Optimal Portfolio Selection with Genetic Algorithm: An Example of BIST-30

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Extensive Summary

Genetic algorithms, which aims to find optimal results in very large solution space for a given problem is an optimization technique. In other words, it is a soft computing techniques used in solving problems that quite time-consuming and called as NP-hard problems. Genetic algorithms are used actively in the solution of many problems in the literature. In this paper, the optimal portfolio selection process is performed by using genetic algorithms. The user is enabled to select the most suitable portfolio combination according to the risk level with the proposed approach.

The most fundamental problems of genetic algorithms is to determine coding and the goal functions. These problems are the main factors the most challenging users and influencing the presence of an optimal solution. Any one of the coding variants in the literature can be chosen according to the problem. The permutation coding method is preferred in designed genetic algorithm under this paper. The solution of the problem is obtained with this coding method because it offers ease of use. Another major problem is the objective function. This function varies from problem to problem and provides the optimal solution for the users.

One of the main problem is an optimal portfolio selection in the financial investment decisions. In this context, the determining of optimal portfolio by using which method is a significant for researcher. On the other hand, genetic algorithm is optimization technical to select optimal portfolio when there are the plurality of cluster solutions. Moreover, there are main basic elements while investment decision is taken by investors. These elements are risk and return. According to modern portfolio theory the most significant subject is correlation between securities. Portfolio risk can be decreased by bringing together high negative correlation assets in this theory, instead of the increasing randomly a number of securities in conventional portfolio theory.
An object function that contains the values of return and risk is created in this proposed approach and the relationship between risk and return is tried to be maximized by using a coefficient value. A portfolio pools consisting of 28 different securities is formed in this study. Genetic algorithm steps that coding, fitness value, selection, crossover and mutation operations were applied to the data on this portfolio to find the optimal solution, respectively. The designed genetic algorithm under this paper is taken covariance matrix, return values and coefficient values obtained from portfolios as the input parameters. The optimal portfolio distribution and the change of affinity values are obtained from the proposed method as the output parameters. In this study, the coefficient values used in the objective function is user-defined and it is [0,1] in the range. Six different coefficient values was used to examine the performance of the algorithm and the optimal result was obtained with the 0.2 coefficient value. This coefficient values indicate fundamentally impact on the objective function of the return and risk factors. In other words, the selection of 0.2 coefficient value is applied to the objective function value of 80% return and 20% risk values. The difference between gaining values and risk values is dawned to the maximum point by the used of objective function. Algorithm is terminated when this difference is maximum and portfolio combination is outputted just as this value obtained. The most important reason for preferring genetic algorithm under this study, this optimization technique is to produce fast and effective results. An improvement of about 26% is provided for all coefficients in the objective function with the proposed genetic algorithm-based portfolio selection approach.

When Lambda value (\(\lambda\)) is 0.20, optimal portfolio selection is consist of 18 shares. According to the application findings which is used data spanned from January-2010 and June-2013. When a dominance of risk factor increases, performance of algorithm decreases and optimal portfolio selection is consist of all BIST-30 Indices. In addition, when examining the results of the algorithm will be seen that the proposed method provides a fast and effective results significantly in the selection of the portfolio.