THE UNIVERSITY OF BURDWAN

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Synopsis of the Doctoral Thesis

SELECTION OF PORTFOLIO WITH COMPARATIVE ANALYSIS FOR SOME LISTED COMPANIES IN NIFTY

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Motivation and Problem Statement

In financial management, risk management is an important concept. Financial Risk Management can be defined as an act of creating economic value of the firm by effectively managing the exposure to the risk, with judicious use of several financial instruments and sophisticated techniques. The different type of exposure to risk, a firm is subjected to mainly involve credit risk and market risk. Financial risk management can be qualitative and quantitative in approach.

In order to determine the optimal asset allocation strategies mathematical models are vastly used by the corporate investors and portfolio managers respectively. The key organizations in finance are households, business firms, financial intermediaries and capital markets. The tradition in neoclassical economics is to consider the existence of households, their tastes and their endowments as exogenous to the theory. But other economic organizations are regarded as primary because of the functions they serve and are therefore endogenous to the theory. Giving concentration more on household, there are two players – consumer and investor. The consumer chooses how much of her income and wealth to allocate to current consumption and thereby, how to save for future consumption. As investor, the household solves the problem to determine the fractional allocation of her savings among the available investment opportunities.

Risk management plays a critical role in determining the financial dynamics of the corporate investors. However, risk management holds equal significance when individual investors and their investment objectives are considered. Therefore for this purpose asset management is important for the individual investors. If a person owns more than one asset for investment, she has an investment portfolio. A portfolio consists of more than one asset. The main aim of the portfolio owner is to enhance the value of portfolio by selecting investments that yield good returns.
Portfolio Management

Portfolio management has a great importance in theory of finance. Managing a portfolio involves inherent risks. Portfolio management is goal driven and target oriented. Constructing a portfolio involves making wide range of decisions regarding buying or selling of stocks, bonds, or other financial instruments. In portfolio management both time and magnitude are very important.

Portfolio optimization plays a critical role in determining portfolio strategies for investors. In portfolio optimization investors want to either maximize portfolio returns or minimize portfolio risks. Since return is compensated based on risk, investors have to balance the risk-return tradeoff for their investments and it depends upon investors risk-return preferences. So, a single optimized portfolio is not in a position to satisfy all investors.

In order to achieve the multiple objective of the investor and to satisfy the aim of obtaining the optimal portfolio it is necessary to understand the proportion of investment of different assets in the portfolio.

Since the middle of twentieth century, financial economist or practitioner and statisticians had been measuring the performance of a managed portfolio from various angles. Even after years of research, several issues remain unsolved. The classical mean variance model is aimed at satisfying the optimizing needs of the risk averse investors. However, in real world investors exhibit a multitude of risk profiles which explicitly points to the fact and necessity of a model which can take into account the dynamics of the different categories of investors on the parameter of risk taking aptitude and attitude. Thus, it becomes evident that the investors are influenced by their nature or value system. According to Heller (1971) there are six values of importance. Out of which, propensity to take risk is most important value system (Jauch and Glueck, 1988).

Nature of the investors may not be same and their investment needs depend on their nature. Some investors are risk taker, some are risk aversive, some other investors invest their wealth after a proper planning, who are known as risk planners and the rests are random selectors who randomly select the assets without giving any importance on expected return.
and risk. Thus, if an investor can correctly predict the proportion of amount to be invested in each assets of the portfolio then right decision can be taken to earn maximum utility.

An important unsolved issue is how to handle the dynamic behaviour of a managed portfolio. Not only because of the existence of time-varying required returns in a portfolio but also due to investor’s strategy or other influencing factors, management of portfolios become difficult. Thus creation of optimal portfolio strategy for investors of various risk profiles becomes a lurking question in the financial risk management scenario. An attempt has been made in this work to formulize and propose a multi-objective approach to portfolio optimization problems. In this work portfolios risk and return are optimized and various portfolio optimization models are integrated. Detailed analysis based on heuristic weight generation and subsequent optimization and application of the model are provided and compared to portfolio generated through the mean-variance approach and Sharpe’s approach.

**Research gap and Research Problem**

Markowitz (1952) is credited to be pioneer in successfully quantifying the two basic conflicting objectives of investing in a portfolio viz. maximizing expected return and minimizing risk. Since the formulation of the modern portfolio theory, his work has attracted the attention of the academic world and has been instrumental in providing the fundamental direction to address the issue of portfolio optimization. Unfortunately, in the real world of investment management, the Markowitz framework has had surprisingly little impact. The reasons are, first, investors tend to focus on small segments of their potential investment universe. Secondly, the investors put emphasis on the weights in a portfolio. They are not much involved in balancing the expected returns against the contribution to portfolio risk which is the relevant margin in the Markowitz framework. The application of Markowitz model to ascertain the weights of the assets to construct the portfolio often results in extreme values which seems to be computationally justified but lacks logical and intuitive appeal to the investor community. Thus, in practice the situation demands that substantial amount of energy needs to be invested in quest for reasonable numbers to make logical appeal and intuitive acceptance by manipulating the original model. The basic motivation for framing the research is driven by the above discussed premise.
Although several recent researches gives some insight for the mean-variance approach, it fails to give a well-known robust estimate for the expected return of most assets and also fails to achieve the benefits promised by portfolio optimization in its conception. Hence, there is a need to delve deep into the nuances of mean-variance approach to design an integrated approach to address the issue of portfolio optimization in more simplistic terms and churn out results from the proposed model which will be more attractive intuitively. To address the issue, the need to frame integrated robust model motivates the present research to integrate different mathematical and statistical models along with heuristics which allow us to estimate and emulate the risk features of a given portfolio and to use simulation techniques to generate scenarios and weights which enable us to perform portfolio optimization taking into account explicitly the role of value system in the decision making framework of the investor.

