

The Introduction of a Method for Optimal Selecting the Portfolio with Multi-Objective Optimization by Metaheuristic Algorithms

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Abstract: Proper selection of investment projects in the capital markets, including the stock is the most important issues in modern day. Proper selection of projects requires the appropriate fields of investment and the appropriate analysis tools. A proper selection can lead to investor's confidence and increase efficiency in the market. In most cases, there is some beneficial investment projects, but there is no access to financial resources for them. In an efficient capital market, the funds are accessible for the best investment options and other resources allocated to the next priorities. Regarding the planned investment in addition to the evaluation and selection of individual projects, interaction and effects of projects should also be noticed. In other words, the projects should be selected, as we do not consider them as the activities separate from the objectives; but also all important issues should be considered in selecting the projects. The study population consisted of 100 listed companies in terms of liquidity of the stock, and the data were analyzed through metaheuristic algorithms.

Keywords: Investment Projects, Efficient Capital Market, Choice of Projects, Metaheuristic.

Introduction

The purpose of optimization is to find the best acceptable answer, despite the constraints and needs. There may be answers for a question that to compare them and choose the optimal solution, a function called objective function is defined. Selecting this function depends on the nature of the question. For example, travel time or cost are common objectives to optimize transportation networks. However, the selection of appropriate objective function is one of the most important steps of optimization. Sometimes the multi-objective is considered in optimization simultaneously; these questions that include multi-objective functions are called multi-objective questions.

The simplest way to deal with such questions is the formation of a new objective function as a linear combination of objective functions. In this compound the impact of each function is determined by the weight assigned to it. Each optimization question has a number of independent variables that are called design variables that is shown by the n-dimensional vector x (Amiri et al., 2010).

To find the optimal solution using innovative algorithms, we use trial and error; here, the initiative (heuristic) is to "find" or "search" by trial and error. In this way, there is no guarantee to find the solution; perhaps there may be many other well-known methods that can be more effective and more efficient. Generally, heuristic algorithms are known as methods based on local search because their searches focus on local variables; however still heuristic algorithms can be considered among the best methods for solving optimization problems, especially when the time limit is important in solving the problem.

Metaheuristic word is an expression of innovative advanced algorithms. In fact, Meta is at the beginning of this word means beyond. Metaheuristic word means to find the optimal solution using the techniques in the advanced levels and also using trial and error methods. Generally, metaheuristic is considered as advanced technique that is actually a combination of techniques to lower levels for obtaining a more extensive and more focused search space.

In recent years, the word metaheuristic refers to all modern algorithms and high levels including evolutionary algorithms (EA) such as: genetic (GA), gradual freezing (SA), Tabu Search (TS), Ant Colony (ACO), particle swarm optimization (PSO), Firefly (FA) and harmony Search algorithm (HS). (Parwan et al., 2013).

Review of literature

Investment and financial resources: There has always been an active capital market as one of the hallmarks of development at the international level. In developed countries, most investments are done through financial markets. Active participation of the community in exchange involves capital market viability and sustainable development of the country. The main problem faced by investors in these markets is the decision to select the securities for investment and optimal portfolio of stocks. Investment process in a coherent state requires analyzing the nature of investment decisions.

The activities related to the decision-making process analysis affect the investors' decisions (Tehrani & Rahnama, 2006).

Financial markets: financial markets are official and organized markets in which the transfer of funds from the units that are faced with surplus resources are done through the applicant units. Obviously, the majority of lenders in the market are households and the applicant funds are economic businesses and government. Financial market provides essential facilities to transfer savings from natural and legal persons and other persons who have productive investment opportunities and requires financial resources. Transferring the shares in all cases leads to the creation of financial assets. It is a claim about the proportion of income in the future personal property (rights) that has issued securities (Shabahang, 1993).

History of Portfolio Theory

The word Portfolio is a combination of assets formed by an investor or investment. The investor can be an individual or institution. Technically, a portfolio includes a set of real estate and financial investments by an investor. Studying all aspects of portfolios is called portfolio management (Tehrani & Rahnama, 2006).

Investment portfolio selection issue

There are many securities that it is possible to invest in them; these securities have uncertain returns that are why they are risky. The first issue that any investor faces with it is to determine risky securities that he wants to invest in them. As each series of securities is a set of investment portfolio, it's like an investment portfolio. That is why it is often referred to as portfolio investments. One way to solve this problem was presented in 1952 by Harry Markowitz.

