Introducing a Method to Select the Optimal Portfolio with Optimal Multi-objective Approach

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INTRODUCTION

One of the most important and challenging problems in the organizations which act in investing is to select the improved portfolio form among the investing designs which are possible and economic. However, this combination should be done considering the limitations and goals and organization strategies and considering the importance degree. When the number of designs is too many and evaluation should be considered in selecting the designs.

Up to now, a lot of patterns are introduced for solving the problems of improved assets each which had some limitations. The primary design in this relation is suggested using the second degree planning. But this model would face calculation problems considering a lot of variables. So, the next specialists used the methods such as creating single indexes, correlation coefficient value and covering analysis of data and changing the issue in linear method. Although the pattern can be solved theoretically with mathematical planning methods but in practice there are problems in this field including the risk factors which prevent a general solution and general methods of non-linear solutions due to the non-curved form of the goal function. Moreover, the normal size of the issues about selecting the assets in the real world includes a hundred types of assets, the efficiency and risks of the assets are obtained using a time series.

So, considering the big dimensions of the issues, proper solving the problem with the software packages in mathematical problems is not possible. Investing managers also apply some limitations on the collection of the assets which makes the problem more complicated and due to the problems in solving non-linear planning patterns of asset collection; other mathematical solving methods are used by the researchers for solving the problem.

Recently, super initiated methods are considered in solving the optimization and a lot of researches are done in this field.

Research Problem:

About selecting the optimized portfolio, some goals are considered including: maximizing the efficiency, minimizing the risk and reducing the coefficient and these goals should be optimized considering the operational and political limitations. Operational limitation is the fund limitation and political limitations are those based on management, environmental and legal limitations imposed on the model. For example, limitations are imposed
for determining the maximum and minimum for the stock and emphasis on a special stock. The main goal of the present research is to select a portfolio from among the stocks in the firms accepted in Tehran stock market using the super initiated algorithms so that the resulted basket satisfies different factors for investing and considers its preferences. Generally, investors consider multiple goals including the efficiency, risk and realization. On the other side, investor prefers to have some priorities about the goals. Literature review shows that one of the goals which is not considered in portfolio is to minimize the risks and maximizing the crookedness of the efficiency portfolio.

Research Hypotheses:
1. Using the new instruments and tools such as genetic algorithms and colonization competition in the investing market can increase the efficiency and reduce the risk.
2. By help of colonization competition algorithm, one can choose the multi-goal portfolio.
3. By help of colonization competition algorithm, one can select the superior stock out of the firms stocks.

Concepts and Definitions Related to Stock Basket:
Financial Market:
Financial markets are the official and organized markets where transporting the cash is done from the people with more sources to the units needed the cash. It is obvious that in this market, most of the lenders are the families and the ones needed the cash.
Financial market provides the needed condition for transporting the savings of the real and legal people and others which have the chances for investing chances and need the financial sources. Transporting the related cash in all cases leads to creation of financial assets which is the claim about the future assets which publish the bonds.

Different types of Financial Markets:
Financial markets are divided based on the investments, maturity of the investments, lenders and borrowers, market location and type of interactions.

Dividing the Financial Markets based on the Existence in the Stock:
After legislation and supervisory orders, the financial markets are divided to the official (exchange) and unofficial markets (out of exchange market).
The exchange market is organized and has physical formations. The market of financial interaction or exchange market is an official investing market where buying and selling of the firms bonds and state bonds or credential private institutions is done based on the specific rules. The important feature of this market is legal support of the saving owners and immovable investments and legal necessities for demanders of the investment. The main important members of the organized exchange markets are the commission brokers, independent brokers, competitive traders and specialists who have the chance to trade the stocks. The exchange markets define the condition for accepting the companies based on the social and economic condition of the firms.
Over the counter market includes the market where the stocks and bonds are traded over the counter. This market has a significant role in creating the efficiency and increasing the cash of the capital market and is one of the main important financial sources in non-exchange firms. This market along with other capital markets increases the investing and leading of the wandered markets and goes toward the profitable activities and increasing the development and economic developments.
Over the counter markets were first focused and gradually along with the development in the market and technological advancement changes the form and finally became decentralized such as NY OCI exchange market (as the first oci in the world) includes the shops in Manhattan street where the non-tradable exchange bonds are traded over the counter. So, formation of such markets did not depend on the trades through computer networks and were done based on the economic and technological infrastructures.

