PORTFOLIO SELECTION PROBLEMS CONSIDERING FUZZY RETURNS OF FUTURE SCENARIOS

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Abstract. This paper considers multi-criteria mathematical decision models with respect to portfolio selection problems, particularly multi-scenario models to the future return of each asset including ambiguity and the fuzzy extension of mean-variance model and mean-absolute deviation model. The proposed models are generally formulated as multi-criteria stochastic programming problems and fuzzy programming problems. Since they are not well-defined problems due to random and fuzzy variables and it is difficult to solve them directly and analytically, two cases with respect to proposed models are considered. Furthermore, introducing the possibility and necessity chance constraints, they are equivalently transformed into linear or quadratic programming problems and the efficient solution methods are constructed. Then, a numerical example of portfolio selection problem is given to compare proposal models with the basic model.

Keywords: Portfolio selection, Multi-criteria, Possibility measure, Necessity measure

1. Introduction. Recently, not only big companies and institutional investors but also individual investors called Day-Traders take part in investment fields, and there exist various investments such as stock, currency, proper, land, etc. Therefore, in order to make an optimal investment fitted with each idea of investor, the role of investment theory becomes more and more important. Of course, it is easy to decide the most suitable asset allocation if decision makers can receive reliable information with respect to future returns a priori. However, there exist some cases that uncertainty from social conditions have a great influence on the future returns. In the real market, there are random factors derived from statistical prediction based on historical data and ambiguous factors derived from the mental point of investors and lack of reliable information. Under such uncertainty situations, they need to consider how to reduce a risk, and it becomes important whether an investment makes profit greatest.

A portfolio selection problem is one of finance assets allocation problems, and the various studies have been done till now. As for the research history on mathematical approach, Markowitz (Markowitz [13]) has proposed a mean-variance model and it has been central to research activity in the real financial field and numerous researchers have contributed to the development of modern portfolio theory (for instance, Luenberger [12], Steinbach [15]). On the other hand, in mathematical programming, mean-variance model is formulated as a quadratic programming problem to minimize the variances or maximize the total profit, and so the use of large-scale mean-variance models is restricted to the stock portfolio selection in spite of the recent development in computational and modeling technologies in financial engineering. Therefore, in order to solve the mean-variance model more efficiently, Konno and his research group [9,10] have proposed the mean-absolute