Summary, Conclusions and Suggestions for Future Research
VI
Summary, Conclusions and Suggestions for Future Research

This chapter showcases a reflection of the research work presented in this thesis. The use of complex programming techniques, latest research software and integration of multiple factors describing investor’s desires is able to tap the requirements of an investor from a portfolio beyond mean and variance. An investor while attempting to minimize risk is faced with a variety of constraints like earning good returns, dividends, earnings per share, company and industry diversification. Investors also want liquidity from their portfolio, substantial interest of promoter’s and other institutions in the script, adequate market capitalization and free float factor for their portfolio. An attempt has been made to incorporate all these considerations of an investor for developing and testing of a mean-variance efficient model for portfolio selection.

Improved access to databases for financial time-series data and availability of software capable of performing complex computations in lesser time is contributing in enhancing the quality of research in the area of portfolio selection. The mathematical sophistication in understanding and application of these techniques is imperative for creation of an algorithm to select efficient portfolios. The rational behaviour and real behavior of an investor may not be the same. The need for a balanced portfolio giving the investor, protections and opportunities for a wide range of contingencies provided the initial motivation for this research work. Possible improvements in the existing portfolio selection modeling framework is attempted by optimizing across multiple constraints.

In Indian Capital Markets, there has been introduction and promotion of a large number of financial and technological innovations introduced by the Securities and Exchange Board of India (SEBI) as well as the exchanges. The emerging issues of algorithmic trading, wireless trading, co-location, smart-order routing, high frequency trading and programming interface with the ever changing technology are gaining pace. The minimum public shareholding requirement of the regulator leading to either excess supply of securities or non compliance by companies may hamper the image of our
capital markets. Incorporation of changes in risk management of the cash and derivatives segment, co-ordination between the regulator and Institute of Chartered Accountants of India (ICAI) for improving the disclosures and accounting standards, clearing the interoperability issues between the two stock exchanges, assessment of impact of investor education initiatives and measures for safety of investor in mobile trading arena are an impending task for all stakeholders of the Indian Capital Markets.

Portfolio creation software is being increasingly used by large institutional investors such as mutual funds and pension funds to assist them in asset allocation across diverse asset classes. Database management module, input coefficient calculation module and optimization module are required for this software to work. Considerable experimentation is needed to achieve an efficient asset allocation.

A widespread interest of business and academic community in Portfolio Selection is witnessed from the growing amount of available literature in this area. This highlights the importance of investor’s investment decision especially after the financial crisis. Mean–variance efficient frontier introduced over sixty years ago by Roy (1952) and Markowitz (1952) and extended by researchers worldwide to include different measures of risk, multi-period analysis, additional variables and constraints serves as the foundation for this research study. Despite a large number of empirical studies in the area of market efficiency and Capital Asset Pricing Model (CAPM), there has been a dearth of research in analysing mean-variance efficient portfolio selection. This research work tries to integrate the existing studies on mean-variance efficient portfolio selection models and extends them using a mathematical programming technique and by incorporating some emerging important security variables in the Indian Capital markets.

Portfolio selection has witnessed use of complex mathematical and quantitative techniques over the years such as polynomial time algorithms, numerical algorithms, structure exploiting algorithms, goal programming, quadratic programming, dynamic programming, decision tree approach, regression equations, multivariate GARCH, impulse response functions, Hilbert space theory, Martingale theory, Bayesian inferential procedures, fuzzy techniques and many more. The studies on efficient frontier are progressing by including utility optimum bounds, alternate variance measures and latest quantitative techniques. However, restrictive assumptions of many
of these models, their mathematical complexity and ignorance of simultaneous inclusion of multiple constraints are hindrances in their testing and applicability.

The studies on diversification indicated the benefits of diversification and evidence of poor performance related with over diversification. Portfolio optimization and variance-covariance based studies hinted at model extensions to include preferences of different types of investors and their real-life constraints. Model formulations incorporating behavioral finance aspects such as disposition effects and repeating habits were perhaps missing. The fast processing and absorption of information effects in the derivatives market have not been included in equity portfolio selection models for spot markets as yet.

