A Hierarchical Fuzzy Portfolio Selection Process Considering Transaction Costs with a Hybrid Intelligent Algorithm

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ABSTRACT

This article presents a hierarchical process for multiobjective portfolio selection in fuzzy environment. Methodology proposed in this paper is consist of three main steps; (a) determining weight of each objective including return, risk and liquidity, by fuzzy logarithmic least square according to investors’ preferences matrix by the means of DE algorithm, (b&c) assigning pareto frontiers of problem and computing portion of each security by multiobjective mathematical programming in accordance to obtained weights by the means of GA. Also transaction cost related to each security which are rarely considered in previous works are brought in the authors’ model.

Keywords: Fuzzy Variable, Hierarchical Process, Intelligent Algorithm, Liquidity, Multiobjective, Portfolio Selection, Transaction Cost

INTRODUCTION

Principles of Portfolio Selection

The most appropriate definition for portfolio selection, could be obtained from Zhang, Wang, Chen, and Nie (2007), Tiryaki and Ablatioğlu (2009) and Huang (2009), which is allocating what proportion of one’s wealth to each asset, to achieve investors’ goals. It is also noticeable that sometimes these goals affect mathematical definition of objectives. Interestingly results obtained by Liu (2011) conform to claim provided by Markowitz (1952) that the greater the amount of risk that an investor is willing to take on, the greater the potential return.

Various measures are defined to represent risk of portfolio; (Markowitz, 1952) as the pioneer, introduces variance to measure the risk. Konno and Yamazaki (1991) demonstrated

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that mean absolute deviation risk function eliminates complexity of computing variance. Huang (2009) mentions that people are only averse of negative deviations not any kind of deviation, Therefore he suggested to employ semivariance as measure of risk.

Leung, Daouk, and Chen (2001) and X. Li, Qin, and Kar (2010) order to maximize skewness beside minimizing variance because increasing skewness will decrease the probability of large negative returns, while increasing the probability of large positive returns. As an evidence we can mention an article by Prakash, Chang, and Pactwa (2003) and a recent work by Chen, Luo, Liao, Yu, and Yang (2011), which state that maximizing the skewness of return could efficiently improve performance of the traditional Markowitz mean–variance portfolio model.

Bilbao-Terol, Pérez-Gladish, Arenas-Parra, and Rodriguez-Uría (2006) explains different attitudes toward risk and classifies its measures in three categories, variance-covariance matrix, single-index model and multi-index model. In this paper it is discussed that single-index model outperforms other ones in defining risk of portfolio.

Liquidity of an asset is defined as follows: “Possibility of converting an investment into cash without any significant loss in value.” (Arenas Parra, Bilbao Terol, & Rodríguez Uría, 2001)

Transaction cost is defined as follows: “In economics and related disciplines, a transaction cost is a cost incurred in making an economic exchange (restated: the cost of participating in a market). For example, most people, when buying or selling a stock, must pay a commission to their broker; that commission is a transaction cost of doing the stock deal.” (Firth, 2010)

Necessity of Using Fuzzy Approach

To clarify the necessity of using fuzzy approach in field of portfolio selection, We mention some portfolio experts’ points of view about this matter below.

Markowitz (1952) without any knowledge about fuzzy logic perceived the need for engaging judgment of practical men and mentioned combination of subjective factors with objective ones. Tanaka, Guo, and Türksen (2000) mention that the simulation results show the possibility portfolio is more suitable than the fuzzy probability one in real investment problems. Arenas Parra et al. (2001) suggest a portfolio selection model which takes into account three criteria: return, risk and liquidity. These objectives, in general, are not crisp, so we must deal with them in fuzzy terms. According to what Joseph and Mazouz (2010) mention about large price shocks, it is vital to insert fuzzy approximations because large shocks are not mostly predictable by the means of probabilistic approaches. Liu (2011) states that because of volatility of financial market we cannot assume that future behaves as past did; So we should consider market parameters fuzzy. Huang (2011) expressed that using only random variables is inefficient especially for short-term securities.

Literature Review

In advance a review of recent works about portfolio selection especially in uncertain environment is brought. These studies are divided in two main categories regarding to number of objectives.

Single-Objective Portfolio Selection Models

In the premier study of modern portfolio selection by Markowitz (1952), Only random variables of risk and return are considered and variance is the measure of risk; The final aim of his model is determining proportion of investment in each security. Carlsson, Fullér, and Majlender (2002) provided a utility score function to compare investment portfolios based on the expected return and risk of the portfolios, the rates of return on securities are modeled by possibility distributions rather than probability ones.
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