta \) times the risk premium from the market \( [\beta \times (R_m - R_f)] \). The total return from an investment is the risk free rate of return plus the risk premium. So the required return from a stock would be \( R_j = R_f + [\beta \times (R_m - R_f)] \). In the above example 5% + 1.3 \times (15-5) = 18%
The risk premium on a stock varies in direct proportion to its Beta. If the market risk premium is 6% and $\beta$ of a stock is 1.2 then the risk premium for that stock is 7.2% ($6\% \times 1.2$) where $(R_m - R_f) = 6\%$ and $\beta = 1.2$

**Illustration 1**

A company’s beta is 1.40. The market return is 14%. The risk free rate is 10%  
(i) What is the expected return based on CAPM  
(ii) If the risk premium on the market goes up by 2.5% points, what would be the revised expected return on this stock?

**Solution**

(i) Computation of expected return based on CAPM

$$R_i = R_f + \beta (R_m - R_f) = 10\% + 1.40 \times (14\% - 10\%) = 10\% + 5.6\% = 15.6\%$$

(ii) Computation of risk premium if the market goes up by 2.5 points

The return from the market goes up by 2.5% i.e. 14% + 2.5% = 16.5%

Expected Return based on CAPM is given by

$$R_i = 10\% + 1.40 \times (16.5\% - 10\%) = 10\% + 1.40 \times 6.5\% = 10\% + 9.1\% = 19.1\%$$

**6.1 Security Market Line**

A graphical representation of CAPM is the Security Market Line, (SML). This line indicates the rate of return required to compensate at a given level of risk. Plotting required return on Y axis and Beta on the X-axis we get an upward sloping line which is given by $(R_m - R_f)$, the risk premium.

The higher the Beta value of a security, higher would be the risk premium relative to the market. This upward sloping line is called the Security Market Line. It measures the relationship between systematic risk and return.

**Illustration 2**

The risk premium for the market is 10%. Assuming Beta values of 0, 0.25, 0.42, 1.00 and 1.67. Compute the risk premium on Security K.
Solution

*Market Risk Premium is 10%*

<table>
<thead>
<tr>
<th>β</th>
<th>Value of K</th>
<th>Risk Premium of K</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>0.25</td>
<td>2.50%</td>
<td></td>
</tr>
<tr>
<td>0.42</td>
<td>4.20%</td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td>10.00%</td>
<td></td>
</tr>
<tr>
<td>1.67</td>
<td>16.70%</td>
<td></td>
</tr>
</tbody>
</table>

**Illustration 3**

Treasury Bills give a return of 5%. Market Return is 13% (i) What is the market risk premium (ii) Compute the β Value and required returns for the following combination of investments.

<table>
<thead>
<tr>
<th>Treasury Bill</th>
<th>100</th>
<th>70</th>
<th>30</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>0</td>
<td>30</td>
<td>70</td>
<td>100</td>
</tr>
</tbody>
</table>

**Solution**

Risk Premium \( R_m - R_f = 13\% - 5\% = 8\% \)

**β** is the weighted average investing in portfolio consisting of market \( β = 1 \) and treasury bills (β = 0)

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Treasury Bills: Market</th>
<th>β</th>
<th>( R_i = R_f + β \times (R_m - R_f) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100:0</td>
<td>0</td>
<td>5% + 0*(13%-5%) = 5%</td>
</tr>
<tr>
<td>2</td>
<td>70:30</td>
<td>0.7(0)+0.3(1)=0.3</td>
<td>5%+0.3*(13%-5%) = 7.40%</td>
</tr>
<tr>
<td>3</td>
<td>30:70</td>
<td>0.3(0)+0.7(1)=0.7</td>
<td>5%+0.7*(13%-5%) = 10.60%</td>
</tr>
<tr>
<td>4</td>
<td>0:100</td>
<td>1</td>
<td>5%+1.0*(13%-5%) = 13%</td>
</tr>
</tbody>
</table>

### 6.2 Risk free Rate of Return

In CAPM, there is only one risk free rate. It presumes that the returns on a security include both directed payments and capital appreciation. These require to be factored in judging the value of Beta and in computing the required rate of return.

**Illustration 4**

Pearl Ltd. expects that considering the current market prices, the equity share holders should get a return of at least 15.50% while the current return on the market is 12%. RBI has closed the latest auction for ₹ 2500 crores of 182 day bills for the lowest bid of 4.3% although there were bidders at a higher rate of 4.6% also for lots of less than ₹ 10 crores. What is Pearl Ltd's Beta?

**Solution**

**Determining Risk free rate:** Two risk free rates are given. The aggressive approach would be to consider 4.6% while the conservative approach would be to take 4.3%. If we take the moderate value then the simple average of the two i.e. 4.45% would be considered
Application of CAPM

\[ R_i = R_f + \beta (R_m - R_f) \]

\[ 15.50\% = 4.45\% + \beta (12\% - 4.45\%) \]

\[ \beta = \frac{15.50\% - 4.45\%}{12\% - 4.45\%} \]

\[ = \frac{11.05}{7.55} \]

\[ = 1.464 \]

Illustration 5

The following information is available with respect of Jaykay Ltd.

<table>
<thead>
<tr>
<th>Year</th>
<th>Jay Kay Limited</th>
<th>Market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Share Price (` )</td>
<td>DPS (`)</td>
</tr>
<tr>
<td>2002</td>
<td>242</td>
<td>20</td>
</tr>
<tr>
<td>2003</td>
<td>279</td>
<td>25</td>
</tr>
<tr>
<td>2004</td>
<td>305</td>
<td>30</td>
</tr>
<tr>
<td>2005</td>
<td>322</td>
<td>35</td>
</tr>
</tbody>
</table>

Compute Beta Value of the company as at the end of 2005. What is your observation?

Solution

Computation of Beta Value

Calculation of Returns

\[ \text{Returns} = \frac{D_1 + (P_1 - P_0)}{P_0} \times 100 \]

<table>
<thead>
<tr>
<th>Year</th>
<th>Returns</th>
</tr>
</thead>
</table>
| 2002 – 2003 | \[
\frac{25 + (279 - 242)}{242} \times 100 = 25.62\% \]
| 2003 – 2004 | \[
\frac{30 + (305 - 279)}{279} \times 100 = 20.07\% \]
| 2004 – 2005 | \[
\frac{35 + (322 - 305)}{305} \times 100 = 17.05\% \]

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Portfolio Theory

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Calculation of Returns from market Index

<table>
<thead>
<tr>
<th>Year</th>
<th>% of Index Appreciation</th>
<th>Dividend</th>
<th>Total</th>
<th>Yield %</th>
<th>Return %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002 – 2003</td>
<td>$(1950 - 1812)/1812 \times 100 = 7.62%$</td>
<td>5%</td>
<td>12.62%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003 – 2004</td>
<td>$(2258 - 1950)/1950 \times 100 = 15.79%$</td>
<td>6%</td>
<td>21.79%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004 – 2005</td>
<td>$(2220 - 2258)/2258 \times 100 = (-)1.68%$</td>
<td>7%</td>
<td>5.32%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Computation of Beta

<table>
<thead>
<tr>
<th>Year</th>
<th>(X)</th>
<th>(Y)</th>
<th>(XY)</th>
<th>(Y^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2003</td>
<td>25.62</td>
<td>12.62</td>
<td>323.32</td>
<td>159.26</td>
</tr>
<tr>
<td>2003-2004</td>
<td>20.07</td>
<td>21.79</td>
<td>437.33</td>
<td>474.80</td>
</tr>
<tr>
<td>2004-2005</td>
<td>17.05</td>
<td>5.32</td>
<td>90.71</td>
<td>28.30</td>
</tr>
<tr>
<td>total</td>
<td>62.74</td>
<td>39.73</td>
<td>851.36</td>
<td>662.36</td>
</tr>
</tbody>
</table>

\[
\bar{X} = \frac{62.74}{3} = 20.91, \quad \bar{Y} = \frac{39.73}{3} = 13.24
\]

\[
\beta = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum Y^2 - n\bar{Y}^2} = \frac{851.36 - 3(20.91)(13.24)}{662.36 - 3(13.24)^2} = \frac{851.36 - 830.55}{662.36 - 525.89} = 0.15
\]

6.3 Under Valued and Over Valued Stocks

The CAPM model can be practically 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 or any other judgmental factors (benchmark) 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 are available.

(a) When CAPM < Expected Return – Buy: This is due to the stock being undervalued i.e. the stock gives more return than what it should give.

(b) When CAPM > Expected Return – Sell: This is due to the stock being overvalued i.e. the stock gives less return than what it should give.

(c) When CAPM = Expected Return – Hold: This is due to the stock being correctly valued i.e. the stock gives same return than what it should give.
From another angle, if the current market price is considered as a basis of CAPM then:

(i) Actual Market Price < CAPM, stock is undervalued
(ii) Actual market Price > CAPM, stock is overvalued
(iii) Actual market Price = CAPM, stock is correctly valued.

Illustration 6

*The expected returns and Beta of three stocks are given below*

<table>
<thead>
<tr>
<th>Stock</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Return (%)</td>
<td>18</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Beta Factor</td>
<td>1.7</td>
<td>0.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>

If the risk free rate is 9% and the expected rate of return on the market portfolio is 14% which of the above stocks are over, under or correctly valued in the market? What shall be the strategy?

**Solution**

Required Rate of Return is given by

\[ R_j = R_f + \beta (R_m - R_f) \]

For Stock A,

\[ R_j = 9 + 1.7 (14 - 9) = 17.50\% \]

Stock B,

\[ R_j = 9 + 0.6 (14-9) = 12.00\% \]

Stock C,

\[ R_j = 9 + 1.2 (14-9) = 15.00\% \]

<table>
<thead>
<tr>
<th>Required Return %</th>
<th>Expected Return %</th>
<th>Valuation</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.50%</td>
<td>18.00%</td>
<td>Under Valued</td>
<td>Buy</td>
</tr>
<tr>
<td>12.00%</td>
<td>11.00%</td>
<td>Over Valued</td>
<td>Sell</td>
</tr>
<tr>
<td>15.00%</td>
<td>15.00%</td>
<td>Correctly Valued</td>
<td>Hold</td>
</tr>
</tbody>
</table>

Illustration 7

*Information about return on an investment is as follows:*

(a) Risk free rate 10% (b) Market Return is 15% (c) Beta is 1.2

(i) What would be the return from this investment?
(ii) If the projected return is 18%, is the investment rightly valued?
(iii) What is your strategy?