Background of Exchange Market in Iran:
Primary studies on exchange in Iran go back to 1936. In this year, a person from Belgium called “Ron Lutrfeld” did some studies about establishing the exchange market in Iran, wrote the statute of the exchange and offered it to Iranian officials. However, due to the condition and the world war the second, the establishment of exchange market in Iran was delayed for 25 years and finally in 1952, a commission was formed in business ministry and then by presence of the representatives, the development and mining bank of Iran was formed and then contract for establishing the exchange market was organized.

Investing
The word investment includes a wide range of activities. This word can includes investment in stock. Bonds, the changeable bonds and assets such as gold, expensive things, land and others. Investment can be
defined as: “buying the real or financial thing efficiency of which is proportional to the risk”.

**Portfolio Management Process:**
Before taking action and doing any trade, first the policy of investing, related limitation to the efficiency level, risk taking and other limitations under the condition and portfolio should be determined. Determining the factors by the investor before selecting the stock is necessary through determining the portfolio combination. The investor experts usually suggest a three stage process for management.

1. Learning the financial principles
2. Creating portfolio
3. Managing and protecting portfolio

Investing process is a chain of activities which finally leads to real purchase or bonds. Saving the revenues of the investor compared to a determined cost, is the first step which should be taken in this way. Next step is to recognize and give information about risk. An investor should calculate and estimate the revenue and risk which are acceptable. At next stage knowing and recognizing different types of bonds in the market is important. Before this stage, the investor calculates the risk and value of the stocks of the companies which want to invest. One of the principles of investing is the access to information through the expert newspapers and financial sites. Knowing the structure of the exchange market is another part of investing process. investor should be aware that from investing perspective, the efficiency and risk are acceptable [4].

**Risk and Return:**
The most important concept in decision making is the risk and return. Each share or portfolio of the bond, if it is bought, kept and sold in a special distance would result in a special return. The return includes changes in costs and sources due to ownership. The term “return” (or revenue) is used to explain the increase or decrease in investment during the asset keeping period. Whenever the future return in predicted and multiplied by each event and then sum up, the result will be “return and expectation”. The expected return ration of the investor is predicted from the average award which is obtained in a specific period of time which in fact can be due to changes which are unpredictable. Risk means that there are different results for feature and none of them is precise.

The factor of measuring risk is good in financial decisions. This factor should be independent from the risk avoiding. In other words, it is necessary to determine the amount of risks in a specific condition apart from the feeling of people. The goal of measuring the risk is to increase the ability in better decision making.

**Risk:**
Risk in common meant a danger due to lack of certainty about a future event and as this insurance is more, it is said that the risk is higher. Webster defines risk as been exposed to danger. Glitz defined risk as any king of return. Risk means that there are a lot of possibilities for future and none of them in certain.

Measuring the real criteria is important in financial decisions. These criteria should be dependent from personal risking. In other words, it is necessary to determine the amount of risk in a condition apart from the personal feeling.

**Return:**
Return is a bond during a specific period of time which is for the owner of the share and this return can be the changes of costs in first and last period of share. In addition, other returns of buying the share are due to the priority right, award and cash return.

**The Relationship between Risk and Return:**
Uncertainty feature of the investing is more complicated than the expected return. Considering the uncertainty, measuring and risk in return is important. One of the factors in risk is standard deviation which tries to calculate both the return and loss.

So, while the expected return is the average of the award in a period of time, risk is the distribution of potentials which is shown with standard deviation.

Another important concept in modern portfolio theory is the relationship between the expected return and risk. The relationship between these two is positive. It means that as the expected return is higher, the risk is higher. The following chart shows the relationship between the expected return and risk. If we show different risks for different rations, a line such as the line drawn in the following chart is resulted where N shows the investing market line and CML is the capital market line.

**The Issue of Selecting the Investing Basket:**
Most of the exchanges which have the possibility of investing, have uncertain retune and so they are risky
and the first issue which every investor face with is to determine the risky exchange which they want to invest in. Since, each basket is a combination of exchanges, this is very important for the investor to select one of the baskets from among the number of investing baskets. So, it is called the issue of selecting the investment basket. One of the ways for solving the problem is suggested by Harry Markowitz in 1952.

Markowitz method starts when the investor has a special amount of money for investing. This money is invested for a special period of time which is called keeping the capital. At the end of the period, the investors sell the exchanges that they bought at first period and then spend the cash or invest it different periods.