**Brief Survey of Earlier Work**

Choosing a single asset for investment is not a difficult task for an investor. However, the investor’s decision becomes difficult when faced with virtually innumerable investable choices and more importantly an infinite number of combinations of assets. The investor chooses those portfolios which lie on the efficient frontier. The choice may be affected by investor’s beliefs, objectives, preferences, expectations, risk aversion, time and budget constraints, estimations among other. In addition, external factors will also affect the choice. Due to all the external and internal factors, the investor faces a dynamic decision problem in selection of optimal portfolio. Also, it is quite evident that the interactions of risk and reward are stated in portfolio theory in a very broad framework and has deeply influenced the way institutional portfolios are managed, and is also successful in motivating the “passive management” investment techniques. The mathematics of portfolio theory is widely used in risk management and is basic for more recent risk measures. But when the investors use the models to solve real world problem, every assumption of the model becomes its limitation and often become obvious and thus is expected to have deep implications on the actual risk and reward that the portfolio’s holders will bear. Most recent works have shown that practically one cannot select an optimal portfolio by considering the mean-variance portfolio theory. And above it, the gains from portfolio optimization are seen to have been nullified by the error explicit on the most common model’s parameters estimators (Uppal, DeMiguel,
Garlappi and Nogales, 2007). Uppal, DeMiguel, Garlappi and Nogales (2007) have put forward their argument by demonstrating how a naively diversified portfolio with equal weights in every asset, can out-perform out-of-sample on a risk adjusted basis (Sharpe-ratio in this case) an “optimally” diversified portfolio. However, some parameters of mean-variance model have been improved in several other studies. Sharpe’s (1963) study is one of the examples where he observed the market portfolio in order to improve the estimations of the expected return and covariance matrix.

Overview of the Thesis

Selection of the optimum portfolio is a complex task for the general investors as choice of optimum weight is very difficult to make. There may be basically two ways of arriving at an optimum portfolio – one by minimizing the risk and the other by maximizing the return. This doctoral work proposes to strike a balance between these two. The thesis starts with an introduction to the problem followed by Chapter 2 which describes the methodology adopted for performing this doctoral work. In chapter 3 optimum portfolios have been constructed subject to minimum return constraints. This minimum return constraint starts from the minimum return of the security in the portfolio and increases step by step to maximum return of the security in the portfolio. Then a heuristic procedure for arriving at security weights has been introduced based on the investors’ propensity to take risk. For this purpose, two extreme situations have been chosen – risk taker and risk averse investor. After constructing heuristic portfolio the extent of closeness between the ideal portfolio constructed on the basis of optimization method and portfolio constructed on the basis of heuristic methods has been examined. For this purpose Euclidean distance is considered. After detailed analysis, a point of change have been identified beyond which the optimum portfolio is closer to optimistic portfolio than to pessimistic portfolio before which the optimum portfolio is closer to pessimistic portfolio than optimistic portfolio.

In chapter 4 the optimum portfolio is obtained through a mathematical programming framework so as to minimize the portfolio risk subject to return constraint expressed in terms of coefficient of optimism ($\alpha$), where $\alpha$ varies from 0 to 1. Simultaneously, four heuristic portfolios have been developed for optimistic and pessimistic investors, risk
planners and random selectors. Given the optimum portfolio and a heuristic portfolio City Block Distance has been calculated to measure the departure of the heuristic solution from the optimum solution.

In chapter 5 coefficient of optimism has been introduced in the weight of risk planner to observe the change of the behaviour of the heuristic portfolio. The City Block Distance is used to calculate the distance between the optimum portfolio and the heuristic portfolios. For moderate values of the coefficient of optimism a heuristic investor’s decision nearly coincides with the corresponding optimum portfolio. However, for extreme situations i.e. optimistic and pessimistic situations heuristic portfolio differs from optimum portfolio.