**Solution**

Required rate of Return as per CAPM is given by

\[ R_j = R_f + \beta (R_m - R_f) \]

\[ = 10 +1.2 (15-10) = 16\% \]

If projected return is 18%, the stock is undervalued as CAPM < Expected Return. The Decision should be BUY.
6.4 Modification for leverage

The above-mentioned discussions have assumed all equity financing and that the beta used in the equations is an unlevered beta. However, the beta is actually a function of the leverage as well as the business risk. As a company increases the proportion of debt capital in its capital structure, both its beta and the required return increase in a linear manner. Hence in case one wishes to use the CAPM as a model for valuing cost of equity in order to determine financially feasible investments, one needs to take into account the difference of leverage in the proxy company/project and the company/project whose required return is to be computed.

Mathematically

$$\beta_l = \beta_u \left[ 1 + \frac{D}{S} (1-T) \right]$$

where $\beta_l$ & $\beta_u$ are the levered and unlevered betas respectively, $D/S$ is the debt to equity ratio in market value terms and $T$ is the corporate tax rate.

6.5 Advantages and Limitations of CAPM

The advantages of CAPM can be listed as:

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

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

There are certain limitations of CAPM as well, which are discussed as follows:

(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 applies to CAPM too.

(b) Other Risks: By emphasizing on systematic risk only, unsystematic risks are of importance 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 is multiple risk free rates for one while for another, markets being volatile it varies over time period.

7. Arbitrage Pricing Theory Model (APT)

Unlike the CAPM which is a single factor model, the APT is a multi factor model having a whole set of Beta Values – one for each factor. Arbitrage Pricing Theory states that the expected return on an investment is dependent upon how that investment reacts to a set of individual macro-economic factors (degree of reaction measured by the Betas) and the risk premium associated with each of those macro-economic factors. The APT developed by Ross (1976) holds that there are four factors which explain the risk premium relationship of a particular security. Several factors being identified e.g. inflation and money supply, interest rate, industrial production and personal consumption have aspects of being inter-related.

According to CAPM, $E (R_i) = R_f + \lambda \beta_i$
Where, \( \lambda \) is the average risk premium \([E(R_m) - R_f]\)

In APT, \( E(R_i) = R_f + \lambda_1 \beta_{1i} + \lambda_2 \beta_{2i} + \lambda_3 \beta_{3i} + \lambda_4 \beta_{4i} \)

Where, \( \lambda_1, \lambda_2, \lambda_3, \lambda_4 \) are average risk premium for each of the four factors in the model and \( \beta_{1i}, \beta_{2i}, \beta_{3i}, \beta_{4i} \) are measures of sensitivity of the particular security \( i \) to each of the four factors.

8. Sharpe Index Model

William Sharpe has developed a simplified variant of Markowitz model that reduces substantially its data and computational requirements. It is known as Single index model or One-factor analysis.

8.1 Single 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. When the Sensex increases, stock prices also tend to increase and vice-versa. This indicates that some underlying factors affect the market index as well as the stock prices. Stock prices are related to the market index and this relationship could be used to estimate the return on stock. Towards this purpose, the following equation can be used:

\[
R_i = \alpha_i + \beta_i R_m + \epsilon_i
\]

Where,

- \( R_i \) = expected return on security \( i \)
- \( \alpha_i \) = intercept of the straight line or alpha co-efficient
- \( \beta_i \) = slope of straight line or beta co-efficient
- \( R_m \) = the rate of return on market index
- \( \epsilon_i \) = error term.

According to the equation, the return of a stock can be divided into two components, the return due to the market and the return independent of the market. \( \beta_i \) indicates the sensitiveness of the stock return to the changes in the market return. For example, \( \beta_i \) of 1.5 means that the stock return is expected to increase by 1.5% when the market index return increases by 1% and vice-versa. Likewise, \( \beta_i \) of 0.5 expresses that the individual stock return would change by 0.5 per cent when there is a change of 1 per cent in the market return. \( \beta_i \) of 1 indicates that the market return and the security return are moving in tandem. The estimates of \( \beta_i \) and \( \alpha_i \) are obtained from regression analysis.

The single index model is based on the assumption that stocks vary together because of the common movement in the stock market and there are no effects beyond the market (i.e. any fundamental factor effects) that account the stocks co-movement. The expected return,
standard deviation and co-variance of the single index model represent the joint movement of securities. The mean return is:

\[ R_i = \alpha_i + \beta_i R_m + \varepsilon_i \]

The variance of security's return:

\[ \sigma^2 = \beta^2 \sigma^2_m + \sigma^2_{\varepsilon_i} \]

The covariance of returns between securities \(i\) and \(j\) is:

\[ \sigma_{ij} = \beta_i \beta_j \sigma^2_m \]

The variance of the security has two components namely, systematic risk or market risk and unsystematic risk or unique risk. The variance explained by the index is referred to systematic risk. The unexplained variance is called residual variance or unsystematic risk.

The systematic risk can be calculated by using following formula:

Systematic risk = \( \beta^2 \times \) variance of market index

\[ = \beta^2 \sigma^2_m \]

Unsystematic risk = Total variance - Systematic risk.

\[ \varepsilon^2 = \sigma^2 - \text{Systematic risk.} \]

Thus, the total risk = Systematic risk + Unsystematic risk.

\[ = \beta^2 \sigma^2_m + \varepsilon^2. \]

From this, the portfolio variance can be derived

\[ \sigma_p^2 = \left[ \left( \sum_{i=1}^{N} X_i \beta_i \right)^2 \sigma^2_m + \left( \sum_{i=1}^{N} X_i^2 \varepsilon_i^2 \right) \right] \]

Where,

\[ \sigma_p^2 = \text{variance of portfolio} \]

\[ \sigma_m^2 = \text{expected variance of index} \]

\[ \varepsilon^2 = \text{variation in security’s return not related to the market index} \]

\[ X_i = \text{the portion of stock } i \text{ in the portfolio.} \]

\[ \beta_i = \text{Beta of stock } i \text{ in the portfolio} \]

Likewise expected return on the portfolio also can be estimated. For each security \( \alpha_i \) and \( \beta_i \) should be estimated.

\[ R_p = \sum_{i=1}^{N} X_i (\alpha_i + \beta_i R_m) \]
\[ \beta_i = \text{Value of the beta for security } i \]
\[ x_i = \text{Proportion of the investment on security } i \]
\[ \alpha_i = \text{Value of alpha for security } i \]
\[ N = \text{The number of securities in the portfolio} \]

Portfolio return is the weighted average of the estimated return for each security in the portfolio. The weights are the respective stocks' proportions in the portfolio.

A portfolio's alpha value is a weighted average of the alpha values for its component securities using the proportion of the investment in a security as weight.

\[ \alpha_p = \sum_{i=1}^{N} x_i \alpha_i \]

\[ \alpha_p = \text{Value of the alpha for the portfolio} \]

Similarly, a portfolio's beta value is the weighted average of the beta values of its component stocks using relative share of them in the portfolio as weights.

\[ \beta_p = \sum_{i=1}^{N} x_i \beta_i \]

Where,

\[ \beta_p = \text{Value of the beta for the portfolio}. \]

**Illustration 8**

*The following details are given for X and Y companies’ stocks and the Bombay Sensex for a period of one year. Calculate the systematic and unsystematic risk for the companies’ stocks. If equal amount of money is allocated for the stocks what would be the portfolio risk?*

<table>
<thead>
<tr>
<th></th>
<th>X Stock</th>
<th>Y Stock</th>
<th>Sensex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average return</td>
<td>0.15</td>
<td>0.25</td>
<td>0.06</td>
</tr>
<tr>
<td>Variance of return</td>
<td>6.30</td>
<td>5.86</td>
<td>2.25</td>
</tr>
<tr>
<td>( \beta )</td>
<td>0.71</td>
<td>0.685</td>
<td></td>
</tr>
<tr>
<td>Correlation Co-efficient</td>
<td>0.424</td>
<td>0.685</td>
<td></td>
</tr>
<tr>
<td>Co-efficient of determination ((r^2))</td>
<td>0.18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Solution**

The co-efficient of determination \((r^2)\) gives the percentage of the variation in the security's return that is explained by the variation of the market index return. In the X company stock return, 18 per cent of variation is explained by the variation of the index and 82 per cent is not explained by the index.

According to Sharpe, the variance explained by the index is the systematic risk. The unexplained variance or the residual variance is the unsystematic risk.
Company X:
Systematic risk = \( \beta_i^2 \times \text{Variance of market index} \)
= \((0.71)^2 \times 2.25 = 1.134\)

Unsystematic risk = Total variance of security return - systematic risk
= 6.3 - 1.134
= 5.166 or
= Variance of Security Return \((1-\beta^2)\)
= 6.3 X (1-0.18) = 6.3 X 0.82 = 5.166

Total risk = \( \beta_i^2 \times \sigma^2_m + \epsilon_i^2 \)
= 1.134 + 5.166 = 6.3

Company Y:
Systematic risk = \( \beta_i^2 \times \sigma^2_m \)
= \((0.685)^2 \times 2.25 = 1.056\)

Unsystematic risk = Total variance of the security return - systematic risk.
= 5.86-1.056 = 4.804

\[
\sigma_p^2 = \left[ \sum_{i=1}^{N} X_i \beta_i \right]^2 \sigma_m^2 + \left[ \sum_{i=1}^{N} \epsilon_i^2 \right]
\]

\[
= [(0.5 \times 0.71 + 0.5 \times 0.685)^2 \times 2.25] + [(0.5)^2(5.166)+(0.5)^2(4.804)]
\]

\[
= [(0.355 + 0.3425)^2 \times 2.25] + [(1.292 + 1.201)]
\]

\[
= 1.0946 + 2.493 = 3.5876
\]

8.2 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. Sharpe Ratio is defined as \((R_i - R_f)/\sigma_i\) and Treynor Ratio is defined as

\[
\frac{R_i - R_f}{\beta_i}
\]

Where,

\[
R_i = \text{Expected return on stock } i
\]

\[
R_f = \text{Return on a risk less asset}
\]

\[
\sigma_i = \text{Standard Deviation of the rates of return for the ith Security}
\]

\[
\beta_i = \text{Expected change in the rate of return on stock } i \text{ associated with one unit change in the market return}
\]

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 as the measure of risk, the Treynor Ratio uses the beta as the measure of risk.
The steps for finding out the stocks to be included in the optimal portfolio are given below:

(a) Find out the “excess return to beta” ratio for each stock under consideration.

(b) Rank them from the highest to the lowest.