In spite of the recent modeling innovations, the mean-variance model introduced by Markowitz in 1952 and further investigated in his research papers and books is still the best known literature on portfolio selection. The mean-variance approximations provide almost maximum expected utility. It is the starting point for many other models. Despite extensive research, it is still not easy to compute a mean–variance (MV) efficient frontier even when all constraints are linear. This is particularly true of problems having dense covariance matrices. Although, the mean–variance efficient frontier of a Markowitz’s problem is a continuous curve, it is rarely rendered as such. Rather, efficient frontiers are customarily shown in the form of dotted representations (ten point, twenty point etc).

An attempt has been made to ease the portfolio selection decision of investors by understanding their desires and limitations. The multiple goals and constraints provide the direction for development and testing of a mean-variance efficient portfolio selection model which optimises across multiple constraints simultaneously. The explanatory power of various equity variables which have been studied in isolation so far has been integrated in this research work. Industrial and company diversification has also been achieved to the extent of twenty and fifteen percent respectively. The preferences of different types of investors have been accommodated by empirical investigation of the model for eight portfolio selection model formulations. An attempt to reduce the gap that exists between theory and application has been made by testing the model on the National Stock Exchange’s Nifty fifty securities.
With securities data now widely available at the stock exchanges, Centre for Monitoring of Indian Economy (CMIE) database PROWESS, and investors open to the consideration of increased number of opportunities for creating optimal portfolio, portfolio programming assumes significant importance. Selection of a wrong optimizer may often result in loss of time and money. Using a wrong optimizer in absence of comparative computational experience might lead to non computation of an efficient portfolio which could have been computed with a different optimizer perhaps in some more time. This research work is an attempt to fill this gap and provide a frame of reference for those who find themselves confronting with portfolio selection problems.

VI.1 Model Development

An attempt to answer to the problems of an investor progressing towards achieving the objectives set according to his/her aspiration levels and minimizing the risk of his/her portfolio has been made. A mean-variance efficient portfolio selection model in which the distributions are characterized by a series of statistical variables like the expected value, the variance, beta, impact cost, dividend, earnings per share, net profit, institutional holding, promoter’s holding, unsystematic risk, price-to-earnings ratio, price to book value ratio, volume, turnover, sales, industrial and company diversification has been proposed.

The multi-objective portfolio selection problem has been transformed into a single objective function in which the variance of a portfolio is minimized while constraints are imposed on the other variables. A tractable problem from the computational point of view has been framed. Alternate portfolio selection model formulations are exhibited to simulate various scenarios with realization of discrete random variables. These model formulations are solved using the quadratic programming approach. The efficient solutions generated are Pareto-optimal such that one statistic cannot be improved without worsening off the other. The particular mean-variance efficient solutions of the proposed model are not dominated only with respect to minimum variance.

VI.1.1 A General Model

In all thirty portfolio selection constraints have been incorporated in the theoretical model. The constraints of funds exhaustion, no short sales and upper bounds
are the classical constraints present. Many new constraints are added accommodating for the needs and limitations of a present day investor. Desire for capital returns and dividend gains by the investor are modelled as constraints. Minimum volume, turnover and impact cost (a new variable available from National Stock Exchange’s official website) are added as constraints to tackle investor’s desire for a liquid portfolio. Industrial diversification and company diversification constraints are added to achieve a diversified portfolio.

The objective of high earnings from a portfolio are incorporated by including constraints on accounting figures and ratios such as net profit, sales, earnings per share, price-earnings ratio and book to market ratio. Investors are also interested in securities where other stakeholder’s interest is substantive. Promoter’s shareholding and institutional shareholding constraint are added to take care of this desire. The lead-lag relationship between the spot market and derivatives market and its effect on the equity portfolio selection is assimilated through the open interest constraint, volume and turnover of futures of the security constraint. Extremely small fractions of shares in the portfolio lead to high transaction costs and must be avoided. Hence, lower bounds have been introduced. Availability of data and programming limitations led to exclusion of a few of these constraints during empirical testing of the model.

VI.1.2 Alternate Portfolio Selection Model Formulations

The model is tested on real data drawn for the Nifty 50 securities for a period of twelve financial years starting from 2000 to 2012. An analysis of the return distribution of the chosen securities and the Nifty index is presented. The security returns were checked for normality. Very few securities had kurtosis equal to or nearing three, thereby representing non normal series of returns. This is a common phenomenon for financial time series data.

