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Research Paper

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The combination of genetic algorithm in the optimization of the stock portfolio in the financial decision of investors

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Abstract

The purpose of this research is to combine the genetic algorithm in the optimization of the stock portfolio in the financial decision making of investors; in a simulation project, the final use of the input data is to build the simulation model. This process includes collecting input data, analyzing the input data, and using these analyzed input data in the simulation model. The statistical population of the research includes 20 symbols (companies) from among the industries (Vabsadar, Vetjarat, Akhaber, Fakhuz, Fars, Balbar, Tapampi, Khasapa, Khodro, Sasharq, Sosofi, Shobhorn, Shapna, Ghopino, Fould, Ghasabat, Kesra, Vanbank, Vanneft, Veniki) and the information related to the daily stock price and the daily index value from Decembre 22, 2008 to January 16, 2020 was considered as a sample. The tool for collecting information and data is using the Phipiran site, and the amount of beta (risk) of stocks is calculated monthly using Excel software, and the frequency of return and beta (risk) calculated using Spss software, and distribution functions were discussed using Easy fit software; the results showed that if the agents are beginners to earn more profit than normal behavior and accept 40% risk, the amount of profit obtained after optimizing the model with genetic algorithm is more than the initial model. If the agents are professionals to earn more profit than risk-averse behavior and accept 80% risk, the amount of profit obtained after optimizing the model with genetic algorithm is more than the initial model.

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Extended Abstract

Introduction

Today, in order to reduce the investment risk, investors in the financial markets prefer to allocate capital to a portfolil consisting of several shares rather than investing in only one share; because this enables them to bear a lower level of risk in order to achieve a certain amount of return in a certain period of time. An issue that has occupied the minds of many financial analysts and investors for many years is how to choose stocks and optimize the investment portfolio over time in a way that meets the investor's expectations in order to maximize the return on investment. When investors are exposed to uncertainty, the investment portfolio selection framework should include a quantitative measure of uncertainty to achieve the expected return or a quantitative measure of risk (Shahraki Sanavi, 2023).

Today, with the increasing growth and changes of financial markets in developed and developing countries, or due to the unpredictable performance of investors, pure mathematical solutions are not enough to solve such problems, and therefore robust algorithms are considered to solve them. (SheidaeiNarmigi et al, 2020).

Genetic algorithm can solve the problem of stock portfolio optimization by considering different levels of risk or success. By means of the genetic algorithm, you can create an optimal portfolio within a few minutes, which will cause a change in the capital market and will greatly help the efficiency of the capital market. One of the main signs of a country's progress is its economic progress, and if new methods are not used in the field of financial transactions, it will harm the economy (Pakmaram et al, 2017).

Therefore, the researcher is trying to answer the question; how is the genetic algorithm in optimizing the stock portfolio in the financial decision of investors?

Theoretical Framework

Genetic algorithm

The principles of genetic algorithm were first presented by Jan Haland, (1975). The genetic algorithm is an optimization algorithm with general application and is modeled on Darwin's evolutionary theory. Genetic algorithms are meta-heuristic algorithms based on biological evolution that try to obtain high-quality answers at the right time by creating an initial population and improving its quality by applying various operators (Farughi et al, 2020). Genetic algorithms are suitable for multi-objective optimization due to examining a set of possible solutions and also less sensitivity to a specific form of optimal points. Objectives are in the form of mathematical functions and represent appropriate use to improve decisions in optimization (Sheydaei Narmighi et al, 2020).

The concept of stock portfolio optimization has become like a tool in the direction of developing and understanding financial markets and financial decision making. Consider the spread of risk and return at the same time and choose the amount of capital allocation between various investment opportunities based on the interaction between the two. Therefore, the investment that seeks to maximize the expected return and minimize the risk has these two opposite goals that must be balanced against each other. One of the interesting results of these two opposing goals is that the investor should diversify by buying several types of securities. On the other hand, due to the complexity of management, the system of rules and regulations and the policies of asset; management companies in the framework of financial markets, investment managers impose restrictions on their optimal asset set, which makes the model nonlinear and complicates the problem. (Faridi et al, 2022).

Niko & Bazrafshan (2023) investigated the stock portfolio using a combined genetic algorithm and simulated refrigeration. The results show that the hybrid algorithm searches for

the optimal solution in a shorter period of time than the genetic algorithm and performs better than the other two algorithms in terms of risk and return.
Shahbazi (2022) investigated stock portfolio optimization with beta coefficient clustering approach. The goal of the challenge is to minimize the portfolio variance. The stock clustering method is to group beta coefficients of stocks into four clusters. The investor has an expected return that the portfolio must meet. Expected returns and clustered shares are inputs to the problem. It is not possible to borrow and sell on credit. A non-linear mixed integer mathematical model is presented to introduce the proposed portfolio and in one case it is checked on 50 most active stock companies. Finally, the Sharp index shows a favorable result.

Research methodology

In a simulation project, the final use of the input data is to build the simulation model. This process includes collecting input data, analyzing the input data, and using these analyzed input data in the simulation model. The statistical population that was used for the implementation of the mentioned research was accepted in the stock exchange company with 52 industries and approximately 1,543 symbols, which were used for daily trading in the stock market. In this research, 20 brands (companies) are considered including (Vabsadar, Vetjarat, Akhaber, Fakhuz, Fars, Balbar, Tapampi, Khasapa, Khodro, Sasharq, Sosofi, Shobhorn, Shapna, Ghopino, Folad, Qathabat, Kesra, Vabank, Veneft, Vaniki). The tool for collecting information and data is using the site https://www.fipiran.com.

Research findings

The amount of beta (risk) of stocks was calculated monthly using Excel software, the frequency of return and beta (risk) was calculated using Spss software, and the distribution functions were analyzed using Easy fit software. The results showed that by making more transactions, people turn from beginners to professionals, and people turn from risk-averse to normal and then risk-taking. Examining the system in a longer time horizon provides more realistic results and the simulation model can be examined in more realistic conditions.

Conclusion

The current research has been carried out with the aim of combining the genetic algorithm in the optimization of the stock portfolio in the financial decision making of investors. The results of this research are consistent with the results of Shahbazi (2022), Kalayci et al, (2020), Li & Tam (2020), Mirabi & Zarei (2020). Pakmaram et al, (2017) showed that the genetic algorithm had a lower objective function value, or in other words, it reached the best result with the least error; it performed better than other algorithms and shows the relative superiority of this algorithm in choosing the optimal stock portfolio.
According to the present research, it is suggested that investors (risk averse/risk taking) should also examine other models with regard to the expected return, because according to their risk tolerance or risk aversion, their returns will be different. One of the important points for investors is portfolio management and considering future transaction costs. Investors always want to achieve their desired portfolio with the least number of transactions and consequently the lowest future transaction costs.