(c) Proceed to calculate $C_i$ for all the stocks/portfolios according to the ranked order using the following formula:

$$C_i = \frac{\sigma_m^2 \sum_{i=1}^{N} \left( R_i - R_f \right) \beta_i}{\sigma_{\epsilon_i}^2} \frac{1 + \sigma_m^2 \sum_{i=1}^{N} \beta_i^2}{\sigma_{\epsilon_i}^2}$$

Where,

- $\sigma_m^2$ = variance of the market index
- $\sigma_{\epsilon_i}^2$ = variance of a stock's movement that is not associated with the movement of market index i.e. stock’s unsystematic risk.

(d) Compute the cut-off point which 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 optional portfolio all higher ranked securities also belong to optimal portfolio.

(e) Once we came to know which securities are to be included in the optimum portfolio, we shall calculate the percent to be invested in each security by using the following formula:

$$X_i^* = \frac{Z_i}{\sum_{i=1}^{N} Z_i}$$

where

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

The first portion determines the weight each stock and total comes to 1 to ensure that all funds are invested and second portion determines the relative investment in each security.

Illustration 9

*Data for finding out the optimal portfolio are given below:*
The riskless rate of interest is 5 per cent and the market variance is 10. Determine the cut-off point.

Solution

<table>
<thead>
<tr>
<th>Security</th>
<th>$R_i - R_f$</th>
<th>$(R_i - R_f) \times \beta_i$</th>
<th>$\sum_{i=1}^{N} (R_i - R_f) \times \beta_i$</th>
<th>$\beta_i^2$</th>
<th>$\sum_{i=1}^{N} \beta_i^2$</th>
<th>$\sigma^2_{\text{ei}}$</th>
<th>$\sigma_{\text{ei}}^2$</th>
<th>$R_i - R_f$</th>
<th>$\beta_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14</td>
<td>0.7</td>
<td>0.7</td>
<td>0.05</td>
<td>0.05</td>
<td>4.67</td>
<td></td>
<td>14</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>0.9</td>
<td>1.6</td>
<td>0.075</td>
<td>0.125</td>
<td>7.11</td>
<td></td>
<td>12</td>
<td>1.5</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>0.3</td>
<td>1.9</td>
<td>0.025</td>
<td>0.15</td>
<td>7.60</td>
<td></td>
<td>8</td>
<td>2.0</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>1.0</td>
<td>2.9</td>
<td>0.1</td>
<td>0.25</td>
<td>8.29</td>
<td></td>
<td>8</td>
<td>1.0</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>0.4</td>
<td>3.3</td>
<td>0.05</td>
<td>0.3</td>
<td>8.25</td>
<td></td>
<td>8.25</td>
<td>2.0</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>0.04</td>
<td>3.34</td>
<td>0.005</td>
<td>0.305</td>
<td>8.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>6</td>
<td>0.45</td>
<td>3.79</td>
<td>0.075</td>
<td>0.38</td>
<td>7.90</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

'C_i' calculations are given below:

For Security 1

$C_1 = \frac{10 \times 0.7}{1 + 10(0.05)} = 4.67$

Here 0.7 is got from column 4 and 0.05 from column 6. Since the preliminary calculations are over, it is easy to calculate the $C_i$.

$C_2 = \frac{10 \times 1.6}{1 + 10(0.125)} = 7.11$

$C_3 = \frac{10 \times 1.9}{1 + 10(0.15)} = 7.6$

$C_4 = \frac{10 \times 2.9}{1 + 10(0.25)} = 8.29$
The highest $C_i$ value is taken as the cut-off point i.e. $C^*$. The stocks ranked above $C^*$ have high excess returns to beta than the cut-off $C$ and all the stocks ranked below $C^*$ have low excess returns to beta. Here, the cut-off point is 8.29. Hence, the first four securities i.e. 1–4 are selected and remaining 3 are rejected.

Now we shall compute how much to be invested in each security by calculating $Z_i$ for these four securities as follows:

$$Z_i = \frac{B_i}{\sigma_i^2} \left( R_i - R_o \right) = \frac{1}{B_i} \cdot C^*$$

Thus,

- $Z_1 = \frac{1.00}{20} \left( \frac{14}{1.0} - 8.29 \right) = 0.05 (5.71) = 0.2855$
- $Z_2 = \frac{1.5}{30} \left( \frac{18}{1.5} - 8.29 \right) = 0.05 (3.71) = 0.1855$
- $Z_3 = \frac{0.5}{10} \left( \frac{6}{0.5} - 8.29 \right) = 0.05 (3.71) = 0.1855$
- $Z_4 = \frac{2}{40} \left( \frac{20}{2} - 8.29 \right) = 0.05 (1.71) = 0.0855$

The proportion of investment in each stock will be computed as follows:

$$X_i = \frac{Z_i}{\sum_{j=1}^{n} Z_j}$$

Thus, $\sum_{j=1}^{n} Z_j = 0.2855 + 0.1855 + 0.1855 + 0.0855 = 0.742$

Accordingly, proportion of investments in

- Security 1 = $\frac{0.2855}{0.742} = 0.3848$ i.e. 38.48%
- Security 2 = $\frac{0.1855}{0.742} = 0.25$ i.e. 25%
Portfolio Theory

7.43

\[ \text{Security 3} = \frac{0.1855}{0.742} = 0.25 \text{ i.e. 25\%} \]

\[ \text{Security 4} = \frac{0.0855}{0.742} = 0.1152 \text{ i.e. 11.52\%} \]

Thus investment as per following proportion will be the optimal portfolio.

<table>
<thead>
<tr>
<th>Security</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>38.48%</td>
</tr>
<tr>
<td>2</td>
<td>25%</td>
</tr>
<tr>
<td>3</td>
<td>25%</td>
</tr>
<tr>
<td>4</td>
<td>11.52%</td>
</tr>
</tbody>
</table>

9. Formulation of Portfolio Strategy

Two broad choices are required for the formulation of an appropriate portfolio strategy. They are active portfolio strategy and passive portfolio strategy.

9.1 Active Portfolio Strategy (APS): An APS is followed by most investment professionals and aggressive investors who strive to earn superior return after adjustment for risk. The vast majority of funds (or schemes) available in India follow an “active” investment approach, wherein fund managers of “active” funds spend a great deal of time on researching individual companies, gathering extensive data about financial performance, business strategies and management characteristics. In other words, “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).

There are four principles of an active strategy. These are:

(a) **Market Timing:** This involves departing from the normal i.e. strategy for long run asset mix to reflect assessment of the prospect of various assets in the near future. Market timing is based on an explicit or implicit forecast of general market movement. A variety of tools are employed for market timing analysis namely business cycle analysis, moving average analysis, advance-decline analysis, Econometric models. The forecast for the general market movement derived with the help of one or more of these tools are tempted by the subjective judgment of the investors. In most cases investor may go largely by its market sense. Those who reveal the fluctuation in the market may be tempted to play the game of market timing but few will succeed in this game. And an investment manager has to forecast the market correctly, 75\% of the time just to break even after taking into account the cost of errors and cost of transactions. According to Fisher Black, the market is just as well as on an average when the investor is out of the market as it does when he is in. So he loses money relative to a single buy and sale strategy by being out of the market part of the time.

(b) **Sector Rotation:** Sector or group rotation may apply to both stock and bond component of the portfolio. It is used more compulsorily with respect to strategy. The components of the portfolio are used when it involves shifting. The weighting for various industry sectors is based on their asset outlook. If one thinks that steel and pharmaceutical would do well as compared
to other sectors in the forthcoming period he may overweigh the sector relative to their position in the market portfolio, with the result that his portfolio will be tilted more towards these sectors in comparison to the market portfolio.

With respect to bond portfolio sector rotation it implies a shift in the composition of the bond portfolio in terms of quality as reflected in credit rating, coupon rate, term of maturity etc. If one anticipates a rise in the interest rate one may shift for long term bonds to medium and short term. A long term bond is more sensitive to interest rate variation compared to a short term bond.

(c) **Security Selection:*** Security selection involves a search for under price security. If one has to resort to active stock selection he may employ fundamental / technical analysis to identify stocks which seems to promise superior return and concentrate the stock components of portfolio on them. Such stock will be over weighted relative to their position in the market portfolio. Like wise stock which are perceived to be unattractive will be under weighted relative to their position in the market portfolio.

As far as bonds are concerned security selection calls for choosing bonds which offer the highest yields to maturity and at a given level of risk.

(d) **Use of Specialised Investment Concept:** To achieve superior return, one has to employ a specialised concept/philosophy particularly with respect to investment in stocks. The concepts which have been exploited successfully are growth stock, neglected or out of favour stocks, asset stocks, technology stocks and cyclical stocks.

The advantage of cultivating a specialized investment concept is that it helps to:

(i) Focus one’s effort on a certain kind of investment that reflects one’s ability and talent.

(ii) Avoid the distraction of perusing other alternatives.

(iii) Master an approach or style through sustained practice and continual self criticism.

The greatest disadvantage of focusing exclusively on a specialized concept is that it may become obsolete. The changes in the market risk may cast a shadow over the validity of the basic premise underlying the investor philosophy.

9.2 **Passive Portfolio Strategy:** Active strategy was based on the premise that the capital market is characterized by efficiency which can be exploited by resorting to market timing or sector rotation or security selection or use of special concept or some combination of these vectors.

Passive strategy, on the other hand, rests on the tenet that the 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. They are:

(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.

A fund which is *passively* managed are called index funds. An Index fund is a mutual fund scheme that invests in the securities of the target Index in the same proportion or weightage.
Though it is designed to provide returns that closely track the benchmark Index, an Index Fund carries all the risks normally associated with the type of asset the fund holds. So, when the overall stock market rises/falls, you can expect the price of shares in the index fund to rise/fall, too. In short, an index fund does not mitigate market risks. Indexing merely ensures that your returns will not stray far from the returns on the Index that the fund mimics. In other words, an index fund is a fund whose daily returns are the same as the daily returns obtained from an index. Thus, it is passively managed in the sense that an index fund manager invests in a portfolio which is exactly the same as the portfolio which makes up an index. For instance, the NSE-50 index (Nifty) is a market index which is made up of 50 companies. A Nifty index fund has all its money invested in the Nifty fifty companies, held in the same weights of the companies which are held in the index.

9.3 Selection of Securities: There are certain criteria which must be kept in mind while selecting securities. The selection criteria for both bonds and equity shares are given as following:

9.3.1 Selection of Bonds: Bonds are fixed income avenues. The following factors have to be evaluated in selecting fixed income avenues:

(a) **Yield to maturity**: The yield to maturity for a fixed income avenues represent the rate of return earned by the investor, if he invests in the fixed income avenues and holds it till its maturity.