Eight portfolios formulations namely diversifier’s portfolio, satisficer’s portfolio, plunger’s portfolio, market trend portfolio, capital gain bias portfolio, dividend gain bias portfolio, equal priority portfolio and the ideal portfolio were created for investors with different priorities and risk appetite. The no short sales constraint, funds exhaustion constraint, company diversification/upper bounds constraint and
industrial diversification constraint of fifteen percent and twenty percent respectively, were common for all the formulations.

The model seeks to achieve the most important objective of an investor i.e. risk minimization for the different categories of investors. Not only this, variance is minimized simultaneously achieving more than or equal to targeted levels of other important portfolio variables such as earnings per share, dividend, promoter’s holding, institutional holding, impact cost, turnover, volume etc. This was witnessed with the presence of surplus values for the constraints in most of the model solutions.

The diversifier’s portfolio depicts an investor with smaller risk bearing capacity. The target values of the variables namely return, beta, dividend, earnings per share, free float, impact cost, institutional holding, market capitalisation, net profit, price to book value ratio, price to earnings ratio promoters holding, sales, turnover, unsystematic risk and volume were set at their Q₁ (quartile one) levels. The portfolio got diversified across fourteen companies and twelve industrial sectors. The portfolio in addition to being mean-variance efficient achieved the target dividend returns, beta, liquidity, market capitalisation and the other constraints. A small portfolio variance of 0.187 was observed.

The satisficer’s portfolio is for an investor with moderate risk appetite. The target values of all the programmed variables were set at their median levels. It got diversified across fifteen companies and twelve industries. Funds exhaustion constraint showed a significant dual price indicating a further reduction in variance by allowing for borrowing and lending of funds for creation of portfolios. Risk (variance) of portfolio was 0.316 for a return of 0.605.

A plunger’s portfolio with targets set at Q₃ (quartile three) values of variables was formulated for a class of investors having extremely high risk bearing capacity. They desire very high levels of return, dividend, net profit, free float, volume, turnover, price to book value ratio, price to earnings ratio, beta, other stakeholder’s interest and are willing to bear a high degree of risk for this. No feasible solution could be generated for this model formulation. Even after more than eleven lakh iterations of the extended global solver of programming software Lingo 13, the problem could not be solved. The model debugger was run to find the constraints leading to this infeasible solution. The institutional holding constraint, promoter’s holding constraint, no short selling
restriction on thirty three securities and upper bounds on twelve of them were found to be the necessary and sufficient rows causing the infeasibility.

A market trend portfolio which aimed mean values for all the modelled variables was created. Mean rather than mode was chosen to describe the market trend as no single value was repeating itself in most of the series of variables. It was also a well diversified portfolio with investment in eighteen companies across thirteen industrial sectors. The average weight of each security was found to be 5.55%. The smallest returns (among all model formulations) of 0.52 percent per month were observed for this portfolio with risk at a level of 0.364.

The capital gain bias portfolio depicts an investor who aims at a very high level of capital returns, beta, earnings per share, net profit, price-to-earnings and price to book value ratios targeting $Q_3$ (quartile three) values and is satisfied with a $Q_1$ (quartile one) level of dividend return. Also, the targets for variables such as free float, institutional holding, market capitalisation and sales are set at their median values. Such an investor seems to be more of a speculator aiming at quick returns and not regular income from trading in stock market. This portfolio which diversified across twelve companies and ten industries was found to have the maximum risk (1.07) among all the portfolio selection model formulations. Surprisingly, high dividend returns were also realised on this portfolio.

The dividend gain bias portfolio has been created for an investor desiring very high levels of regular income in the form of dividends. The dividend constraint was set at $Q_3$ (quartile three) level whereas returns, beta, earnings per share, impact cost, market capitalisation, price to earnings ratio and price to book value ratio constraints were set at $Q_1$ (quartile one) level. Other constraints namely free float, institutional holding, promoter’s holding, sales, turnover and volume were set at their median values. The portfolio diversified across sixteen companies and twelve industrial sectors. A risk of 0.206 for 0.55 levels of returns was achieved for this portfolio.

