CHAPTER 3

DATA AND METHODOLOGY

The primary objective of this research study is to evaluate the performance of various portfolio selection models based on Fundamental Analysis and Modern Portfolio Theory and its extensions by using data from Indian equity market.

This study aims to provide a computerised system that would support the decision making process of institutional investors. Number of shares that are listed and/or permitted to be traded on Indian bourses is more than 5000. Analysing the fundamental data of the companies, computing expected return and risk and then choosing scrips for investment/disinvestment is a tedious job for fund managers and investment analysts in the investment companies and corporates.

The computerised system comprises widely used models based on a variety of fundamental factors. Performance evaluation of the models would help in knowing what factors had influenced share prices and to what extent. This would aid investors to base the investment decisions accordingly. For instance, shares are selected by majority of models (which are based on a variety of fundamental factors) can be shortlisted for further scrutiny and analysis.
The study also aimed at providing ancillary services to investment firms. That is, the system can be put to other related uses like portfolio generation, evaluation of performance of the portfolio, comparing efficacy of the fund managers apart from data querying.

For the purpose of this study, Fundamental models are grouped into two categories viz., Selection models and Decision models. Selection models essentially deal with security selection from a universe whereas decision models enable investors to 'time' their decisions. While these models give an idea to the investors as to 'what' to buy/sell and 'when' to buy/sell, the models based on modern portfolio theory will provide a clue as to 'how much' of "what" to buy/sell to have a risk-return optimum portfolio. The extension of modern portfolio theory viz., Capital Asset Pricing Model based on capital market theory provides a benchmark against which portfolio selection as well as portfolio performance evaluation is possible.

These models have been widely used by investors, especially institutional investors, in developed markets. Numerous studies have been carried out as to the consistency and applicability of these models under different economic and capital market scenario. In India, the extent of research done on this area has been limited. If these models, when tested using data from Indian capital markets, are found to be having consistency over a medium to long term and providing risk-return trade-off, the investors – individuals and institutions – will be in a position to use these models for making investment decisions.
DATA

Data needed for the models based on fundamental analysis are company-specific financial ratios whereas for MPT models and the CAPM, market return and security returns are the main data needed. Given below is the list of data required for various models considered for the purpose of this study:

**Fundamental Models**

a) Variables like Sales, net profit, net worth, total assets etc.,  
b) Financial ratios such as debt-equity, return on net worth, net profit margin etc.,  
c) Per share statistics viz., earnings per share (EPS) dividend per share (DPS), Book value per share (BV) etc.,  
d) Other ratios calculated by using market price such as, price-earnings (p/e) ratio, price-book value (p/b) ratio, price-dividend (yield) etc.,

**Modern Portfolio Theory & Capital Market Theory:**

a) Rates of return of securities  
b) Rates of return of market proxy  
c) Variance or standard deviation of rates of return of securities.  
d) Variance or standard deviation of rates of return of market proxy.  
e) Covariance of Variance or standard deviation of rates of return of different combination of two securities.  
f) Covariance of Variance or standard deviation of rates of return of securities and market proxy.
Sample

As on March 31, 1996, there were more than 5000 companies listed on Bombay Stock Exchange. The following criteria are used to include the companies in the sample:

- High market capitalisation; and
- Frequency of trading.

Three years’ (1994, 1995 & 1996) average market capitalisation of around 1000 actively traded companies were calculated and a sample of 500 companies with higher market capitalisation were shortlisted.

Applying next criteria viz., availability of market quotes for at least 90% of the study period from April 1990 to March 1998 (i.e., total 96 months) resulted in final sample size of 200 companies.

The companies that were merged or amalgamated with other companies, shares that have been delisted since 1990 and sick companies were not considered for inclusion in the sample. Non-banking finance companies and investment companies are also not included as these companies generally have high debt-equity ratio. The companies, which were listed after 1990, are also not considered for the purpose of this study.

For generating portfolios and for comparing the performance under Decision models, companies with uniform year ending are considered. Applying this criterion resulted in the further reduction in the size of the sample to 125 companies having account closing in the month of March. Thus, the models based on Modern Portfolio Theory and
Capital Market Theory and Selection Models have a sample size of 200 companies whereas for Decision Models a sub-set of 120 companies' fundamental data have been used in this study.