(b) **Risk of Default**: To assess such risk on a bond, one has to look at the credit rating of the bond. If no credit rating is available relevant financial ratios of the firm have to be examined such as debt equity, interest coverage, earning power etc and the general prospect of the industry to which the firm belongs have to be assessed.

(c) **Tax Shield**: In the past, several fixed income avenues offers tax shields but at present only a few of them do so.

(d) **Liquidity**: If the fixed income avenues can be converted wholly or substantially into cash at a fairly short notice it possesses a liquidity of a high order.

9.3.2 Selection of Stock (Equity Share): Three approaches are applied for selection of equity shares - Technical analysis, Fundamental analysis and Random selection analysis.

(a) Technical analysis looks at price behaviours and volume data to determine whether the share will move up or down or remain trend less.

(b) Fundamental analysis focuses on fundamental factors like earning level, growth prospects and risk exposure to establish intrinsic value of a share. The recommendation to buy hold or sell is based on comparison of intrinsic value and prevailing market price.

(c) Random selection analysis is based on the premise that the market is efficient and security is properly priced.
Levels of Market Efficiency And Approach To Security Selection

<table>
<thead>
<tr>
<th>Levels of Efficiency</th>
<th>Approach</th>
<th>Technical Analysis</th>
<th>Fundaments Analysis</th>
<th>Random Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Inefficiency</td>
<td></td>
<td>Best</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td>2) Weak form efficiency</td>
<td></td>
<td>Poor</td>
<td>Best</td>
<td>Poor</td>
</tr>
<tr>
<td>3) Semi-strong efficiency</td>
<td></td>
<td>Poor</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>4) Strong Form efficiency</td>
<td></td>
<td>Poor</td>
<td>Fair</td>
<td>Best</td>
</tr>
</tbody>
</table>

10. Portfolio Rebalancing

It means the value of portfolio as well as its composition. The relative proportion of bond and stocks may change as stock and bonds fluctuate in response to such changes. Portfolio rebalancing is necessary. There are three policies of portfolio rebalancing - Buy and hold policy, Constant mix policy, and Constant proportion portfolio insurance policy (CPPI). These policies have different pay off under varying market conditions. Under all these policies portfolio consists of investment in stock and bonds.

(a) Buy and Hold Policy: Sometime this policy is also called ‘do nothing policy’ as under this strategy no balancing is required and therefore investor maintain an exposure to stocks and therefore linearly related to the value of stock in general.

Under this strategy investors set a limit (floor) below which he does not wish the value of portfolio should go. Therefore, he invests an amount equal to floor value in non-fluctuating assets (Bonds). Since the value of portfolio is linearly related to value of stocks the pay-off diagram is a straight line. This can be better understood with the help of an example. Suppose a portfolio consisting of Debt/Bonds for ₹ 50,000 and ₹ 50,000 in equity shares currently priced at ₹ 100 per share. If price of the share moves from ₹ 100 to ₹ 200 the value of portfolio shall become ₹ 1,50,000. The pay-off diagram is shown in figure below i.e. a straight line:

This policy is suitable for the investor whose risk tolerance is positively related to portfolio and stock market return but drops to zero of below floor value.

Concluding, it can be said that following are main features of this policy:
(a) The value of portfolio is positively related and linearly dependent on the value of the stock.

(b) The value of portfolio cannot fall below the floor value i.e. investment in Bonds.

(c) This policy performs better if initial percentage is higher in stock and stock outperform the bond. Reverse will happen if stock under perform in comparison of bond or their prices goes down.

(b) Constant Mix Policy: Contrary to above policy this policy is a ‘do something policy’. Under this policy investor maintains an exposure to stock at a constant percentage of total portfolio. This strategy involves periodic rebalancing to required (desired) proportion by purchasing and selling stocks as and when their prices goes down and up respectively. In other words this plan specifies that value of aggressive portfolio to the value of conservative portfolio will be held constant at a pre-determined ratio. However, it is important that this action is taken only there is change in the prices of share at a predetermined percentage.

For example if an investor has decided that his portfolio shall consist of 60% in equity shares and balance 40% in bonds on upward or downward of 10% in share prices he will strike a balance.

In such situation if the price of share goes down by 10% or more, he will sell the bonds and invest money in equities so that the proportion among the portfolio i.e. 60:40 remains the same. According if the prices of share goes up by 10% or more he will sell equity shares and shall in bonds so that the ratio remains the same i.e. 60:40. This strategy is suitable for the investor whose tolerance varies proportionally with the level of wealth and such investor holds equity at all levels.

The pay-off diagram of this policy shall be as follows:

Accordingly, it gives a concave pay off, tends to do well in flat but fluctuating market.

Continuing above example let us how investor shall rebalance his portfolio under different scenarios as follows:
7.48 Strategic Financial Management

(a) If price decreases

<table>
<thead>
<tr>
<th>Share Price</th>
<th>Value of Shares</th>
<th>Value of Bonds</th>
<th>Total</th>
<th>Stock to Bond Switching</th>
<th>Bond to Stock Switching</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Starting Level</td>
<td>50,000</td>
<td>50,000</td>
<td>1,00,000</td>
<td>0</td>
</tr>
<tr>
<td>80</td>
<td>Before Rebalancing</td>
<td>40,000</td>
<td>50,000</td>
<td>90,000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>After Rebalancing</td>
<td>45,000</td>
<td>45,000</td>
<td>90,000</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>Before Rebalancing</td>
<td>33,750</td>
<td>45,000</td>
<td>78,750</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>After Rebalancing</td>
<td>39,360</td>
<td>39,390</td>
<td>78,750</td>
<td>0</td>
</tr>
</tbody>
</table>

(b) If price increases

<table>
<thead>
<tr>
<th>Share Price</th>
<th>Value of Shares</th>
<th>Value of Bonds</th>
<th>Total</th>
<th>Stock to Bond Switching</th>
<th>Bond to Stock Switching</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>Starting Level</td>
<td>50,000</td>
<td>50,000</td>
<td>1,00,000</td>
<td>0</td>
</tr>
<tr>
<td>150</td>
<td>Before Rebalancing</td>
<td>75,000</td>
<td>50,000</td>
<td>1,25,000</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>After Rebalancing</td>
<td>62,400</td>
<td>62,600</td>
<td>1,25,000</td>
<td>12,600</td>
</tr>
<tr>
<td>200</td>
<td>Before Rebalancing</td>
<td>83,200</td>
<td>62,600</td>
<td>1,45,800</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>After Rebalancing</td>
<td>72,800</td>
<td>73,000</td>
<td>1,45,800</td>
<td>10,400</td>
</tr>
</tbody>
</table>

(c) **Constant Proportion Insurance Policy (CPPI):** Under this strategy investor sets a floor below which he does not wish his asset to fall called floor, which is invested in some non-fluctuating assets such as Treasury Bills, Bonds etc. The value of portfolio under this strategy shall not fall below this specified floor under normal market conditions. This strategy performs well especially in bull market as the value of shares purchased as cushion increases. In contrast in bearish market losses are avoided by sale of shares. It should however be noted that this strategy performs very poorly in the market hurt by sharp reversals. The following equation is used to determine equity allocation:

\[
\text{Target Investment in Shares} = \text{multiplier} \times (\text{Portfolio Value} - \text{Floor Value})
\]

Multiplier is a fixed constant whose value shall be more than 1.

The pay-off under this strategy can be understood better with the help of an example. Suppose wealth of Mr. A is ₹ 10,00,000, a floor value of ₹ 7,50,000 and a multiplier of 2. Since the initial cushion (difference between Portfolio Value and Floor) is ₹ 2,50,000, the initial investment in the share shall be ₹ 5,00,000 (double of the initial cushion). Accordingly, initial portfolio mix shall be consisted of ₹ 5,00,000 in shares and balance ₹ 5,00,000 in Bonds.
Situation 1: Suppose stock market rises from 100 to 150. The value of shares of Mr. A's holding shall rise from ₹ 5,00,000 to ₹ 7,50,000 and value of portfolio shall jump to ₹ 12,50,000 and value of cushion to ₹ 7,50,000. Since the CPPI Policy requires the component of shares should go up to ₹ 10,00,000. This will necessitate the selling of bonds amounting ₹ 2,50,000 and re-investing proceeds in shares.

Situation 2: If stock market falls from 100 to 80, the value of shares of portfolio falls from ₹ 5,00,000 to ₹ 4,00,000 resulting in reduction of value of portfolio to ₹ 9,00,000 and cushion to ₹ 1,50,000. Since as per CPPI the share component should be ₹ 3,00,000 (₹ 1,50,000 x 2), hence shares of ₹ 1,00,000 should be sold and invest in Bonds.

Thus from above it is clear that as per CPPI sell the shares as their prices fall and buy them as their prices rise. This policy is contrary to the Constant Mix Policy and hence pay-off of CPPI shall be convex as shown below:

(d) Comparative Evaluation

<table>
<thead>
<tr>
<th>Basis</th>
<th>Buy &amp; Hold Policy</th>
<th>Constant Mix Policy</th>
<th>Constant Proportion Portfolio Insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay-off Line</td>
<td>Straight</td>
<td>Concave</td>
<td>Convex</td>
</tr>
<tr>
<td>Protection in Down/Up Markets</td>
<td>Definite in Down market</td>
<td>Not much in Down market but relatively poor in Up market</td>
<td>Good in Down market and performs well in Up market</td>
</tr>
<tr>
<td>Performance in flat but fluctuating market</td>
<td>Performs between Constant and CPPI</td>
<td>Tend to do well in flat market.</td>
<td>Performs poorly.</td>
</tr>
</tbody>
</table>

11. Tax Efficient Strategies for Taxable Portfolios

Active portfolio managers especially need to consider taxes when deciding whether to sell or hold a stock whose value has increased. If a security is sold at a profit, capital gains are paid
and less is left in the portfolio to reinvest. A new security (the reinvestment security) needs to have a superior return sufficient to make up for these taxes. The size of the necessary return depends on the expected holding period and the cost basis (and amount of the capital gain) of the original security.

Some of the possible tax-efficient strategies for taxable portfolios are:

- Employ a buy-and-hold strategy since unrealized capital gains are not taxed.
- Loss harvesting, using tax losses to offset capital gains on other investments.
- Use options to help convert short-term capital gains into a long-term gain (with more favorable tax treatment).
- Tax-lot accounting for shares, specifying those with the highest cost basis for sale.
- For some investors, simply focus on growth stocks that will provide long-term gains rather than income from dividends.