Selecting the Optimized Investing Basket:

As it is shown in chart 2-6, investor should show the indifference curves in a chart in which efficient collection is drawn and then select the basket which is on the most “north west” curve of indifference. This basket is related to the point in which the indifference curve is in touch with the efficient collection.

Chart 1 selecting the optimized investing basket.

Fig. 1: The models for selecting the exchange basket.

From the middle of 19th century, theorists and classic theorists tried to find a way for selecting the share and forming the share basket which have the highest efficiency and lowest risk.

The pioneers of the issue are Markowitz, Sharp and Ross.

After a while, by development and advances in mathematical and economic science, people such as Charnes and Copper tried to use the mathematical model and concepts and design the models of selecting the share basket.

Then, the history of the models and studies done in the field of selecting the exchange basket will be introduced in sum.

Markowitz Model:

Before the article of Markowitz, decision making about the exchange is done independently and generally there is a relationship between the exchanges. So, when the goal of increasing the expected return and risk are considered alone, it is natural that everyone can select an exchange. Theory of Markowitz is in fact the entrance of the accrual and exchange market.

Some believe that great return of the Markowitz is introducing the variation in the exchange.

This method is based on a series of special assumptions, the most important of which is that the market is efficient and distributing information is done in a comprehensive form and based on the transparency of the information.

The method is based on the reasoning that the probability of losing the risk of the capital is a kind of exchange in the market which is more than the combination of exchange. So, the professional investor should not invest all his capital in one case but he should invest it in a combination of the assets which is called portfolio collection. Portfolio or exchange basket includes different companies which have the zero or near zero reduction probability and it is tried to minimize the unsystematic risk with least variation. So, in order to have a better portfolio, it is better not to have variations that are when the revenue if reduced and another one are increased. The following stages are observed by the investors or transactor.

1. Determining the expected return of the exchange and all the exchanges
2. Evaluating the exchange condition and selecting them
3. Optimizing the share combination
4. Evaluating the portfolio and reviewing the share collection
Analysis of the portfolio has a lot of application in analyzing the risk and return and analysis of the market, in modern portfolio method, a collection of attempts devoted to the portfolio return of the market. And in the proper return condition uses an evaluation index which is calculated by the beta index.

Markowitz for the first time gave a proper definition of the one that was only a spate rally of risk and return. Markowitz defined the investing return by the expectation value and mathematical hope of the possible investments and risks with the variance and deviation squares. Recognizing the risk and bad return based on the variance average which is clear for the financial experts and has been invisible and unbelievable.

The main important and first role of the statistical algebra is the famous formula of the variance which is the collection of random variables. This formula shows that the analysis unit of the investors should be the total portfolio of each share. Share of a single share which cannot be considered as portfolio. Here, the risk of a share is equal to the covariance of the share with other components of the portfolio. The base of the most models in selecting the portfolio in financial literature is to pay attention to the factors suggested by the Markowitz. One of the most important points is to pay attention to the investing risk not only based on the standard deviation but also based on risk of the investing collection. The Markowitz mathematical model is as follows (2-10):

\[
\begin{align*}
\min & \quad z = (1 - \gamma) \left( \sum_{i=1}^{n} x_i E_i \right) + \gamma \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j c_{ij} \\
\text{St:} & \quad \sum_{i=1}^{n} x_i = 1 \\
& \quad \gamma, x_i \geq 0 \\
\end{align*}
\]

Where:
- \( \gamma \) is the risk of investing
- \( E_i \) is the expected return of the \( i \)th design
- \( x_i \) is a part of budget in \( i \)th design
- \( x_j \) is a part of budget in \( i \)th investing design
- \( c_{ij} \) covariance of investing \( i \) with investing \( j \)

Determining the optimized portfolio based on Markowitz model has a lot of complications including the volume of the calculation and the number of variables so that in a market with \( N \) investors, \( \frac{n^2 + 3n + 2}{2} \) variable should be calculated. However, determining the effect of risk of investing on the risk of the investing collection is to calculate the covariance and correlation coefficient which was inevitably time consuming and hard. One the other hand, distributing the return of the plans opposed to the model assumption does not necessarily follow the normal distribution and in addition in some cases the standard deviation cannot be calculated (Islami Bidgoli, 1996). In other words, modern theory of portfolio based on risk and return cannot always show the realities of the investing market.

