

SAFETY FIRST MODELS OF PORTFOLIO SELECTION PROBLEMS CONSIDERING THE MULTI-SCENARIO INCLUDING FUZZY RETURNS

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Received February 2008; revised July 2008

ABSTRACT. This paper considers safety first models with respect to portfolio selection problems, particularly using the multi-scenario for the future return of each asset including ambiguity. Then, the fuzzy extensions for safety first models are proposed. These models are generally formulated as stochastic 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, introducing the probability and possibility chance constraints, they are equivalently transformed into 0-1 mixed linear programming problems and the efficient solution methods are constructed. Furthermore, a numerical example of portfolio selection problem is provided to compare proposed models with the basic model.

Keywords: Portfolio selection, Safety first model, Multi-criteria, Possibility measure, Necessity measure

1. Introduction. In recent investment fields, by developments of information technology and computers, a number of not only institutional investors but also individual investors called Day-Traders increases. Thereby, the role of investment theory such as a portfolio theory becomes more and more important. Of course, it is easy to decide the optimal portfolio in the case that decision makers can receive all reliable information with respect to future returns a priori. However, there exist some cases that uncertainty from practical social conditions have a great influence on the future returns. In the real market, there are random and ambiguous factors at least derived from the statistical prediction based on historical data, the lack of efficient information from practical investment fields and each investor's subjectivity derived from her or his longtime experience. Under such uncertainty situations, investors must find ways to reduce risks and earn maximum profits.

A portfolio selection problem is one of the important assets selection problems, and various studies have been done till now. As for the research history on mathematical approach, Markowitz (Markowitz [17]) proposed the mean-variance model and it has been centre of research activities in the real financial field and numerous researchers have contributed to the development of modern portfolio theory (for instance, Luenberger [16], Steinbach [19]). On the other hand, since the mean-variance model is formulated as a quadratic programming problem to minimize the total variance or maximize the total profit, 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. Konno and his research group [12, 13] have proposed the mean-absolute derivation model which results in linear programming problem and can be solved faster than a corresponding mean-variance model. Furthermore, many researchers have