12. Asset Allocation Strategies

Many portfolios containing equities also contain other asset categories, so the management factors are not limited to equities. There are four asset allocation strategies:

(a) **Integrated Asset Allocation**: Under this strategy, capital market conditions and investor objectives and constraints are examined and the allocation that best serves the investor’s needs while incorporating the capital market forecast is determined.

(b) **Strategic Asset Allocation**: Under this strategy, optimal portfolio mixes based on returns, risk, and co-variances is generated using historical information and adjusted periodically to restore target allocation within the context of the investor’s objectives and constraints.

(c) **Tactical Asset Allocation**: Under this strategy, investor’s risk tolerance is assumed constant and the asset allocation is changed based on expectations about capital market conditions.

(d) **Insured Asset Allocation**: Under this strategy, risk exposure for changing portfolio values (wealth) is adjusted; more value means more ability to take risk.

13. Principles and Management of 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).

Legally, hedge funds are most often set up as private investment partnerships that are open to a limited number of investors and require a very large initial minimum investment. 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.

For the most part, hedge funds (unlike mutual funds) are unregulated because they cater to sophisticated investors. In the U.S., laws require that the majority of investors in the fund
be accredited. That is, they must earn a minimum amount of money annually and have a net worth of over $1 million, along with a significant amount of investment knowledge. You can think of hedge funds as mutual funds for the super-rich. They are similar to mutual funds in that investments are pooled and professionally managed, but differ in that the fund has far more flexibility in its investment strategies.

The popular misconception regarding hedge funds is that all hedge funds are volatile - that they all use global macro strategies and place large directional bets on stocks, currencies, bonds, commodities, and gold, while using lots of leverage. In reality, less than 5% of hedge funds are global macro funds like Quantum, Tiger, and Strome. Most hedge funds use derivatives only for hedging or don’t use derivatives at all, and many use no leverage.

It is important to note that hedging is actually the practice of attempting to reduce risk, but the goal of most hedge funds is to maximize return on investment. The name is mostly historical, as the first hedge funds tried to hedge against the downside risk of a bear market with their ability to short the market (mutual funds generally cannot enter into short positions as one of their primary goals). Nowadays, hedge funds use dozens of different strategies, so it isn’t accurate to say that hedge funds just “hedge risk”. In fact, because hedge fund managers make speculative investments, these funds can carry more risk than the overall market. A hedge fund is a fund that can take both long and short positions, use arbitrage, buy and sell undervalued securities, trade options or bonds, and invest in almost any opportunity in any market where it foresees impressive gains at reduced risk. Hedge fund strategies vary enormously - many hedge against downturns in the markets - especially important today with volatility and anticipation of corrections in overheated stock markets. The primary aim of most hedge funds is to reduce volatility and risk while attempting to preserve capital and deliver positive returns under all market conditions.

There are approximately 14 distinct investment strategies used by hedge funds, each offering different degrees of risk and return. A macro hedge fund, for example, invests in stock and bond markets and other investment opportunities, such as currencies, in hopes of profiting on significant shifts in such things as global interest rates and countries’ economic policies. A macro hedge fund is more volatile but potentially faster growing than a distressed-securities hedge fund that buys the equity or debt of companies about to enter or exit financial distress. An equity hedge fund may be global or country specific, hedging against downturns in equity markets by shorting overvalued stocks or stock indexes. A relative value hedge fund takes advantage of price or spread inefficiencies. Knowing and understanding the characteristics of the many different hedge fund strategies is essential to capitalizing on their variety of investment opportunities.

It is important to understand the differences between the various hedge fund strategies because all hedge funds are not the same - investment returns, volatility, and risk vary enormously among the different hedge fund strategies. Some strategies which are not correlated to equity markets are able to deliver consistent returns with extremely low risk of loss, while others may be as or more volatile than mutual funds. A successful fund of funds recognizes these differences and blends various strategies and asset classes together to create more stable long-term investment returns than any of the individual funds.
7.52 Strategic Financial Management

(a) Hedge fund strategies vary enormously – many, but not all, hedge against market downturns – especially important today with volatility and anticipation of corrections in overheated stock markets.

(b) The primary aim of most hedge funds is to reduce volatility and risk while attempting to preserve capital and deliver positive (absolute) returns under all market conditions.

(c) The popular misconception is that all hedge funds are volatile - that they all use global macro strategies and place large directional bets on stocks, currencies, bonds, commodities or gold, while using lots of leverage. In reality, less than 5% of hedge funds are global macro funds. Most hedge funds use derivatives only for hedging or don’t use derivatives at all, and many use no leverage.

13.1 Main Features of Hedge funds: The key characteristics of hedge funds can be stated as follows:

(a) Hedge funds utilize a variety of financial instruments to reduce risk, enhance returns and minimize the correlation with equity and bond markets. Many hedge funds are flexible in their investment options (can use short selling, leverage, derivatives such as puts, calls, options, futures, etc.).

(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) Many 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) Most 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 to minimize overall portfolio volatility and enhance returns.

(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. In addition, hedge fund managers usually have their own money invested in their fund.

13.2 Hedge Fund Industry Scenario of the World: The hedge funds industry around the world is estimated to be $300-$400 billion and is growing at about 20% per year with between 4,000 and 5,000 active hedge funds. It includes a variety of investment strategies, some of which use leverage and derivatives while others are more conservative and employ little or no leverage. Many hedge fund strategies seek to reduce market risk specifically by shorting equities or through the use of derivatives.

Most hedge funds are highly specialized, relying on the specific expertise of the manager or management team. Performance of many hedge fund strategies, particularly relative value
strategies, is not dependent on the direction of the bond or equity markets - unlike conventional equity or mutual funds (unit trusts), which are generally 100% exposed to market risk. Many hedge fund strategies, particularly arbitrage strategies, are limited as to how much capital they can successfully employ before returns diminish. As a result, many successful hedge fund managers limit the amount of capital they will accept. Hedge fund managers are generally highly professional, disciplined and diligent.

The returns of hedge funds over a sustained period of time have outperformed standard equity and bond indexes with less volatility and less risk of loss than equities. Beyond the averages, there are some truly outstanding performers. Investing in hedge funds tends to be favored by more sophisticated investors, including many Swiss and other private banks that have lived through, and understand the consequences of, major stock market corrections. An increasing number of endowments and pension funds allocate assets to hedge funds.

13.3 Hedging Strategies: Wide ranges of hedging strategies are available to hedge funds. For example:

(i) **Selling Short**: Selling shares without owning them, hoping to buy them back at a future date at a lower price in the expectation that their price will drop.

(ii) **Using Arbitrage**: Seeking to exploit pricing inefficiencies between related securities - for example, can be long convertible bonds and short the underlying issuer’s equity.

(iii) **Trading Options or Derivatives**: Contracts whose values are based on the performance of any underlying financial asset, index or other investment.

(iv) **Investing in Anticipation of a Specific Event**: Merger transaction, hostile takeover, spin-off, exiting of bankruptcy proceedings, etc.

(v) **Investing in Deeply Discounted Securities**: Of companies about to enter or exit financial distress or bankruptcy, often below liquidation value.

(vi) Many of the strategies used by hedge funds benefit from being non-correlated to the direction of equity markets.

13.4 Benefits of Hedge Funds: There are many advantages of hedge funds. Some of the important advantages are:

(a) Many hedge fund strategies have the ability to generate positive returns in both rising and falling equity and bond markets.

(b) Inclusion of hedge funds in a balanced portfolio reduces overall portfolio risk and volatility and increases returns.

(c) Huge variety of hedge fund investment styles – many uncorrelated with each other – provides investors with a wide choice of hedge fund strategies to meet their investment objectives. Academic research proves hedge funds have higher returns and lower overall risk than traditional investment funds.

(d) Hedge funds provide an ideal long-term investment solution, eliminating the need to correctly time entry and exit from markets.

(e) Adding hedge funds to an investment portfolio provides diversification not otherwise available in traditional investing.
13.5 Different Styles of Hedge Funds: The predictability of future results shows a strong correlation with the volatility of each strategy. Future performance of strategies with high volatility is far less predictable than future performance from strategies experiencing low or moderate volatility.

(a) **Aggressive Growth**: Invests in equities; expected to experience acceleration in growth of earnings per share; generally high P/E ratios, low or no dividends; often smaller and microcap stocks which are expected to experience rapid growth. Includes sector specialist funds such as technology, banking, or biotechnology. Hedges by shorting equities where earnings disappointment is expected or by shorting stock indexes. Tends to be "long-biased." Expected volatility is high.

(b) **Distressed Securities**: Buys equity, debt, or trade claims at deep discounts of companies in or facing bankruptcy or reorganization. Profits from the market's lack of understanding of the true value of the deeply discounted securities and because the majority of institutional investors cannot own below investment grade securities. (This selling pressure creates the deep discount.) Results generally not dependent on the direction of the markets. Expected volatility ranges from Low – Moderate.

(c) **Emerging Markets**: Invests in equity or debt of emerging (less mature) markets that tend to have higher inflation and volatile growth. Short selling is not permitted in many emerging markets, and, therefore, effective hedging is often not available. Expected volatility is very high.

(d) **Funds of Hedge Funds**: Mix and match hedge funds and other pooled investment vehicles. This blending of different strategies and asset classes aims to provide a more stable long-term investment return than any of the individual funds. Returns, risk, and volatility can be controlled by the mix of underlying strategies and funds. Capital preservation is generally an important consideration. Volatility depends on the mix and ratio of strategies employed. Expected volatility range is Low – Moderate – High.

(e) **Income**: Invests with primary focus on yield or current income rather than solely on capital gains. May utilize leverage to buy bonds and sometimes fixed income derivatives in order to profit from principal appreciation and interest income. Expected volatility is low.

(f) **Macro**: Aims to profit from changes in global economies, typically brought about by shifts in government policy that impact interest rates, in turn affecting currency, stock, and bond markets. Participates in all major markets - equities, bonds, currencies and commodities - though not always at the same time. Uses leverage and derivatives to accentuate the impact of market moves. Utilizes hedging, but the leveraged directional investments tend to make the largest impact on performance. Expected volatility is very high.