The equal priority portfolio gave same priority to capital returns as well as dividend income aiming at $Q_3$ (quartile three) levels for both of these variables. A high degree of capital gain returns and dividends are desired with lesser emphasis on beta, earnings per share, free float, impact cost, institutional holding, market capitalisation, net profit, price to earnings ratio, price-to-book value ratio, promoter’s holding, sales,
The portfolio diversified across seventeen companies and twelve industrial sectors. The average weight of each security was found to be 5.88 percent. A risk-return combination of 0.322 (variance) and 0.63 (return) was achieved.

The ideal portfolio was created with lesser number of constraints. The important constraints were identified from the results of the multiple regression and granger causality tests. Returns, dividend and impact cost found to be of utmost importance to an investor were aimed at high Q₃ (quartile three) level. Institutional holding of 31.13% was desired. Net profit, promoter’s holding, sales, turnover and volume constraint were targeted at median levels. The constraints of beta, earnings per share, free float, market capitalisation, price-to-book value ratio, price earnings ratio and unsystematic risk were removed from the problem as they were not found to significantly explain returns. The average weight of each security was found to be 7.69 percent with the portfolio diversifying across thirteen companies and twelve industrial sectors.

A graphical comparison of the risk-return combinations of all portfolios along the twenty point Markowitz’s efficient frontier showed that the risk-return combinations of the ideal portfolio were lying closest to the Markowitz’s portfolio. All the modelled portfolios lie below the Markowitz’s frontier, but all of them except one (capital gain bias portfolio) were quite close to it. The returns generated by ideal portfolio were extremely near to those of the Markowitz’s portfolio with their risks being the same. This closeness of the two portfolios has been further investigated through tests of equality on yearly data.

VI.1.3 Multiple Regression Analysis

Multivariate regression analysis has been undertaken to identify the variables which have the significantly high explanatory power to estimate expected returns. Two multiple regression equations were estimated, one with returns as the dependent variable and the other with excess return to standard deviation ratio as the dependent variable. The list of regressors included earnings per share, dividend, free float, impact cost, institutional holding, market capitalisation, net profit, price to book value ratio, price-earnings ratio, promoter’s shareholding, sales, turnover, unsystematic risk and volume.
Beta has been intentionally excluded from the regression analysis due to its known significant power to explain the cross section of returns.

A new explanatory variable, impact cost emerged in regression analysis as possessing significantly high explanatory powers for predicting security returns and Sharpe ratio. Liquidity of a portfolio is of prime importance to the investor. The other important explanatory variables included institutional holding, promoter’s holding and turnover. The stake of other prominent parties in the shareholding also forms an important investment factor. The graphical representation of estimated equations attempted through actual, fitted and residual graphs showed the model to have a good fit as the actual values were quite close to fitted values and residuals were small. Also, the model forecasted returns showing small Theil inequality coefficient of 0.21 and 0.34 implied a good fit of forecast model.

VI.1.4 Granger Causality Interpretations

Causation between returns on a security and the variables set as constraints in the programming problem were tested using Granger causality tests. High probability values were observed for null hypotheses of no causation between security returns and dividend, impact cost, net profit, promoter’s holding, sales and volume. Thus, one cannot reject the hypothesis that dividend, impact cost, net profit, promoter’s holding, sales and volume do not cause returns. These factors assume importance in portfolio selection modelling due to their explanatory power for returns. The tests rejected null hypothesis of no causation amongst the other paired variables.

VI.1.5 Portfolio Utility Analysis

The concept of Portfolio Utility introduced by Markowitz’s and has been applied in this monograph. The portfolio utility analysis attempted to empirically find that the utility derived by the investor from alternate portfolios is different for changing levels of risk tolerance. Utility of Markowitz’s portfolio, ideal portfolio and the index portfolio have been calculated for the risk tolerance levels of ten percent to ninety percent. A direct relationship between the degree of risk tolerance and the value of portfolio utility was found.

