MULTISTAGE PORTFOLIO OPTIMIZATION WITH VAR AS RISK MEASURE

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Abstract. *Multistage portfolio optimization models are difficult to solve when market risk is measured by Value-at-Risk (VaR), this paper proposes a soft method for solving VaR-based portfolio optimization models based on a soft optimization approach.*

In order to demonstrate the validity of the proposed soft method, we perform portfolio management experiments with real data from the New York stock market, and compare the performances of the strategies suggested by the soft method with those of two other investment strategies.

Keywords: Portfolio management, Multistage portfolio optimization, Value-at-Risk, Soft optimization approach

1. **Introduction.** Portfolio management usually includes initial portfolio selection and portfolio rebalancing during a plan horizon so that the risk and return of investment will meet certain requirements. Multistage portfolio optimization is expected to facilitate these investment decisions. Refer to Hibiki [4] and Takemura [13] for a general introduction to multistage portfolio optimization.

While return of investment is primarily measured by the expected profit rate, various measures have been proposed for risk. Variance, proposed by Markowitz [7], has been the most popular risk measure in academia, but variance penalizes gains and losses in the same way, and there are computational difficulties in large-scale portfolio optimization problems when risk is measured by variance. To overcome these shortcomings, a number of other risk measures, including absolute deviation (Konno, Yamazaki [6]), Value-at-Risk (VaR, see Morgan [8]), and Conditional Value-at-Risk (CVaR, see Rockafellar and Uryasev [10]), have been proposed. Refer to Dowd [2] for an introduction to various risk measures.

The present paper takes VaR as the risk measure, although VaR is still fervently debated [1]. The VaR is incorporated directly into portfolio management for two reasons. First, VaR is the most popular measure of risk and is currently the standard in the finance industry. As such, VaR should be chosen over other risk measures. Second, it is desirable to work with VaR directly in the context of mean-risk tradeoff when the preferences of investors are expressed in terms of VaR. Gaivoronski and Pflug [3] pointed out that efficient frontiers constructed on the basis of other measures can be a poor approximation

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[1]See Artzner, et al. [1] and Szego [12] for this argument.