(g) **Market Neutral: Arbitrage**: Attempts to hedge out most market risk by taking offsetting positions, often in different securities of the same issuer. For example, can be long convertible bonds and short the underlying issuers' equity. May also use futures to hedge out interest rate risk. Focuses on obtaining returns with low or no correlation to both the equity and bond markets. These relative value strategies include fixed income arbitrage, mortgage backed securities, capital structure arbitrage, and closed-end fund arbitrage. Expected volatility is low.
(h) **Market Neutral:** *Securities Hedging:* Invests equally in long and short equity portfolios generally in the same sectors of the market. Market risk is greatly reduced, but effective stock analysis and stock picking is essential to obtaining meaningful results. Leverage may be used to enhance returns. Usually low or no correlation to the market. Sometimes uses market index futures to hedge out systematic (market) risk. Relative benchmark index usually T-bills. Expected volatility is low.

(i) **Market Timing:** Allocates assets among different asset classes depending on the manager's view of the economic or market outlook. Portfolio emphasis may swing widely between asset classes. Unpredictability of market movements and the difficulty of timing entry and exit from markets add to the volatility of this strategy. Expected volatility is high.

(j) **Opportunistic:** Investment theme changes from strategy to strategy as opportunities arise to profit from events such as IPOs, sudden price changes often caused by an interim earnings disappointment, hostile bids, and other event-driven opportunities. May utilize several of these investing styles at a given time and is not restricted to any particular investment approach or asset class. Expected volatility is variable.

(k) **Multi Strategy:** Investment approach is diversified by employing various strategies simultaneously to realize short- and long-term gains. Other strategies may include systems trading such as trend following and various diversified technical strategies. This style of investing allows the manager to overweight or underweight different strategies to best capitalize on current investment opportunities. Expected volatility is variable.

(l) **Short Selling:** Sells securities short in anticipation of being able to re-purchase them at a future date at a lower price due to the manager's assessment of the overvaluation of the securities, or the market, or in anticipation of earnings disappointments often due to accounting irregularities, new competition, change of management, etc. Often used as a hedge to offset long-only portfolios and by those who feel the market is approaching a bearish cycle. Risk is high. Expected volatility is very high.

(m) **Special Situations:** Invests in event-driven situations such as mergers, hostile takeovers, reorganizations, or leveraged buyouts. May involve simultaneous purchase of stock in companies being acquired, and the sale of stock in its acquirer, hoping to profit from the spread between the current market price and the ultimate purchase price of the company. May also utilize derivatives to leverage returns and to hedge out interest rate and/or market risk. Results generally not dependent on direction of market. Expected volatility is moderate.

(n) **Value:** Invests in securities perceived to be selling at deep discounts to their intrinsic or potential worth. Such securities may be out of favor or under followed by analysts. Long-term holding, patience, and strong discipline are often required until the ultimate value is recognized by the market. Expected volatility is Low – Moderate.

### 13.6 Difference between Hedge Funds and Mutual Funds

Hedge funds are like mutual funds in two respects: (i) they are pooled investment vehicles (i.e. several investors entrust their money to a manager) and (ii) they invest in publicly traded securities. But there are important differences between a hedge fund and a mutual fund. These stem from and are
best understood in light of the hedge fund’s charter: investors give hedge funds the freedom to pursue absolute return strategies.

**Mutual Funds Seek Relative Returns:** Most mutual funds invest in a predefined style, such as "small cap value", or into a particular sector, such as the Internet sector. To measure performance, the mutual fund’s returns are compared to a style-specific index or benchmark. For example, if you buy into a "small cap value" fund, the managers of that fund may try to outperform the Nifty Small Cap Index. Less active managers might construct the portfolio by following the index and then applying stock-picking skills to increase (over-weigh) favoured stocks and decrease (under-weigh) less appealing stocks.

A mutual fund’s goal is to beat the index or "beat the bogey", even if only modestly. If the index is down 10% while the mutual fund is down only 7%, the fund’s performance would be called a success. On the passive-active spectrum, on which pure index investing is the passive extreme, mutual funds lie somewhere in the middle as they semi-actively aim to generate returns that are favourable compared to a benchmark.

**Hedge Funds Actively Seek Absolute Returns:** Hedge funds lie at the active end of the investing spectrum as they seek positive absolute returns, regardless of the performance of an index or sector benchmark. Unlike mutual funds, which are "long-only" (make only buy-sell decisions), a hedge fund engages in more aggressive strategies and positions, such as short selling, trading in derivative instruments like options and using leverage (borrowing) to enhance the risk/reward profile of their bets.

This activeness of hedge funds explains their popularity in bear markets. In a bull market, hedge funds may not perform as well as mutual funds, but in a bear market - taken as a group or asset class - they should do better than mutual funds because they hold short positions and hedges. The absolute return goals of hedge funds vary, but a goal might be stated as something like "6% to 9% annualized return regardless of the market conditions".

Investors, however, need to understand that the hedge-fund promise of pursuing absolute returns means hedge funds are "liberated" with respect to registration, investment positions, liquidity and fee structure. First, hedge funds in general are not registered with the authorities like in USA with SEC. They have been able to avoid registration by limiting the number of investors and requiring that their investors be accredited, which means they meet an income or net worth standard. Furthermore, hedge funds are prohibited from soliciting or advertising to a general audience, a prohibition that lends to their mystique.

In hedge funds, liquidity is a key concern for investors. Liquidity provisions vary, but invested funds may be difficult to withdraw "at will". For example, many funds have a lock-out period, which is an initial period of time during which investors cannot remove their money.

Lastly, hedge funds are more expensive even though a portion of the fees are performance-based. Typically, they charge an annual fee equal to 1% of assets managed (sometimes up to 2%), plus they receive a share - usually 20% - of the investment gains. The managers of many funds, however, invest their own money along with the other investors of the fund and, as such, may be said to "eat their own cooking".
13.7 Broad Categories of Hedge Funds: Most hedge funds are entrepreneurial organizations that employ proprietary or well-guarded strategies. The three broad hedge fund categories are based on the types of strategies they use:

(a) Arbitrage Strategies (Relative Value): Arbitrage is the exploitation of observable price inefficiency and, as such, pure arbitrage is considered risk less. Consider a very simple example. Say ABV stock currently trades at ₹ 910 and a single stock futures contract due in six months is priced at ₹ 914. The futures contract is a promise to buy or sell the stock at a predetermined price. So by purchasing the stock and simultaneously selling the futures contract, you can, without taking on any risk, lock in an ₹ 4 gain before transaction and borrowing costs. In practice, arbitrage is more complicated, but three trends in investing practices have opened up the possibility of all sorts of arbitrage strategies: the use of (1) derivative instruments, (2) trading software, and (3) various trading exchanges (for example, electronic communication networks and foreign exchanges make it possible to take advantage of *exchange arbitrage*, the arbitraging of prices among different exchanges).

Only a few hedge funds are pure arbitrageurs, but when they are, historical studies often prove they are a good source of low-risk reliably-moderate returns. But, because observable price inefficiencies tend to be quite small, pure arbitrage requires large, usually leveraged investments and high turnover. Further, arbitrage is perishable and self-defeating: if a strategy is too successful, it gets duplicated and gradually disappears.

Most so-called arbitrage strategies are better labelled "relative value". These strategies do try to capitalize on price differences, but they are not risk free. For example, convertible arbitrage entails buying a corporate convertible bond, which can be converted into common shares, while simultaneously selling short the common stock of the same company that issued the bond. This strategy tries to exploit the relative prices of the convertible bond and the stock: the arbitrageur of this strategy would think the bond is a little cheap and the stock is a little expensive. The idea is to make money from the bond's yield if the stock goes up but also make money from the short sale if the stock goes down. However, as the convertible bond and the stock can move independently, the arbitrageur can lose on both the bond and the stock, which means the position carries risk.

(b) Event-Driven Strategies: Event-driven strategies take advantage of transaction announcements and other one-time events. One example is merger arbitrage, which is used in the event of an acquisition announcement and involves buying the stock of the target company and hedging the purchase by selling short the stock of the acquiring company. Usually at announcement, the purchase price that the acquiring company will pay to buy its target exceeds the current trading price of the target company. The merger arbitrageur bets the acquisition will happen and cause the target company's price to converge (rise) to the purchase price that the acquiring company pays. This also is not pure arbitrage. If the market happens to frown on the deal, the acquisition may unravel and send the stock of the acquirer up (in relief) and the target company's stock down (wiping out the temporary bump) which would cause a loss for the position.

There are various types of event-driven strategies. One other example is "distressed securities", which involves investing in companies that are re-organizing or have been unfairly
beaten down. Another interesting type of event-driven fund is the activist fund, which is predatory in nature. This type takes sizeable positions in small, flawed companies and then uses its ownership to force management changes or a restructuring of the balance sheet.

(c) Directional or Tactical Strategies: The largest group of hedge funds uses directional or tactical strategies. Macro funds are global, making "top-down" bets on currencies, interest rates, commodities or foreign economies. Because they are for "big picture" investors, macro funds often do not analyze individual companies.

Some other examples of directional or tactical strategies are:

(i) Long/short strategies combine purchases (long positions) with short sales. For example, a long/short manager might purchase a portfolio of core stocks that occupy the S&P 500 and hedge by selling (shorting) S&P 500 Index futures. If the S&P 500 goes down, the short position will offset the losses in the core portfolio, limiting overall losses.

(ii) Market neutral strategies are a specific type of long/short whose goal is to negate the impact and risk of general market movements, trying to isolate the pure returns of individual stocks. This type of strategy is a good example of how hedge funds can aim for positive, absolute returns even in a bear market. For example, a market neutral manager might purchase Birla company’s and simultaneously short Tata company’s, betting that the former will outperform the latter. The market could go down and both stocks could go down along with the market, but as long as Birla’s outperforms Tata’s, the short sale on Tata company’s will produce a net profit for the position.

(iii) Dedicated short strategies specialize in the short sale of over-valued securities. Because losses on short-only positions are theoretically unlimited (because the stock can rise indefinitely), these strategies are particularly risky. Some of these dedicated short funds are among the first to foresee corporate collapses - the managers of these funds can be particularly skilled at scrutinizing company fundamentals and financial statements in search of red flags.

13.8 Reasons for Investing in Hedge Funds: There are two basic reasons for investing in a hedge fund: to seek higher net returns (net of management and performance fees) and/or to seek diversification.

(a) Potential for Higher Returns, Especially in a Bear Market: Higher returns are hardly guaranteed. As discussed earlier, most hedge funds invest in the same securities available to mutual funds and individual investors. You can therefore only reasonably expect higher returns if you select a superior manager or pick a timely strategy. Many experts argue that selecting a talented manager is the only thing that really matters. This helps to explain why hedge fund strategies are not scalable, meaning bigger is not better. With mutual funds, an investment process can be replicated and taught to new managers, but many hedge funds are built around individual "stars", and genius is difficult to clone. For this reason, some of the better funds are likely to be small.