The Index portfolio Nifty 50 yielded the maximum utility of 0.7 at the highest risk tolerance level of hundred percent and least utility (-4.79) at lowest risk tolerance
level of ten percent. At moderate levels of risk tolerance (30%-60%) the utility of Markowitz’s portfolio is the highest, closely followed by Ideal portfolio. From risk tolerance level of 70% onwards, the index portfolio gives a higher utility than the Markowitz’s portfolio and Ideal portfolio. However, the volatility in utility of Index portfolio is higher than that of Markowitz’s portfolio or Ideal portfolio. It may be concluded that the portfolio utility of index portfolio is least at small risk tolerance levels and highest for higher risk appetite investors than the Markowitz’s portfolio.

The intersection of utility curves and portfolios in the risk-return space determined the portfolio choice of a particular category of investor (plunger, diversifier, risk neutrals and risk lovers). The plunger was found to prefer the index portfolio. Four portfolios namely ideal portfolio, Markowitz’s portfolio, satisficer’s portfolio and equal priority portfolio all lie on the highest utility curve (U3) with a higher level of utility. The diversifier will choose the index portfolio Nifty 50. The diversifier’s portfolio and dividend gain bias portfolio lying on utility curve U3 provided equal utility to this investor. The Markowitz’s portfolio and ideal portfolio should also provide the same and a higher utility as was shown by drawing another utility curve U4. The capital gain bias portfolio and index portfolio Nifty was preferred by risk lovers. The capital gain bias portfolio also yielded highest utility for the risk-neutral investor as shown in the graphical analysis.

VI.1.6 Performance Evaluation of Portfolios

The performance evaluation of all these portfolios is attempted by using Sharpe ratio (1966) and Treynor ratio (1965). Portfolios are then ranked and arranged in descending order of their performance. The Sharpe ratio was found to be the highest for Markowitz’s portfolio followed by the ideal portfolio. The other portfolios in decreasing order of their performance were equal priority portfolio, satisficer’s portfolio, dividend gain bias portfolio, diversifier’s portfolio and capital gain bias portfolio. The market trend portfolio performed the worst according to this performance measure.

When evaluated according to Treynor’s ratio the ideal portfolio performed the best, even better than the Markowitz’s portfolio. Equal priority portfolio, capital gain bias portfolio and satisficer portfolio also performed quite well. Dividend gain portfolio and diversifier’s portfolio showed small ratios hinting at this portfolio’s poor
performance. As per Treynor’s ratio also, the market trend portfolio was found to be the worst performer reporting the least ratio of only 0.02.

VI.1.7 Tests for Equality: Main Findings

To further investigate the equivalence of returns, variance and utility of the ideal portfolio with the Markowitz’s portfolio, a yearly analysis has been conducted. Portfolios for the twelve years with yearly revision are constructed as per Markowitz’s model and mean-variance efficient ideal portfolio model. The risk-return trade-offs of these portfolios are identified. No surpluses in returns (than the values targeted) were generated in any of the portfolios in any of the years. The variance achieved in Markowitz’s portfolio was little lesser than ideal portfolio for all these years.

Further investigations into the proximity of risk-return trade-off and portfolio utility in the Markowitz’s portfolio, ideal portfolio and index portfolio were attempted through the tests of equality. The tests for equality of returns, variances and portfolio utilities of these portfolios were conducted. Five null hypotheses of equality of (1) returns of ideal portfolio and index portfolio; (2) variance of ideal portfolio and Markowitz’s portfolio; (3) variance of ideal portfolio and index portfolio; (4) utility of ideal portfolio and Markowitz’s portfolio and (5) utility of ideal portfolio and index portfolio were tested. The same level of returns were targeted and achieved for Markowitz’s portfolio and ideal portfolio, hence no testing was done for this.

By analysing the t-test and ANOVA F-statistic values and probability figures, null hypothesis of equality of returns from ideal portfolio and index portfolio could not be rejected. Also, tests statistics could not reject the hypothesis of equality of variance of the ideal portfolio and Markowitz’s portfolio. The variance of Index portfolio however could not be considered equal to that of the ideal portfolio. The tests for equality of portfolio utility found that the utility of ideal portfolio and the Markowitz’s portfolio on one hand and ideal portfolio and index portfolio on the other could be considered equal. The ideal portfolio created by identifying important portfolio variables not only meets the Markowitz’s mean-variance efficient criterion but also taps the dynamic changes in the stock market represented by multiple constraints. It tries to maximise the utility of an investor by meeting their objectives in a multiple constraint setting.
VI.2 Conclusions