Sources

a) Fundamental data of corporates viz., balance sheets and profit and loss accounts of all 200 companies and data on Dividend, rights, bonus and split issue details are sourced from CIMM package.

b) National Index (Natex), a broadbased index having 100 companies in its sample have been sourced from BSE Publications.

c) RBI Index and Interest Rates offered by banks on time deposits are taken from RBI Publication on Currency and Finance, Volume II.

Financial ratios, growth rates and returns on share and market index are calculated by using the data thus sourced.

Adjustment of Prices

Monthly prices of the scrips were adjusted for bonus, rights and split issues as well as for dividend payments. No adjustment in the prices was made for public issues of equity and debenture as well as warrant conversion. Post-issue share prices are adjusted prospectively from the month of the capital issues till the end of the study period i.e March 1998 by using an adjustment factor as follows:

\[ P_a = P_b \times \text{adjustment factor} \]
where

\[ P_a = \text{Price after issue} \]
\[ P_b = \text{Price before issue} \]

**Bonus & Split Adjustment**

Bonus and split issues do not call for any additional investment to be made by the investors. The factor used for price adjustment after these issues is computed as follows:

\[ \frac{X + Y}{Y} \]

where,

- \( X \) - No. of shares held before bonus / split issue
- \( Y \) - No. of shares after bonus / split issue

**Rights Adjustment**

The formula used for calculating adjustment factor for rights issue is somewhat different from the one used for bonus and split issues. Many options such as non-exercise of rights fully or partially by making additional investment, selling of rights entitlement in the market, full / partial exercise of rights by offloading existing shares, etc., are available to shareholders. Depending on the option chosen, the cum-rights price and the level of premium charged the rate of return on such issues varies and right adjustment factor is computed. The option of exercising the right to the fullest extent without making any additional investment has been found to be reflective of the terms
of rights issue. This is one option which captures the reality that the shareholders stand to gain by subscribing to rights if the issue price is lower than the market price; shareholders’ value gets reduced if the rights issue is overpriced.

Adjustment factor for rights issue is calculated as follows:

$$\frac{X \times IP + Y \times CR}{(X + Y) XR}$$

where,
- IP - issue price
- CR - share price with rights on
- XR - share price after rights

Basic assumption made in rights adjustment is that shareholders exercise their option to subscribe to rights share regardless of the level of the offer price.

**Adjustment for Dividend**

Total dividend (both interim as well as final) paid by the company in an accounting period has been assumed to have been received after 3 months from the date of book closure. Dividend received is treated as cash inflow in the hands of the investors and are included in the return calculation. Dividends received have not been used for the purpose of reinvestment. Adjusted prices were used to calculate expected returns, variance of returns and Betas. The period of study is from April 1990 to March 1998.
METHODOLOGY

1. SELECTION MODELS

a) Rating System:

Using the Selection Model, investment analysts would be in a position to shortlist securities from a universe on the basis of a set of desirable (undesirable) parameters that have been proved to be successful (unsuccessful) in the past. Under Ranking System, financial ratios of the companies included in the sample are ranked in the order of preference and the sum of these ranks has been considered for the selection of securities.

The methodology followed for rating companies are:

1. Selective financial ratios for 250 companies were considered for a period 1990 to 1994.
2. The average values for each of the ratios were calculated for this period (1990 to 1994). Average values are geometric averages of the financial ratios for the specified period.
3. The companies were sorted on the basis of each of the parameters independently. On the basis of each ratio a rank was assigned to the companies.
4. Final ranking is assigned by considering the sum of ranks based on each of the ratios.

For the purpose of testing, two ratios, viz., average book value and average gross profit margin during the period 1990-94 and 1991-95...
have been considered. Top 20 companies on the basis of sum of ranks have been formed as a portfolio.

b) Ranking System:

The methodology used for ranking companies for stock selection is given below:

1. Selective financial ratios for 250 companies were considered during the period 1990 to 1994.
2. The average values for each of the ratios were calculated for this period. Average values are geometric averages of the financial ratios for the specified period.
3. Companies were sorted in descending order on the basis of average financial ratio that was considered first. The companies so selected were further rated on basis of second financial ratio, then on third ratio and so on.
4. Finally companies were ranked considering the sum of all the ratings.

The performance of the portfolio was then tested over a period from May 1994 for 12 month holding period and 24 month holding period. Same methodology was followed for forming portfolios based on 5 year data period commencing from 1991 to 1995 and the results are evaluated.