A timely strategy is also critical. The often cited statistics in international arena from CSFB/Tremont in regard to hedge fund performance during the 1990s are revealing. From January 1994 to September 2000 - a raging bull market by any definition - the passive S&P
500 index outperformed every major hedge fund strategy by a whopping 6% in annualized return. But particular strategies performed very differently. For example, dedicated short strategies suffered badly, but market neutral strategies outperformed the S&P 500 index in risk-adjusted terms (i.e. underperformed in annualized return but incurred less than one-fourth the risk). If your market outlook is bullish, you will need a specific reason to expect a hedge fund to beat the index. Conversely, if your outlook is bearish, hedge funds should be an attractive asset class compared to buy-and-hold or long-only mutual funds.

(b) **Diversification Benefits:** Many institutions invest in hedge funds for the diversification benefits. If you have a portfolio of investments, adding uncorrelated (and positive-returning) assets will reduce total portfolio risk. Hedge funds - because they employ derivatives, short sales or non-equity investments - tend to be uncorrelated with broad stock market indices. But again, correlation varies by strategy. Historical correlation data (e.g. over the 1990s) remains somewhat consistent and here is a reasonable hierarchy, as available from international scenario:

<table>
<thead>
<tr>
<th>Correlation with the S&amp;P 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect Negative (-1.0)</td>
</tr>
<tr>
<td>Perfect Correlation (1.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dedicated</th>
<th>Arbitrage</th>
<th>Macro</th>
<th>Event-Short</th>
<th>Market-Neutral</th>
<th>Long/Short</th>
</tr>
</thead>
<tbody>
<tr>
<td>(&lt;0)</td>
<td>(&gt;0)</td>
<td>(&lt;0)</td>
<td>(&lt;0)</td>
<td>(&gt;0)</td>
<td>(&gt;0.5)</td>
</tr>
</tbody>
</table>

13.9 **Demerits of Hedge Funds - Fat Tails are the Problem:** Hedge fund investors are exposed to multiple risks, and each strategy has its own unique risks. For example, long/short funds are exposed to the short-squeeze.

The traditional measure of risk is volatility, that is, the annualized standard deviation of returns. Surprisingly, most academic studies demonstrate that hedge funds, on average, are less volatile than the market. For example, over the bull market period we referred to earlier, volatility of the S&P 500 was about 14% while volatility of the aggregated hedge funds was only about 10%. That is, about two-thirds of the time, we might have expected returns to be within 10% of the average return. In risk-adjusted terms, as measured by the Sharpe ratio (unit of excess return per unit of risk), some strategies outperformed the S&P 500 index over the bull market period mentioned earlier.

The problem is that hedge fund returns do not follow the symmetrical return paths implied by traditional volatility. Instead, hedge fund returns tend to be skewed. Specifically, they tend to be negatively skewed, which means they bear the dreaded "fat tails", which are mostly
characterized by positive returns but a few cases of extreme losses. For this reason, measures of downside risk can be more useful than volatility or Sharpe ratio. Downside risk measures, such as value at risk (VaR), focus only on the left side of the return distribution curve where losses occur. They answer questions such as, "What are the odds that I lose 15% of the principal in one year?"

A Fat Tail Mean Small Odds of a Large Loss

13.10 Funds of Hedge Funds: Because investing in a single hedge fund requires time-consuming due diligence and concentrates risk, funds of hedge funds have become popular. These are pooled funds that allocate their capital among several hedge funds, usually in the neighborhood of 15 to 25 different hedge funds. Unlike the underlying hedge funds, these vehicles are often registered with the regulatory authorities like SEC in US and promoted to individual investors. Sometimes called a "retail" fund of funds, the net worth and income tests may be lower than usual.

The advantages of funds of hedge funds include automatic diversification, monitoring efficiency and selection expertise. Because these funds are invested in a minimum of around eight funds, the failure or underperformance of one hedge fund will not ruin the whole. As the funds of funds are supposed to monitor and conduct due diligence on their holdings, their investors should in theory be exposed only to reputable hedge funds. Finally, these funds of
hedge funds are often good at sourcing talented or undiscovered managers who may be "under the radar" of the broader investment community. In fact, the business model of the fund of funds hinges on identifying talented managers and pruning the portfolio of underperforming managers.

The biggest disadvantage is cost, because these funds create a double-fee structure. Typically, you pay a management fee (and maybe even a performance fee) to the fund manager in addition to fees normally paid to the underlying hedge funds. Arrangements vary, but you might pay a 1% management fee to both the fund of funds and the underlying hedge funds. In regards to performance fees, the underlying hedge funds may charge 20% of their profits, and it is not unusual for the fund of funds to charge an additional 10%. Under this typical arrangement, you would pay 2% annually plus 30% of the gains. This makes cost a serious issue, even though the 2% management fee by itself is only about 50 basis points higher than the average small cap mutual fund (i.e. about 1.5%).

Another important and underestimated risk is the potential for over-diversification. A fund of hedge funds needs to coordinate its holdings or it will not add value: if it is not careful, it may inadvertently collect a group of hedge funds that duplicates its various holdings or - even worse - ends up constituting a representative sample of the entire market. Too many single hedge fund holdings (with the aim of diversification) are likely to erode the benefits of active management, while incurring the double-fee structure in the meantime. Various studies have been conducted, but the "sweet spot" seems to be around eight to 15 hedge funds.


The objective of portfolio investment management is to consider an optimal portfolio where the risk-return trade off is optimal. The return may be maximum at a certain level of risk or the risk may be minimum at a certain level of return. It is therefore necessary to determine whether optimization of international portfolio can be achieved by striking a balance between risk and return.

14.1 Expected Returns from a Security: For international investment, the estimation of expected returns takes into consideration the changes in exchange rate too so that the return from a security abroad in terms of home-country currency takes the following form:

\[ 1 + R_{HC} = \left[ 1 + (S_1 - S_0 + I) / S_0 \right] \times (1 + e) \]

Where,

- \( S_0 \) = Home country currency value of security during proceeding time period \( t_0 \)
- \( S_1 \) = Home country currency value of security during succeeding time period \( t_1 \)
- \( I \) = Income from interest and dividend
- \( e \) = Change in exchange rate

Illustration 10

An Indian investor invests in a bond in America. If the price of the bond in the beginning of the period is $100 and it is $105 at the end of the period. The coupon interest during the period is $7. The US
dollar appreciates during this period by 3%. Find the return on investment in terms of home country currency.

Solution

\[
R_{HC} = \left[ 1 + \left( \frac{105 - 100 + 7}{100} \right) \right] \left( 1 + 0.03 \right) - 1
\]

\[
= (1.12) (1.03) - 1
\]

\[
= 1.1536 - 1 = .1536
\]

\[
= 15.36\%
\]

14.2 Portfolio Return: Portfolio return is the weighted average of the expected return from different securities comprising the portfolio. The portfolio for a two security portfolio will be:

\[
R_p = R_A W_A + R_B W_B
\]

Where,

\[
R_p = \text{Portfolio Return}
\]

\[
R_A \text{ and } R_B = \text{Portfolio Returns for securities A and B}
\]

\[
W_A \text{ and } W_B = \text{Weighted average of the securities comprising the portfolio.}
\]

14.3 Reduction of Risk through Diversification: The investor can reduce the portfolio risk through diversification. Diversification is simultaneous investment in other securities within or outside the home country. Risk may be reduced by diversification if the covariance/correlation between the existing portfolio and the new portfolio is negative i.e. returns in one basket are increasing while in the other they are falling. On the other hand, if it is positive it will signify that returns in one set are increasing while in the other also they are increasing leading to the level of risk being raised through diversification. Thus diversification becomes a futile exercise. With covariance being \( \sigma_{12} = 0 \), the returns from two sets of investment are not correlated or are positively correlated.

\[
\text{Covariance between two sets of returns } A_1, \text{ and } A_2 \text{ is given by:}
\]

\[
\text{Covariance } = P_1 (A_1 - \overline{A_1}) (A_2 - \overline{A_2}) + P_2 (A_1 - \overline{A_1}) (A_2 - \overline{A_2})
\]

\[
\text{Correlation Coefficient } \rho_{12} = \frac{\text{Cov}(A_1, A_2)}{\sigma_1 \sigma_2}
\]

Covariance is sensitive to different sets of measurement and takes any value while Correlation Coefficient removes the sensitivity and lies between -1 and +1

The Portfolio Risk of both the existing and new portfolio in terms of standard deviation is obtained from:

\[
\sigma_p = \left[ w_1^2 \text{Var} A_1 + w_2^2 \text{Var} A_2 + 2(w_1)(w_2)\text{Cov}(A_1, A_2) \right]^{1/2}
\]

Where,

\[
w_1, w_2 \text{ represent the weights of the different sets of portfolio in the total investment.}
\]
Illustration 11

An Indian investor invests in American and British securities in the proportion of 75% and 25%. The expected return is 15% from the former and 12% from the latter. The risk manifesting in variance is 15% in US securities and 18% in UK securities. Correlation is 0.6. Determine the Portfolio Return and Portfolio risk.

Solution

Portfolio Return

\[ 0.75 \times 0.15 + 0.25 \times 0.12 = 0.1425 = 14.25\% \]

Portfolio Risk

\[
(0.75)^2 (0.15)^2 + (0.25)^2 (0.18)^2 + 2(0.75)(0.25)(0.15)(0.18)(0.6)
\]

\[ = \sqrt{0.020756} \]

\[ = 0.1441 = 14.41\% \]

14.4 Benefits of International Portfolio Management: International Diversification of portfolio of assets helps to obtain higher risk adjusted returns i.e. reduce risk and raise return through international investment. Some of the benefits are listed as under:

(a) Reduce Risk: International investment aids to diversify risk. The different sectors in an individual economy in some way or the other are interrelated and as a whole subject to the same impact of the entire domestic policy. The returns on investment in a domestic economy depend on the prospects of domestic activity together with the uncertainty attached thereto. The gains from diversification within a country are therefore very much limited.

Though macro economic factors of different countries vary widely and do not follow the same phases of business cycles, different countries have securities of different industries in their market portfolio leading to correlation of expected returns from investment in different countries being lower than in a single country. Thus foreign investment provides diversification benefits which a domestic investment does not.