As a final remark, it may be noted that the proposed model does not dismiss mean-variance or any other portfolio selection models, but on the contrary, it ‘embeds’ them. The model formulations developed in this thesis complements the existing literature by adding to it. They are not a substitute to any of the existing portfolio selection model. The solutions of proposed model are efficient not only in the mean-variance sense but also for the list of constrained variables studied. The formulated portfolios achieve the minimum risk for a targeted level of returns, eps, dividends, price-to-earnings ratio, price-to-book ratio, beta, unsystematic risk, free float, market capitalisation, impact cost, volume, turnover, institutional and promoter’s holding. Thus, the proposed model makes a ‘positive’ discrimination between mean-variance efficient solutions and mean-variance efficient solutions with efficiency for other constrained variables. In making the final choice, the personal preference of the decision-maker as depicted by their utility curves plays a key role in portfolio selection.

The proposed model is tested on real data drawn for the Nifty securities for a period of twelve financial years starting from 2000 to 2012. Eight portfolios formulations namely diversifier’s portfolio, satisficer’s portfolio, plunger’s portfolio, market trend portfolio, capital gain bias portfolio, dividend gain bias portfolio, equal priority portfolio and the ideal portfolio were created for investors with different priorities and risk appetite. The objective of risk (variance) minimization is achieved by optimising across other important portfolio variables such as earnings per share, dividend, free float, impact cost, institutional holding, market capitalisation, net profit, price to book value ratio, price-earnings ratio, promoter’s shareholding, sales, turnover, beta, unsystematic risk and volume simultaneously. All the portfolios created were compared with the Markowitz’s efficient frontier in the risk-return space. Ideal portfolio was found to be the closest to the Markowitz’s portfolio.

Two main multiple regression equations have been estimated with returns and excess returns to standard deviation as the dependant variables. Regression models explained the relevance of a new variable namely impact cost having significant explanatory powers for predicting security return and Sharpe ratio. Granger causality test was undertaken to find out the relationship of causation between returns on a security and the variables set as constraints in the programming problem. The null hypothesis that dividend, impact cost, net profit, promoter’s holding, sales and volume do not cause returns could not be rejected.
The portfolio utility analysis was undertaken to empirically find the utility derived by an investor from alternate portfolios for changing levels of risk tolerance. A direct relationship between the degree of risk tolerance and the value of portfolio utility was found from the quantitative analysis. The portfolio selection model formulations were plotted in the risk-return space along with the utility curves to find the optimal portfolio choice for different types of investors. The evaluation of the alternate portfolio selection model formulations is attempted by using Sharpe ratio (1966) and Treynor ratio (1965). The Sharpe ratio is the highest for Markowitz portfolio followed by the ideal portfolio. The ideal portfolio performed the best, even better than the Markowitz portfolio when evaluated according to Treynor’s ratio. Tests of equality of mean, variance and portfolio utility for ideal portfolio, Markowitz portfolio and index portfolio were conducted to investigate the proximity of these portfolios.

The mean-variance model formulated and applied in this research work will be of immense use for the Indian investors both individual and institutional, brokerage houses, mutual fund managers, banks, high net worth individuals, portfolio management service providers, financial advisors, regulators, stock exchanges and research scholars in the area of Portfolio Selection.

VI.3 Suggestions for Future Research

Research is a never ending, ongoing and continuous process. It is objective and does not vary as per the perspective of a researcher. This research work may be carried forward in a variety of ways. The mean-variance efficient portfolio selection model formulated in this study can be extended to include all the companies listed on the National Stock Exchange. The same formulations can be tested using daily/ minute by minute real time data available at a price from the stock exchanges. Also inclusion of variables such as transaction costs, risk penalty, portfolio utility, conditional volatility etc. which were excluded due to data limitations can be attempted in future. A strong lead-lag relationship of derivatives market and the stock markets has been observed by researchers in Indian Capital Markets. Inclusion of this effect of the derivative markets on the cash segment would certainly improve the predictability of equity portfolio selection models. Hence, attempts to include variables from the derivative segment such as open interest, price of futures, price of call/put options, volume and turnover of derivatives of securities may be attempted in future.
Endnotes

1 Efficiency defined in terms of either lower variance at the same level of mean return or higher mean return at the same level of variance.