The ranking system is more or less similar to the rating system described above. The difference is that in case of ratings all the parameters are applied to the whole set of companies while in case of ranking only the first parameter is applied to whole set of companies.
c) **Selection Based on Sorting:**

Growth rates of selective fundamental factors are considered and are expressed as ratios. The idea underlying the model is that if the growth rate of one variable exceeds (falls short of) another related variable, the share is identified as mispriced and the same is considered for investment/disinvestment. The ratios considered for the purpose of this study are:

i) Growth rate of net profit to assets

\[
\frac{\Delta \pi}{\Delta \Pi} = \frac{\pi}{\Pi}
\]

ii) Growth rate of net profit to net worth

\[
\frac{\Delta \pi}{\Delta N} = \frac{\pi}{N}
\]

iii) Growth rate of adjusted earnings per share to price

\[
\frac{\Delta EPS}{\Delta P} = \frac{EPS}{P}
\]

The first ratio analyses what percent of growth in assets has been financed through earnings whereas the second ratio depicts the extent of profit that is ploughed back in the business and its growth. The third ratio relates growth in earnings to appreciation/depreciation of share price. Considering each of these ratios, the companies in the sample are arranged in descending order. Of this, top 20 companies and bottom 20 companies have been selected and have been grouped into “buy portfolio” and “sell portfolio” respectively.
2. DECISION MODELS

a) Dividend Discount Model:

Under this, intrinsic value of a security is computed using discounted cash flow method. Cash flow from the share is total dividend paid out to the shareholders. Dividend per share of a company has been adjusted for bonus, rights and split issues from the year 1990 and growth rates have been calculated on adjusted dividend per share.

Two-period model is used for the purpose of computing intrinsic value of share. The assumptions underlying this model are:

i) Dividend per share is expected to grow at a constant rate during an initial period.

ii) After the initial period, the growth rate in dividend is assumed to be zero.

iii) Constant growth rate is based on average past growth witnessed by the company.

iv) Depending on the payback period an investor has in mind, the intrinsic values are computed.

The model has been designed in such a way that the investor can give three options about the payback period and a required rate of return. By applying a combination of constant and zero growth patterns the intrinsic values of securities are calculated and then compared with the market price.
Thus, the inputs needed for the computation of fair value and identifying mispriced securities are:

i) No. of previous years' data based on which growth rates are computed.

ii) Risk free rate of return, which is used for discounting dividend flows.

iii) The number of future years for which the share is expected to be held (in ascending order).

The formula used for the calculation is as follows:

$$\sum_{t=1}^{\text{n}} \frac{D_t}{(1+k)^t} + \left[ \frac{D_0 (1+g)^n}{k} \cdot \frac{1}{(1+k)^n} \right]$$

where,

$D_0$ = Dividend at current or initial period  
$k$ = Discount Rate  
$g$ = Growth rate in dividends

Three intrinsic values are calculated based on the specified growth period. These are then used for deciding buy/sell recommendations. The formula used for programming is:

$$a_1 = \frac{(1+mgdps^{nfy1+1})/(mgdps-mrsk_free)*1/(1+mrsk_free)^{nfy1}}{1+mgdps^{nfy1+1}}$$

$$a_2 = \frac{(1+mgdps^{nfy2+1})/(mgdps-mrsk_free)*1/(1+mrsk_free)^{nfy2}}{1+mgdps^{nfy2+1}}$$

$$a_3 = \frac{(1+mgdps^{nfy3+1})/(mgdps-mrsk_free)*1/(1+mrsk_free)^{nfy3}}{1+mgdps^{nfy3+1}}$$