(b) Raise Return through better Risk – Return Trade off: International Investment aids to raise the return with a given risk and/or aids to lower the risk with a given rate of return. This is possible due to profitable investment opportunities being available in an enlarged situation and at the same time inter country dissimilarities reduce the quantum of risk. With a gradual increase in foreign portfolio returns from investment also increases till the ratio of foreign portfolio reaches 60% of the total portfolio.

15. Estimating the Project Discount Rate

The CAPM can also be used to calculate WACC used as the discount rate to compute NPV of the firm. Normally there is an underlying assumption that the project has the same business and financial risk as that of the parent company. However, WACC of the firm can be applied only when the project is a carbon copy of the firm’s assets. However it may be possible that, the project may have a different operating risk profile and more or less leveraged than the parent has. In such a case it will be wrong to apply the firm’s WACC as the discount rate.
CAPM can be used to arrive at the project discount rate by taking the following steps:

1. Estimate the project beta.
2. Putting the value of Beta computed above into the Capital Asset Pricing Model (CAPM) to arrive at the cost of equity.
3. Estimate the cost of debt.
4. Calculate the WACC for the project.

**Pure Play Technique:** To compute the Beta of project the technique known as ‘Pure Play’ can be used. As it is difficult to compute the beta for the project in the marketplace, a proxy beta derived from a publicly-traded firm whose operations are as similar as possible to the project in question can be used as the measure of the project’s systematic risk. This technique attempts to identify firms with publicly-traded securities, which are engaged solely in the same line of business as the division or project. These comparable firms are called ‘pureplay’ firm and should have the following characteristics.

1. The firm should have only one business line and no miscellaneous revenues.
2. The pureplay should be in the same industry or business line as the division in question.
3. The revenues of the pureplay should be approximately the same as those of the division under consideration.
4. When more than one firm could be identified as potential pureplay, the firm with the median beta could be chosen as the pureplay. Otherwise mean of beta of these firms can also be used.

Once the proxy betas are obtained, next step involves the estimation of the unlevered betas for each of these firms. The basic purpose of this exercise is to remove the effect of capital structure on beta as unlevered beta reflects only the operating risk.

The relationship between levered and unlevered beta is as follows:

\[
\beta_L = \beta_U \left[1 + \left(1 - T\right) \frac{D}{E}\right]
\]

or

\[
\beta_U = \frac{\beta_L}{\left[1+\left(1- T\right)\frac{D}{E}\right]}
\]

The next step shall involve the re-levering the project beta reflecting the project’s financing mix using above formula,

\[
\beta_L = \beta_U \left[1 + \left(1 - T\right) \frac{D}{E}\right]
\]

This technique can be understood with the help of following illustration.

**Illustration 12**

The XYZ Ltd. in the manufacturing business is planning to set up an software development company. The project will have a D/E ratio of 0.27. The company has identified following four pureplay firms in the line of software business.
Assuming tax rate applicable to XYZ Ltd. as 35 per cent, $R_f$ as 12%, $K_d$ as 14% and $R_M$ as 18%, you are required to compute the WACC to be used to compute NPV of the project.

**Solution**

First of all we shall unlever the beta of the pureplay firms as follows:

$$\beta_U = \left[ \frac{\beta_L}{1 + (1 - T) \frac{D}{E}} \right]$$

<table>
<thead>
<tr>
<th>Pureplay firm</th>
<th>$\beta_L$</th>
<th>$\frac{D}{E}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC</td>
<td>1.1</td>
<td>0.3</td>
</tr>
<tr>
<td>DEF</td>
<td>0.9</td>
<td>0.25</td>
</tr>
<tr>
<td>GHI</td>
<td>0.95</td>
<td>0.35</td>
</tr>
<tr>
<td>JKL</td>
<td>1.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Unlevered Beta**

- **ABC**: $1.1 \times \frac{1}{1 + (0.65) (0.3)} = 0.921$
- **DEF**: $0.9 \times \frac{1}{1 + (0.65) (0.25)} = 0.774$
- **GHI**: $0.95 \times \frac{1}{1 + (0.65) (0.35)} = 0.774$
- **JKL**: $1.0 \times \frac{1}{1 + (0.65) (0.3)} = 0.837$

Average $\beta_U = \frac{0.921 + 0.774 + 0.774 + 0.837}{4} = 0.827$

This can be taken as proxy for unlevered beta of the project.

Next, we shall lever the beta for the project as follows:

$$\beta_L = \beta_U \times \left[ 1 + (1 - T) \frac{D}{E} \right]$$

$$= 0.827 \times \left[ 1 + (0.65) (0.27) \right] = 0.97$$

Since $R_f = 12\%$ and $R_M = 18\%$

Cost of equity for the project will be:

$$= R_f + \beta_L \times [E(R_M) - R_f]$$

$$= 12\% + 0.97 \times [18\% - 12\%] = 17.82\%$$

The project’s WACC ($K_o$) will be:

$$K_o = \frac{D}{V} K_o (1 - T) + \frac{E}{V} K_e$$
7.66 Strategic Financial Management

\[ K_o = \frac{0.27 \times 0.14(1 - 0.35)}{1.27} + \frac{1.00 \times 0.1782}{1.27} = 0.1597 \]

\[ K_o = 15.97\% \]

The project’s WACC \( (K_o) \) i.e. 15.97\% can be used to calculate to discount the project.

16. Random Walk Theory

While discussing the Dow Jones theory, we have seen that the theory is based on the assumption that the behaviour of stock market itself contains trends which give clues to the future behaviour of stock market prices. Thus supporters of the theory argue that market prices can be predicted if their patterns can be properly understood. Such analysis of stock market patterns is called technical analysis. Apart from this theory there are many approaches to technical analysis. Most of them, however, involve a good deal of subjective judgment.

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. In other words, 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 drunk 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.

The supporters of this theory put out a simple argument. It follows that:

(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).

17. Efficient Market Theory (Efficient Market Hypothesis)

Efficient Market Theory was developed by University of Chicago professor Eugen Fama in the 1960s. As per this theory, at any given time, all available price sensitive 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.

Stating otherwise theory states that no none can "beat the market" hence making it impossible for investors to either purchase undervalued stocks or sell stocks for inflated prices as stocks are always traded at their fair value on stock exchanges. Hence it is impossible to outperform
the overall market through expert stock selection or market timing and that the only way an investor can possibly obtain higher returns is by purchasing riskier investments.

17.1 Search for Theory: When empirical evidence in favour of Random walk hypothesis seemed overwhelming, researchers wanted to know about the Economic processes that produced a Random walk. They concluded that randomness of stock price was a result of efficient market that led to the following view points:

- Information is freely and instantaneously available to all market participants.
- Keen competition among the market participants more or less ensures that market will reflect intrinsic values. This means that they will fully impound all available information.
- Price change only response to new information that is unrelated to previous information and therefore unpredictable.

17.2 Misconception about Efficient Market Theory: Efficient Market Theory implies that market prices factor in all available information and as such it is not possible for any investor to earn consistent long term returns from market operations. Although price tends to fluctuate they cannot reflect fair value. This is because the future is uncertain. The market springs surprises continually and as prices reflect the surprises they fluctuate.

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 market efficiency exists due to portfolio managers doing this job well in a competitive setting.

The random movement of stock prices suggests that stock market is irrational. Randomness and irrationality are two different things, if investors are rational and competitive, price changes are bound to be random.

17.3 Level of Market Efficiency: That price reflects all available information, the highest order of market efficiency. According to FAMA, there exist three levels of market efficiency:

(i) **Weak form efficiency** – Price reflect all information found in the record of past prices and volumes.

(ii) **Semi – Strong efficiency** – Price reflect not only all information found in the record of past prices and volumes but also all other publicly available information.

(iii) **Strong form efficiency** – Price reflect all available information public as well as private.

17.4 Empirical Evidence on Weak form Efficient Market Theory: According to the Weak form Efficient Market Theory current price of a stock reflect all information found in the record of past prices and volumes. This means that there is no relationship between the past and future price movements.

Three types of tests have been employed to empirically verify the weak form of Efficient Market Theory- Serial Correlation Test, Run Test and Filter Rule Test.
(a) **Serial Correlation Test**: To test for randomness in stock price changes, one has to look at serial correlation. For this purpose, price change in one period has to be correlated with price change in some other period. Price changes are considered to be serially independent. Serial correlation studies employing different stocks, 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.

\[
\begin{array}{ccccccccccc}
\end{array}
\]

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 size and in the process determines whether it is statistically different. By and large, the result of these studies strongly supports the Random Walk Model.

(c) **Filter Rules Test**: If the price of 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 apply in such a buy and hold strategy. By and large, studies suggest that filter rules do not out perform a single buy and hold strategy particular after considering commission on transaction.

17.5 **Empirical Evidence on Semi-strong Efficient Market Theory**: Semi-strong form efficient market theory holds that 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 was conducted which lead to the following queries: Whether it was possible to earn on 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 support the Semi-strong form Efficient Market Theory. Fama, Fisher, Jensen and Roll in their adjustment of stock prices to new information examined the effect of stock split on return of 940 stock splits in New York Stock Exchange during the period 1957-1959. They found that prior to the split, stock earns higher returns than predicted by any market model.

Boll and Brown in an empirical evaluation of accounting income numbers studied the effect of annual earnings announcements. They divided the firms into two groups. First group consisted of firms whose earnings increased in relation to the average corporate earnings while second
group consists of firms whose earnings decreased in relation to the average corporate earnings. They found that before the announcement of earnings, stock in the first group earned positive abnormal returns while stock in the second group earned negative abnormal returns after the announcement of earnings. Stock in both the groups earned normal returns.

There have been studies which have been empirically documented showing the following inefficiencies and anomalies:

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

17.6 Empirical Evidence on Strong form Efficient Market Theory: According to the Efficient Market Theory, all available information, public or private, is reflected in the stock prices. This represents an extreme hypothesis.

To test this theory, the researcher 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 has been any better than that of randomly selected portfolios. This was the finding of Burton Malkiel in his Random Walk Down Wall Street, New York.

17.7 Challenges to the Efficient Market Theory: Information inadequacy – Information is neither freely available nor rapidly transmitted to all participants in the stock market. There is a calculated attempt by many companies to circulate misinformation.

(a) Limited information processing capabilities – Human information processing capabilities are sharply limited. According to Herbert Simon every human organism lives in an environment which generates millions of new bits of information every second but the bottleneck of the perceptual apparatus does not admit more than thousand bits per seconds and possibly much less.

David Dreman maintained that 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. J. M. Keynes argued that all sorts of consideration 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 grate influence over the market. The monopolistic power enjoyed by them diminishes the competitiveness of the market.