Metaheuristic Algorithms:

In order to find the optimized answer or applying the initiated algorithms, testing is used. Here, we mean finding or searching by the Metaheuristic. In this method, there is no guarantee for finding the solution. It is possible that most of the famous methods are more efficient. Generally, metaheuristic algorithms are the methods based on local research since searching them is focused on the local variables; however, the Metaheuristic algorithm is defined as the best method for solving the optimization problem specially when the time limitation is important.

The word Metaheuristic shows the advancement of the algorithm. This word means finding the optimized solution by using the techniques at advanced levels and also using the testing method. Generally, the Metaheuristic is an advanced method which in fact is a combination of the lower level techniques for studying more precisely and also more focused.

In recent years, the word Metaheuristic points to all the modern and high level algorithms including the complementary algorithm (EA), Genetic algorithm (GA), Solid gradual algorithm (SA), Taboo Search (TS), ant colony algorithm (ACO), particle social optimization (PSO), Firefly algorithm (FA) and Harmony search algorithm (HS).

Two main concepts exist in metaheuristic algorithms.

- Diversification
- Intensitication

In fact, efficiency of an algorithm is measured by these components. Diversification is the ability of the algorithm for effective research in a general space. As the algorithm power is more for studying all the points of research, the diversification degree of it is more. At the same time, the ability of the algorithm is opposed to another concept of the algorithm called Intensitication. Intensifying the ability of the algorithm is in focusing on
the points and regions of the searching space where the optimization point are. Only a small fraction of solution space is visible and the probability of error increases. In these occasions, the techniques based on the gradients are used including the Newton method. If the variation components are too much strong, convergence in the algorithms is done slowly and finding an optimized solution becomes harder and then Intensification increases.

Another feature of the Metaheuristic algorithm is the reliance of this algorithm to the movement routing and population. For example, SA is a good example of the algorithm based on movement route which is the search route with the form of brownie movement. On the other hand, GA is a good example of the method based on population which is done by combining the gens and different factors. Defining which method is better seems difficult. The recent studies show that the methods based on population are more effective. However, this issue can be practically correct but considering calculation there is no certainty.

Research Population and Sample:
The present study is based on the information of the time period from 2011-2013. Population of the present study, considering the limitation for increasing the reliability of the applied research are as:
1. The companies which were listed in Tehran Exchange Market until the end of 2012.
2. The information related to the companies in the time period is completely available so companies whose data was not available for all 36 periods of time, are omitted.
3. Their shares in the studied period have always been traded, so the companies related in this study have more than 10 days trades.

Considering the above mentioned limitation and related data of the companies listed in Tehran exchange market, 110 companies were considered and studied as the population of the present study.

Research Time Period:
The research time period of the present research is from April 2011 to March 2013. The aim of the study is to investigate three recent time period. It should also be noted that considering the time period such as daily, weekly, monthly and yearly would not affect the results of the present research. But considering the access to the monthly data was easier and considering the limitations of the population, more companies can be found to be evaluated. So, the monthly data was used. Since the reliability of the risk calculation for exchange needed 30 to 36 time period. The present study considered the data related to the time period of 36 periods of one month period.

Data Collection Method:
Since the data related to the present study are based on the 36 periods of one month, the data were collected using Tehran Exchange Market and the software of Modern strategy.

Data Analysis:
1. Artificial Bee Colony Algorithm

![Image of the Artificial Bee Colony Algorithm](image-url)
2. Biogeography-Based Optimization

3. FireFly Algorithm
4. Harmony Search Algorithm

Research Suggestion:

The investing process has always been based on same principle. The investor always tends to have the highest return and at the same time lowest risk. So, it is here that the risk management becomes important. The goal of risk management is to increase the access to the defined goals and reducing the dangers. Each investor has a lot of tools and methods to meet the goal. Continuous advancement of knowledge provides the field for updating the methods and tools. The portfolio management discussion is one of the issues considered here. Using modern methods of selecting the portfolio and optimized management has been common for many years and it has been recently considered in our country. The present research tries to use a small sample in the market to use the modern algorithms for optimizing the investment. On the other hand, the financial market activists use different method simultaneously and symmetrically. The possibility of using the methods such as nerve systems, fuzzy logic, genetic algorithm, technical analysis, expert systems and others has become possible recently. The most important point is significant reduction of error and mistakes in simultaneous use of various methods.

5. Imperialist Competitive Algorithm
REFERENCES