$$b_1 = \frac{(1+mgdps)/(mgdps-mrsk_free)}{1+mgdps^{nfy1}}$$
\[ c_1 = \frac{(1 + \text{mgdps})^\text{fyr1}}{(1 + \text{mrsk\_free})^\text{fyr1-1}} \times \frac{1}{\text{mrsk\_free}} \]
\[ c_2 = \frac{(1 + \text{mgdps})^\text{fyr2}}{(1 + \text{mrsk\_free})^\text{fyr2-1}} \times \frac{1}{\text{mrsk\_free}} \]
\[ c_3 = \frac{(1 + \text{mgdps})^\text{fyr3}}{(1 + \text{mrsk\_free})^\text{fyr3-1}} \times \frac{1}{\text{mrsk\_free}} \]
\[ b_2 = \frac{1 + \text{mgdps}}{(\text{mrsk\_free} - \text{mgdps})} \]
\[ a_4 = \frac{(1 + \text{mgdps})^{\text{fyr1}+1}}{(\text{mrsk\_free} - \text{mgdps})} \times \frac{1}{(1 + \text{mrsk\_free})^\text{fyr1}} \]
\[ a_5 = \frac{(1 + \text{mgdps})^{\text{fyr2}+1}}{(\text{mrsk\_free} - \text{mgdps})} \times \frac{1}{(1 + \text{mrsk\_free})^\text{fyr2}} \]
\[ a_6 = \frac{(1 + \text{mgdps})^{\text{fyr3}+1}}{(\text{mrsk\_free} - \text{mgdps})} \times \frac{1}{(1 + \text{mrsk\_free})^\text{fyr3}} \]

If \( \text{mgdps} > \text{mrsk\_free} \)
\[
\begin{align*}
\text{mint1} &= (\text{madps} \times a1) - (\text{madps} \times b1) + (\text{madps} \times c1) \\
\text{mint2} &= (\text{madps} \times a2) - (\text{madps} \times b1) + (\text{madps} \times c2) \\
\text{mint3} &= (\text{madps} \times a3) - (\text{madps} \times b1) + (\text{madps} \times c3)
\end{align*}
\]
Else
\[
\begin{align*}
\text{mint1} &= (\text{madps} \times b2) - (\text{madps} \times a4) + (\text{madps} \times c1) \\
\text{mint2} &= (\text{madps} \times b2) - (\text{madps} \times a5) + (\text{madps} \times c2) \\
\text{mint3} &= (\text{madps} \times b2) - (\text{madps} \times a6) + (\text{madps} \times c3)
\end{align*}
\]

Where,
- \( \text{mgdps} \): Growth rate in earnings per share
- \( \text{madps} \): Earnings per share
- \( \text{mrsk\_free} \): Risk free rate of return
- \( \text{fyr1} \): No. of years considered for calculating intrinsic value 1
- \( \text{fyr2} \): No. of years considered for calculating intrinsic value 2
- \( \text{fyr3} \): No. of years considered for calculating intrinsic value 3
- \( \text{mint1} \): First intrinsic value
- \( \text{mint2} \): Second intrinsic value
- \( \text{mint3} \): Third intrinsic value

\( \text{fyr3} > \text{fyr2} > \text{fyr1} > 1 \)

When we set \( \text{fyr1} = 2 \)
In the first two years, growth rate in DPS is held to be constant and afterwards DPS is to remain constant. Suppose the DPS at time $t_0$ is 1. Growth rate = 20% and Discount rate = 10%.

<table>
<thead>
<tr>
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<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPS</td>
<td>1</td>
<td>1.2</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Intrinsic value 1 = 14.18

Keeping other assumptions unchanged, when we set fyr2 = 3

<table>
<thead>
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<th>Time</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPS</td>
<td>1</td>
<td>1.2</td>
<td>1.44</td>
<td>1.728</td>
<td>1.728</td>
<td>1.728</td>
<td>1.728</td>
</tr>
</tbody>
</table>

Intrinsic value 2 = 16.35

Similarly, when we set fyr3 = 4

<table>
<thead>
<tr>
<th>Time</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPS</td>
<td>1</td>
<td>1.2</td>
<td>1.44</td>
<td>1.728</td>
<td>2.0736</td>
<td>2.0736</td>
<td>2.0736</td>
</tr>
</tbody>
</table>

Intrinsic value 3 = 19.16

Fair values thus computed are compared with market price of the share. If the market price is lower than computed intrinsic value, the share is identified for investment and if the market price is higher than computed intrinsic value(s), the share is identified for disinvestment. With a short payback period, that is intrinsic value1, if a share is identified for investment / disinvestment, for long pay back periods, the decision will equally hold true. Thus, the buy/sell decision is categorised into four groups. They are:
**Very Strong Buy**: Market Price < Intrinsic value 1

**Strong Buy**: Intrinsic value 2 < Market Price < Intrinsic value 1; and

Intrinsic value 3 < Market Price > Intrinsic value 2

**Sell**: Market Price > Intrinsic value 3

**Strong Sell**: Market Price > Intrinsic value 1

There are certain periods/cases in which the growth rate computation is not mathematically possible and the intrinsic value cannot be worked out. These cases are identified separately and the system evaluates the security through other model(s).