The Markowitz method starts with the assumption that investors to invest in the present have a certain amount of money for a certain time that is called the maintenance of investment. At the end of the maintenance period, the investors sell the securities that bought and consume the resulted funds to reinvest it in various securities. The Markowitz technique can be looked at as a single-period method that t_0 is the beginning of period and T_1 is considered as the end of period. In t_0 , the investor must decide which securities to buy maintain T_1 .

In taking this decision at the time T_0 , the investors should be aware that stock returns and investment portfolio is uncertain during future maintenance. However, the investor can estimate the expected rate of return (or average of securities), and he can invest in securities that have the highest expected return. Markowitz suggests that such an approach is unreasonable because although investors typically tend to have a high yield, but at the same time they want to be sure about this return as much as possible. This means that investor could balance in the search to maximize efficiency and minimize uncertainty (that is called risk) and in deciding in t_0 . In Markowitz method, both objectives are focused for deciding.

Genetic Algorithm (GA): Genetic Algorithms is presented for the first time in 1975 by John Holland to a process of optimization. At GA, we randomly generated a number of people as the initial population; and the competence of each of them is determined according to the function. Then, the number of people is selected on the basis of competence, and new generation is created. New children in the population are copied to the new population. It continues to meet the termination condition.

Genetic algorithms (abbreviated symbol (GA) search techniques in computer science to find approximate solutions to optimization and search problems. GA is a special kind of evolutionary algorithm that uses evolutionary biology such as inheritance and mutation techniques.

Firefly algorithm (FA): Firefly algorithm is offered by Yang She Xin based on patterns of behavior and flashing fireflies. One methods of group intelligent (ISI) and a kind of metaheuristic algorithm is inspired by the random and naturally that is employed almost in all the fields of optimization, engineering as well as Hard-NP issues. This algorithm is a randomized algorithm. This means that a random search for the set of solutions is used. Firefly algorithm at its lowest level in a search space focuses on developing solutions and the best solutions to survive. Random search of local optimization avoids being caught in the trap. For metaheuristic algorithms, exploring means the process of finding solutions within the search space, while, the operation means the focused search process in the best solutions.

FA is a population-based algorithm. The main characteristic of firefly is its flashing light. These lights have two basic functions: Attracting the opposite sex and warning enemy. This flashing light follows the laws of physics: The behavior of flashing is on the basis of the charm, brightness and distance changes. The greater the distance of r , the light intensity decreases. It was inspired by Yang for algorithm development of fireflies. The flashing light can be formulated in different ways according to the objective function that will create new optimization algorithms.

Evolutionary Algorithms (EA): This is called evolutionary algorithm because of evolutionary computation and due to its dynamism. In fact, these search methods, inspired by the philosophy of the best choice presented by Charles Darwin. Evolutionary algorithms are population-based algorithms handle the use of genetic operators at a certain level.

Gradual freezing algorithm (SA): Diversity often appears random combinations by adding or subtracting the compounds was done in an effort to streamline the search space, however, the past aggravated by exploring solutions and searched in memory harmony tries to choose the most optimal answer. Each successful metaheuristic algorithm requires a proper balance between these two seemingly contradictory elements; if aggravating factors are much stronger than usual, only a small fraction of the solution is visible, and the risk of error increases. In this case often techniques based on Burgradian such as Newton's method are applied.

Imperialist Competitive Algorithm (ICA): In this section, the proposed algorithm for optimization which is inspired by mathematical modeling imperialist competition is presented and its different components are explained. With a function $f(x)$, x argument in optimizing want to find a way corresponding costs, optimum (usually minimal).

Tabu search (TS): Tabu search (Tabu Search) is a meta-heuristic optimization algorithm first introduced in 1986 by Glover and Laguna. In 1997, the first book devoted entirely to the search for banned released by Glover and Laguna. Taboo word is derived from Tongan language of the Polynesian islands in the Pacific Ocean. This word means a sacred object that should not be touched because of sanctity (Glover et al., 2002).

