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Multi-scenario portfolio selection problem with fuzzy returns and aspiration levels

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Abstract

This paper considers several multi-scenario portfolio selection problems under randomness and fuzziness. When they invest possession funds on finance assets such as stocks, they predict how much profit is provided in the future and must decide the most suitable investment. Furthermore, in recent investment filed, not only big companies and institutional investors but also individual investors called as Day-Traders invest in stock, currency and land and property. Therefore, the role of investment theory becomes more and more important. Of course it is easy to decide the most suitable investment if they know the future return a priori. However, since returns always change and there may exist the cases that an uncertainty from social conditions has a great influence on the future return and that available information is lack, we must consider how to reduce a risk, and it becomes important whether an investment makes profit greatest under an uncertainty condition.

As for research history on mathematical approach, such a finance assets selection called a portfolio selection problem has been introduced by Markowitz (mean-variance model) and the various studies have been done till now. Then, many researchers have proposed models of portfolio selection problems which extend Markowitz model: CAPM, Value-at-Risk, etc.. In many traditional portfolio selection problems, an expected return of the future return is assumed to be a fixed value. However, in real world, we received a lot of efficient or inefficient information and the reliability to information is different and ambiguous. Furthermore, even if we know all the historical and current data, it is difficult that we predict the future return as the fixed value. Hence we need to consider that the future return has the ambiguous. In this paper, we consider the future return as a fuzzy number, and proposed portfolio selection problems including them. Then, in the case that we predict the future return, we generally consider not only one scenario but also several scenarios. Konno has proposed the multi-scenario portfolio selection problem which extends Markowitz portfolio theory. In this paper, we consider the fuzzy extension to this multi-scenario portfolio selection problem. Furthermore, investors often have an aspiration level with respect to each return scenario and expect a portfolio decision satisfying its aspiration level assumed to a fuzzy goal: i.e. they earn the total future return more than its target value. Hence we need to consider randomness, fuzziness and multi-scenario to the future return including the aspiration level to each scenario, and so we propose multi-scenario portfolio selection problems including random variables and fuzzy numbers.

In mathematical programming problems, since the problems including randomness and fuzziness are called stochastic and fuzzy programming problems and usually transformed into nonlinear programming problems, it is difficult to solve these problems directly. Furthermore, since proposed models are multi objective fuzzy programming problems, it is more difficult to solve them. However, beside new types of portfolio selection problems, we transform these problems into the equivalent deterministic programming problems using chance constraints and manage to construct efficient solution methods for them. Furthermore, using the obtained conclusion, we discuss the multi-period portfolio selection problems, particularly a portfolio rebalance model.

Keywords: Portfolio selection problem; Scenario model; Stochastic and Fuzzy programming; nonlinear programming problem

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