Monika Kal'atová, Miloš Kopa: Bilevel Portfolio Optimization Problems

It is a common practice for an investor to make a decision based on the portfolio's return and risk. To find an efficient portfolio, we consider the mean-risk optimization model, where Conditional Value-at-Risk, as a frequently used risk measure, is applied. Since the efficient frontier comprises many efficient portfolios, additional criteria should be applied. The connection between the mean-CVaR optimization model and the application of additional criteria to the portfolio choice leads to bilevel optimization problems.

First, having a given mean-CVaR inefficient portfolio as the benchmark, the problem of identifying the closest mean-CVaR efficient portfolio to the benchmark is addressed. For a given CVaR confidence level, the lower level guarantees that only mean-CVaR efficient portfolios are feasible, and the upper level chooses the portfolio that minimizes proportional transaction costs when changing from the benchmark.

The second problem combines in-sample mean-CVaR efficiency with the out-of-sample gross return maximization. Contrary to the previous model, the mean-CVaR efficiency is considered with respect to both the risk aversion parameter and the CVaR confidence level.

The last problem converts the second one to the moving window framework, where every window corresponds to one lower-level mean-CVaR criterion and the upper level maximizes the total gross return over all out-of-sample periods. Two versions of this bilevel problem are considered: (i) risk aversion parameters and CVaR levels are the same in all windows; (ii) risk aversion parameters and CVaR levels could change from window to window.

Some numerical results will be presented.

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