2 “Rajiv Gandhi Equity Saving Scheme to allow for income tax deduction of 50 per cent to new retail investors, who invest up to Rs. 50,000 directly in equities and whose annual income is below Rs. 10 lakh to be introduced. The scheme will have a lock-in period of 3 years.”

3 “Smart Order Routing (SOR) is used by stock brokers/clients to determine the ‘best venue’ to execute an order, i.e., ‘where’ to execute the order, based on client specified criteria like best price, liquidity, etc. SEBI has permitted SOR in Indian securities market for all classes of investors. SOR has been envisaged as a mechanism to provide ‘best execution’ to the investors. It allows the brokers trading engines to systematically choose the execution destination based on factors viz. price, costs, speed, likelihood of execution and settlement, size, nature, etc.”


5 Mr. Mark Wiley (LINDO Systems, Inc, USA) provided research licence for access to the evaluation copy of LINGO 13.0 used for quadratic programming portfolio selection optimisation in chapter V of this thesis.


9 Markowitz (1952).


13 Under the Institutional Placement Programme (IPP), a company can either by fresh issue of shares or by dilution of promoter's shareholding increase their public shareholding. Bidding through Applications supported by Blocked Amount (ASBA) is mandatory and offers can be made only to Qualified Institutional Buyers (QIBs) with 25% reserved for mutual funds. Also minimum of 10 allottees should be there with no allottee getting more than 25% of the offer size.
An Offer for Sale (OFS) is a special window of stock exchanges made available to promoters and promoter group for selling their stockholding. OFS facility is only available to either the noncompliant companies or the top 100 companies as per market capitalisation. A separate trading window is provided under OFS. The bids are supposed to be supported by 100% cash margin in case of non institutional investors and 25% in the case of the institutional investors. The appointment of one or more BSE/NSE registered brokers is mandatory to carry out the OFS. However, the appointment of a merchant banker is optional. The only limitation of OFS is that the issue size should be Rs. 25 crores or less only if undertaken to meet the minimum public shareholding requirement.

Public financial institutions as specified in section 4A of the Companies Act, scheduled commercial banks, mutual funds, Venture Capital Funds (VCFs), Foreign Venture Capital Investors (FVCIs) and Authorised Investment Funds (AIFs) registered with SEBI, Foreign Institutional Investor (FIIs) and sub-account registered with SEBI (other than a sub-account which is a foreign corporate or foreign individual), multilateral and bilateral development financial institutions, state industrial development corporation, insurance company registered with Insurance Regulatory Development Authority (IRDA), provident fund with minimum corpus of Rs. 25 Crores, pension fund with minimum corpus of Rs. 25 Crores and National Investment Fund set up by the Government of India, insurance funds set up and managed by army, navy or air force of the Union of India and insurance funds set up and managed by the Department of Posts, India.

Resident Indian individuals, Eligible Non Resident Indians (NRIs), Hindu Undivided Family (HUFs in the name of Karta), companies, corporate bodies, scientific institutions societies and trusts, sub-accounts of Foreign Institutional Investors (FIIs) registered with SEBI which are foreign corporate or foreign individuals and Eligible Qualified Investors (QFIs).

Resident Indian individuals, Eligible Non Resident Indians (NRIs) and Hindu Undivided Family (HUFs in the name of Karta).

Return formula \( E = \sum_{i=1}^{n} X_i \mu_i \) and Risk Formula \( V = \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_{ij} x_i x_j \)

Kindly see Markowitz 1952, 1959.

The analysis was deliberately limited to choice among monetary assets.

Capital Asset Pricing Model (CAPM).

See Samuelson 1963.

This is the standard error of estimate of the regression on external index of business conditions.

Earlier recognized by Mandelbrot (1966) and Samuelson (1965).
The research paper titled, “Recent Advancements in Theories and Empirical Studies on Portfolio Selection” was presented at 13th West Lake International Conference on Small and Medium Business (WLICSMB 2011) organized by Economic Commission, Hangzhou Municipal Government, Zhejiang Provincial Institute of Small and Mid-sized Business and College of Business Administration, Zhejiang University of Technology, October 15th -17th 2011, Hangzhou, China. The comments and suggestions of the participants have been incorporated.