Ant Colony Optimization (ACO): Man has always looked for the world that surrounds him. One of the best known projects is the human flight plan that was presented by da Vinci for the first time, it's a sketch of a flying machine based on body building of bat. Four hundred years later, Coleman made a flying machine with engine and was used instead of the wings of grasshoppers. Currently working on the development of intelligent systems inspired by the nature of the field of artificial intelligence is very popular. Genetic algorithms use the idea of evolution and natural selection posed a great way to find optimization problems.

The idea of Darwinian evolution has shown that each generation is more developed compared to the previous generation and what occurs in nature. The result of million years of human's evolution is creatures like ants.

Artificial bee colony Algorithm (BA): Bee algorithm is a search-based algorithm that first developed in 2005, this method is like the behavior of groups of bees searching for food. In the basic version, of this algorithm, some kind of local search that combined with random (stochastic) search and can be used to optimize the combination. A colony of bees can be spread long distances and in various directions to exploit food sources. The flowering parts with large amounts of nectar and pollen that can be collected with little effort attract a large number of bees. The process of searching for food begins by the surveillance bees in a colony to search in a promising garden (high hopes for nectar or pollen). These bees randomly move from a garden to the other. During the harvest season (flowering), colony population keeps ready the number of bee colonies as the surveillance bees continue their search. When searching ended, every surveillance bee with its nectar and pollen

does a certain dance. This dance is known as the circular dance. Information on the piece of garden (about the distance Food and Food Quality) transferred to other bees. This information send the members and followers to the garden.

Discussion and Conclusion

Generally, randomized algorithms are divided into two categories heuristic and metaheuristic. Heuristic means "finding" or "discovery" by trial and error. Further development of these algorithms is called metaheuristic algorithms. Meta means "higher level" and these algorithms generally have better performance than simple heuristics. All metaheuristic algorithms use local search and optimization. Randomization provides a good way to move from local search to global search. As a result, almost all metaheuristic algorithms tend to optimization. Metaheuristic algorithms are classified in many ways. A method of classification is population-based or path-based method that we reviewed some of these algorithms such as firefly algorithm, and also we studied the benefits and applications of them. An optimization algorithm is an iterative process starting from an initial value. After a certain number of repetitions, a stable and optimal solution for a given problem can be deduced. Actually, this method is a self-organizing system with common solutions and quality that repeats a set of rules or equations can be derived from this model. Designing an efficient algorithm is like finding efficient ways to mimic the evolution of a system. An algorithm can be analyzed through the point of view of its key components, including exploration and exploitation or ways to produce solutions using evolutionary operators. In this paper, we reviewed the algorithms inspired by nature from different angles, and we concluded that the metaheuristic algorithms and particularly those who have been inspired by nature have the advantages of simplicity, flexibility and are easy to implement. They also include properties such as ensuring rapid and global convergence optimization, multifaceted optimization, and some other special benefits. The unique benefits have caused that the researchers tend to understanding and application of these algorithms and such a kind of self-organizing systems in demanding applications.

In this paper, an algorithm is for solving scheduling tasks by combining genetic algorithm that is a global search algorithm. Firefly algorithm that is a local search algorithm is presented. The purpose of the proposed algorithm is minimizing the maximum runtime (Make span). As firefly algorithm has features such as high convergence rate, non-sensitive to initial values, flexibility and a high fault tolerance is one of the best initiative methods. By combining the advantages of genetic algorithms and fireflies, it improves convergence speed and finding the optimal solution. The proposed algorithm was compared with genetic algorithm and firefly, and the proposed algorithm has better performance than other algorithms.

As it was mentioned, by increase of the number of shares diversification has been made more; and the result is portfolio with lower risk and returns. On the other hand, considering the number of lower shares, diversification of portfolio is low; and risk and return are increased.

The limits in integer number of shares, ie shares that the investor is willing to have available in his portfolio can closer the equation to real decisions on investment. The model can be widely used in investment decisions. Thus, the investor may specify the desired number of shares to form efficient portfolios at different levels of risk and return due to the performance of model, the number of shares is determined by the investor for trading. For further research, it is recommended to use models to assess and measure risk (such as standard var) to compare the performance of models and boundaries resulting performance. It is also possible to compare it with the proposed model using other metaheuristic algorithms such as ant colony algorithms, development or neural networks and compare the results with the proposed model. On the other hand, it is suggested that we analyze the similarities and differences by comparing the results of the model with the top 50 stock introduced by the Tehran Stock Exchange in different years.

Conflict of interest

The authors declare no conflict of interest

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