The shares are grouped on the basis of decision categories into four portfolios. Individual securities and portfolios are taken as bought / sold as the case may be and their performance is evaluated during four testing periods.

b) **Earnings Discount Model:**

This model calculates intrinsic value by considering earnings per share as cash flow from a share. The formula employed for this purpose is:

\[
\sum_{t=1}^{n} \frac{E_t}{(1 + k)^t} + \left[ \frac{E_0 (1 + g)}{k} \star \frac{1}{(1 + k)^{n+1}} \right]
\]

where,

- \(E_0\) = Earnings at current or initial period
- \(k\) = Discount Rate
- \(g\) = Growth rate in Earnings
Like dividend discount model described above, this model needs past period growth rate in earnings per share adjusted for bonus, rights and split issues and a discounting rate as inputs. Intrinsic values based on expected pay back period are calculated and compared with market price to arrive at decision, which is graded on the basis of margin of safety as described earlier.

The performance of individual securities and portfolios thus selected are grouped under four categories viz., Very Strong Buy, Strong Buy, Strong Sell and Sell and are evaluated during the testing periods.

c) Price to Bookvalue Model:
Another variation in intrinsic value calculation is also considered for making investment decision. This variation considers two important financial ratios namely book value per share and return on net worth, instead of dividends or earnings. Net profit and Owners' Capital, when expressed on a per share basis, are Earning Per Share and Book Value respectively. When earnings and networth are considered, the general equation for intrinsic value computation can be restated in different terms:

\[ \frac{P}{b} = \frac{e}{b} \]

where

- \( P = \) book value per share
- \( e = \) earnings per share

Return on equity (r) is the ratio of net profit to equity, the same can be arrived at by dividing \( e \) by \( p \). By restating,
The intrinsic values computed are compared with market price to determine the desirability of including in or excluding a stock from the portfolio. The performance of the stocks selected has been evaluated in subsequent periods.

d) Regression Model:

This is based on Whitbeck & Kisor model. Under this model, at a given time period, the relationship between a set of independent variables (financial ratios) and a dependent variable (price or price - earnings ratio) is established and is used for spotting 'mispriced' securities. For the purpose of testing the model using data from Indian companies, two financial ratios viz., growth rate in adjusted earnings per share (ageps) and return on net worth (ronw) have been considered as independent variables and the P/E ratio has been taken as the dependent variable.

These variables of 120 companies are considered and regression analysis is used to find out the 'representative P/E'. By comparing the actual P/E of the companies with this 'representative P/E', the shares that have been underpriced or overpriced are identified and are bought or sold respectively. Two portfolios, 'buy portfolio' and 'sell portfolio' have been constructed in each of the testing periods and performance has been evaluated.
Performance Evaluation

The objective of analysing the performance is to assess how well the model employed for stock selection had been in realising desired results. This analysis is done to study how the model aids investors in

a) meeting investment goals; and
b) asset allocation.

A measure that is widely employed to assess the performance and in turn, to judge the effectiveness of investment decision is the rate of return earned on the funds employed over a period of time. The evaluation is done by comparing rate of return earned on securities with that of a benchmark, normally market index. As there is a risk-return relationship that is basic to capital markets, it is necessary to determine to what extent returns were commensurate with risk.

1. Selection Models:

Twenty shares are selected by applying Ranking and Rating model. A set of 25 'buy' and a set of 25 'sell' securities have been selected and made into two portfolios viz., 'buy portfolio' and 'sell portfolio' by applying Flexton model. Performance of portfolios selected has been evaluated by comparing the portfolio return with market return for holding period of one year.
2. **Decision Models:**

For evaluating the performance of individual securities and portfolios selected through different decision models the following analysis has been carried out:

<table>
<thead>
<tr>
<th>Individual Securities</th>
<th>Portfolios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return Basis</td>
<td>Return Basis</td>
</tr>
<tr>
<td>Risk Adjusted Return Basis</td>
<td>Excess Return Basis</td>
</tr>
<tr>
<td></td>
<td>Risk Adjusted Return Basis</td>
</tr>
</tbody>
</table>

Applying the models enumerated above on the sample of 120 companies which have an uniform accounting period ending in the month of March every year, the shares have been grouped into portfolios. Decision models based on discounted cash flow have been grouped into four portfolios as

a) Very Strong Buy  
b) Strong Buy  
c) Strong Sell  
d) Sell

Under cross–section regression model, 'buy portfolio' and 'sell portfolio' have been constructed.