Chapter 6 states the comparison between Sharpe’s cut off principle portfolio and proposed near optimum portfolio with that of optimum portfolio under Sharpe’s Single Index Model. Here also the coefficient of optimism in the decision making process has been considered to compare Sharpe’s approach under optimality principle and cut off principle and the proposed near optimum portfolio, based on Single Index Model and to examine the suitability of near optimum portfolio over Sharpe’s cut off principle portfolio. These optimum portfolios have been obtained through a mathematical programming framework so as to minimize the portfolio risk subject to return constraint expressed in terms of coefficient of optimism. To know the similarity between the cut off principle portfolio and the near optimum portfolio with that of optimum portfolio under Sharpe’s Single Index model, City Block Distance has been considered. Up to moderate value and very high value of coefficient of optimism, near optimum portfolio shows better result. However, for moderate to high value of coefficient of optimism, the cut off principle portfolio shows closer result. This put forward the admissibility of the near optimum portfolio. Chapter 7 concludes the work and presents some limitation of the present work. It also provides a direction for future research which can be carried out to make the proposed approach more robust and practically applicable.
Major Contributions

For those investors who find it difficult to mathematically or statistically arrive at sophisticated optimum solution, they can heuristically obtain a portfolio similar to the optimum portfolio. It means that one can reach to the near optimum solution with the help of heuristic solution. In this doctoral thesis, the heuristic solutions are already discussed with empirical evidence. Detailed analysis revealed an ideal point of change to be taken into consideration while examining the behaviour of an investor, following heuristic approach in investment planning. A mathematical formulation is presented to design the optimum portfolio given a value for coefficient of optimism.

After detailed discussion it is observed that heuristically one can reach the optimum solution. In this doctoral thesis, the concept of co-efficient of optimism is introduced in the decision framework of the portfolio optimization and it is observed that coefficient of optimism plays a crucial role in selecting portfolio by considering human value system. Thus, investors have to be aware of their coefficient of optimism.

When we introduced investor’s value system (according to propensity to take risk) and coefficient of optimism in choosing optimum portfolio heuristically, it is observed that the optimistic investors and the risk planners are giving best decision. That means the risk planner’s decision is very close to the optimum decision. For lower to moderate value of coefficient of optimism risk planners’ decision and optimistic investor’s decision is best as compared to the other heuristic solutions. On the other hand, at the higher value of coefficient of optimism all the heuristic solutions showed more or less same result. For the lower to the moderate value of coefficient of optimism random selectors showed worst result as compared to the other heuristic solutions.

Next in this doctoral thesis, the Sharpe’s Single Index model is re-examined and it is presented as a non-linear mathematical model. A comparatively easy analytical framework is achieved by modifying the Sharpe’s model which is called near optimum portfolio. The modified decision rule is compared with the Sharpe’s model Based on the detailed empirical analysis, it may be claimed that the closeness between the optimum portfolio under Sharpe’s Single Index Model and Sharpe’s cut off principle portfolio and the closeness between the optimum portfolio under Sharpe’s Single Index Model and the near optimum portfolio.
depends on the value of coefficient of optimism. Also by validating the models by with the selected data set it is observed that from moderate value of coefficient of optimism to moderately high value of coefficient of optimism the Sharpe’s Cut-off principle method gives the best result. For lower value of coefficient of optimism to moderate value of coefficient of optimism the near optimum portfolio gives the best result. On the other hand, for a very high value of the coefficient of optimism near optimum solution is also performing well. That means an investor can reach near to the optimum portfolio heuristically. This put forward the admissibility of the near optimum portfolio.

Conclusion

The portfolio optimization problem is mainly concerned with selecting the optimal investment strategy of an investor. In other words, the investor looks for an optimal decision on how many shares of which security should be purchased to maximize the expected utility. If the investor knows the securities that may give maximum expected return or minimum expected risk, it is easy to take optimal decision. But in real world it is difficult to find out those securities due to presence of efficient market. The statistical models used in behavioural finance are not very easily understandable to the general investor. When a general investor wishes to invest money in any portfolio of securities they are more concerned about the expected return and risk of the portfolio not about the various statistical models. The present study mainly focuses on the weight of the securities in the portfolio and proposes a simple heuristic tool to help those investors so that they can get a near optimum portfolio for investment. Heuristic method is not universally accepted but is having intuitive appeal.

The present study aims to identify the objectives, background, methodology, and proposes a model which proposes to simplify the portfolio optimization problem. The academic endeavour provides a rigorous treatment to the weight as a decision variable in the optimization framework. The decision variable obtained heuristically is also factored into the optimization framework so as to provide an all inclusive dimension to the simplified approach. The work also provides a framework and analysis of the allocation decisions of the linear programming model and non-linear programming model. The interactions of the different value system with different decision- making systems of the investors have been
well captured in the heuristic model generation process and its applicability has been ensured by comparing with the performance of the optimal solution generated by classical models.

One can get number of values for weight, risk and return in the optimization framework depending on the computational techniques used to compute weight, risk and return. The resultant weight values churned out from optimized solutions provides a complex set which thereby makes it practically impossible to determine the global optima. Hence, in order to simplify the process, weights have been considered as the only decision variable in the optimization framework considering the assumption that for different set of investors the risk and return are held constant but the proportion of total investment in different securities in the portfolio can be manipulated and hence controlled to reach at the optimum solution. Therefore, according to the class of investors and their corresponding risk appetite heuristic weights can be generated. Heuristic portfolios are designed to compute the heuristic risk and return to compare with the optimum portfolios’ risk and return to ascertain their closeness and make informed decisions.