Expressed as a ratio of foreign assets to total assets.


These are stocks of eight large Category A companies in the industry.

This reflects the possibility of estimation error unlike classical mean-variance models of point estimates of returns or Bayesian models with single prior parameters neutral to uncertainty.

Such as Futures and Options in the Indian context.

Expected shortfall puts a linear penalty on returns below a reference point. Earlier used by Benartzi and Thaler (1997).


Pertaining to a non-negligible trading cost.

Value line’s timeliness rankings, group stocks as per their expected price performance for the next twelve months.

This refutes Roll’s Critique (1977).

With specification similar to Lakonishok and Lee (2001).

The intratemporal utility is given by adding a log function (Houthakker, 1960). The household’s utility function has a higher curvature over basic good than a luxury good denoting a decreasing relative risk aversion.

Denoting variation in expenditure shares as a function of total consumption.

Value (glamour) stocks refer to stocks having low (high) price relative to their fundamental value.

\[ R_p - R_f = \alpha + \beta (R_m - R_f) + \delta_i \delta_{SMB} + \theta_i \delta_{HML} + \epsilon_{i,t} \]

Fama and French (1993) factors and momentum factor (Carhart, 1997).

For household portfolio ranging between 1/N to one, N being the number of available securities.

Stocks not included in Standard and Poor’s 500 index.

55 percent in 1999 to 45 per cent in 2002 is put in risky portfolio by the Swedish households as a whole.
Verbal information that may be interpreted by the decision maker.

With a convex segment sandwiched between two concave segments.

Self financing means that funds are neither added to nor removed from the portfolio during a particular time period.

With no transaction costs.

Per unit of time.

La Porta et al. (1998), and Bebchuk, Kraakman, and Triantis (2000).

Defined as the difference between the price per share paid for a control block and the price quoted in the market after the sale announcement (Dyck and Zingales, 2004).


Returns, liquidity and other measures are assumed to follow a vector autoregressive system.


Factors such as age, gender, religion, qualifications, income and profession.

Using the formula given by Miller and Reilly (1987).

Listing day return with respect to the issue price.

The tendency of investors to hold losing investments too long and selling winning ones too soon (Shefrin and Statsman, 1985).

At the end of the fiscal year.


As per MacKinlay, 1997.

As used by Holthausen et al. (1990).

Stock price deviations from the fundamentals.

Milkhed and Zemcik (2009).

As proposed by Kumar and Lee (2006).

Previous studies in Taiwan have found that most of the retail investors are less rational and easily ape the behavior of institutional investors.

Research paper titled “Impact of Index Futures on the Index Spot Market: The Indian Evidence” was presented at the 2nd IIMA International conference on Advanced Data Analysis, Business Analytics and Intelligence held on 8th -9th January 2011 organised by Indian Institute of Management, Ahmedabad. The comments and suggestions by anonymous referees and participants have been incorporated.

Research paper titled “Advances in Theories and Empirical Studies on Portfolio Management” was presented at 64th All India Commerce Conference organized by
Indian Commerce Association, 13th -15th December 2011, Department of Commerce, School of Management, Pondicherry University, Pondicherry, India. The comments and suggestions of the participants have been incorporated.

69 The efficient frontier is a smooth continuous curve although made up of several parabolic pieces.


71 Granger Causality test is a bivariate test of causality, whereas our estimation is based on multiple regression.

72 Only thirteen industrial diversification constraints exist in the programming whereas there are twenty three industries in the problem. This is because ten industries have only one company representation in Nifty fifty. The company diversification constraint of fifteen percent makes the industrial diversification constraint of twenty percent redundant for these ten industries. Hence, it has been excluded.

73 Further Tests for equality of the risk and return of the Markowitz’ portfolio and Ideal portfolio constructed on an yearly basis has been undertaken.

74 A similar regression model was estimated including beta as an independent variable. Beta explained 46 percent of the variance in returns and coefficient for all other variables were extremely small. To find new and relevant explanatory variables apart from beta, it was excluded from the regression analysis.

75 Efficiency Index is calculated by dividing the actual values with the fitted values and multiplying it by 100.