In order to make assessment in terms of risk as well as return, the performance is measured in terms of return per unit of risk. There are two alternative methods of measuring returns per unit of risk. They are:
a) the reward-to-variability ratio developed by Sharpe, referred to as Sharpe Ratio; and
b) the reward-to-volatility ratio developed by Treynor, referred to as Treynor Ratio.

The Sharpe ratio considers total risk as measured by standard deviation but the Treynor ratio considers only market risk as measured by beta. Capital Market Theory has established that the total risk is an appropriate measure of risk for evaluating the risk-return relationship for well-diversified portfolios and when ranking portfolio performance. On the other hand, for evaluating the performance of individual stocks and not-so-diversified portfolios, a relevant measure of risk is beta coefficient. Hence, for portfolio performance evaluation Treynor ratio is considered in this study.

The securities selected and the portfolios formed are evaluated on the following lines:

i) **Evaluation of individual securities:**

Evaluation is done on the basis of composite return from the security, rather than on share price basis. Composite return from a security means capital appreciation / depreciation on a particular security during the holding period as well as the dividend received from holding the security and the bonus / rights / split shares received are also taken into consideration. In other words, share prices adjusted for capital issues and dividends are considered for return calculation as follows:
The return on a share thus calculated are then compared with return on market index viz., BSE 100. For the shares identified for 'buy/strong buy', if the return on shares are higher than return on market index, the decision to invest in the scrip has been taken as valid. The share had outperformed the market proxy and the same is indicated with the abbreviation "O/P". On the contrary, during the holding period, if the market returns exceed the return on the share that has been identified for investment, indicating underperformance and the same is indicated as "U/P". Similarly, for the 'sell/strong sell' shares, return on the share is compared with market return. If the share return is lower than index return, the flag given is "O/P" and vice versa.

**ii) Evaluation of Portfolios:**

In order to evaluate the performance of the securities collectively, portfolios have been formed (on the basis of decision categories) and the holding period return on portfolios is compared with that of market return. Also, excess rate of return on the portfolio (portfolio return minus risk free rate of return) is computed and compared with excess returns on market index (index return minus risk free rate of return). In addition to this, by considering monthly returns of the shares included in the portfolio, for the holding period, systematic risk is computed and Treynor ratio is used for performance evaluation.
Treynor ratio is defined as

$$\frac{R_p - R_f}{\beta_p}$$

where,

$R_f =$ Riskfree Rate of Return

$R_p =$ Rate of return on portfolio

$\beta_p =$ Systematic risk on portfolio

The risk-adjusted rates of return on portfolios are then compared with risk adjusted rates of return on market index.

The results of the models chosen for this study have been taken out for 4 sub-periods viz., May 1994, November 1994, May 1995 and November 1995. Taking into consideration the fact that there is sometime before the corporates publish their annual results and the fund managers to collect information, update the system and to carry out the transactions, the portfolios are formed and evaluation is done after two months of accounting period.

The individual securities and portfolios selected during the 4 sub-periods are assumed to have been held for periods of 12 months and 24 months and their performances have been evaluated on return basis and risk adjusted return basis.

In case of all four portfolios, the evaluation is done on the basis of a) Return b) Excess Return c) Risk Adjusted Rate of Return, using Treynor ratio. Each of these decisions have been marked either “O/P” or “U/P” on the basis of comparative performance of securities/portfolios vis-à-vis the market index.
3. ELTON & GRUBER MODEL:

This is a simple mathematical model, which optimizes risk and return based on single index model. This model is based on the presumption that if there were a single number that measured the desirability of including a stock in the optimal portfolio the process of portfolio selection would be widely put into use. The desirability index chosen by the model is to rank stocks by 'excess return to beta' ratio. The model calculates a unique cut-off ratio and all the stocks with ratios higher than the cut off ratio is included in the portfolio.

For the purpose of testing the model, closing prices of 250 companies traded on the Bombay Stock Exchange during the period 1990 to 1998 have been considered. The stock returns needed for beta calculation and excess return computation are reckoned after adjusting the share prices for capital issues like rights, bonus and split issues and dividend payments.

The model requires following inputs:

a) The risk free rate of return for the purpose of computing excess return from a security.

b) The number of past months data needed for calculating historical betas that are used for portfolio optimization.

c) The period from which the past month data to be considered, say from April, 1990, to October 1996 etc..

d) The number of months for monitoring the performance, this is \( t_2 \) to evaluate the performance of model.
The model considers BSE 100 index as the proxy for the market index and by correlating index returns with stock returns for the selected period calculates the beta on the shares. The stocks with negative returns or with negative excess returns are not considered for portfolio selection by the model. In other words, the excess return is always positive and then the ratio of excess return to beta is maximized subject to a constraint that the sum of the proportion invested in individual securities equal to one.

The model is tested on the following basis:

a) Sample data considered for computing historical betas were for 48 months.

b) Risk free rate has been taken as 10% p.a

c) The portfolios so selected were monitored during a holding period of 12 months and 24 months.

In this study, results of following five optimal portfolios selected by the model have been incorporated.

<table>
<thead>
<tr>
<th>PORTFOLIO</th>
<th>FORMATION PERIOD</th>
<th>GENERATION PERIOD</th>
<th>EVALUATION PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>APRIL 90 – MARCH 94</td>
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4. CAPITAL ASSET PRICING MODEL

Most of the empirical studies testing the efficiency of equilibrium model employ an instrumental variable, which is the beta for each security in the previous time period (t-1) for forming portfolios. The reason being the high correlation this instrumental variable would have with the true beta in time period t. In order to avoid bias in portfolio selection, observed betas have been used for forming portfolios in this study as well.

Betas can be calculated in either of the two forms given below:

1. By using time series regression to find out associationship between
   \textit{excess return on securities and excess return on the market index}.

2. By regressing of time series \textit{returns on security on returns on index}
   which is considered as a proxy for market portfolio;

If risk free rate is constant over the period, betas calculated under both the forms given above would be similar. However, in the liberalised setup, market forces determine interest rates on risk free securities, thus forcing frequent changes in the rate levels. Miller and Scholes showed that betas should be estimated in the form similar to the CAPM testing. For instance, if the framework for testing involves using the excess return (R_t - R_f) as dependent variable, betas should be estimated using excess return form.
There are two obvious advantages for testing the CAPM by forming portfolios based on beta rankings. First, it is possible to have wide range of betas against which returns can be compared; the second and the most important usage is that error in beta estimation is substantially reduced when individual securities are combined into a portfolio, as positive and negative errors in individual security's estimates cancel out due to aggregation. In this study, empirical testing has been done by forming portfolio which are overlapping and non-overlapping. That is after sorting all the 200 companies' scrips included in the sample by beta in time period t-1, they are grouped either into deciles (with 20 scrips each) or 20 groups of ten scrips each to form non-overlapping portfolios. It is also possible to form portfolios, by leaving some securities with very high and very low betas, which would be on overlapping basis. Similarly, the period considered for beta estimation may be overlapping or non-overlapping.

Thus, in this study, portfolio betas are estimated by using the following combinations:

I. Portfolios based on non-overlapping betas computed during non-overlapping periods;
II. Portfolios based on overlapping betas computed during overlapping periods.
III. Portfolios based on non-overlapping betas computed during overlapping periods;
IV. Portfolios based on overlapping betas computed during non-overlapping period viz. 32 months period (i.e. from August 95 to March 98).
Betas estimated on return as well as excess return form are used to make combinations mentioned above. This exercise is aimed at finding out how the fluctuations in risk free rate affects the risk-return equilibrium framework.

Once portfolio betas are estimated under above-mentioned combinations, the CAPM test is done in two types:

1. *Predictive Model*, where the associationship between portfolio betas in time period $t$ and returns in time period $t+1$ is tested.

2. *Non-Predictive Model*, where associationship between both risk and return at time period $t$ is tested.

If the market portfolio is the minimum variance portfolio and is positioned on the efficient set, the relationship between estimated betas for individual stocks / portfolios is exactly linear. Thus, the properties of security market line were tested by using 't' test.