Portfolio Learning via VaR/CVaR Minimization

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Abstract

Traditional portfolio selection models optimize a criterion in terms of the in-sample performance so as to obtain an estimate of the ideal portfolio vector. Since the samples of return data used in the optimization are limited in practice, estimation error of the optimal portfolio can then be significant. In this research, we propose a new portfolio optimization approach which aims to improve the out-of-sample performance by minimizing the upper and lower bounds of the out-of-sample loss probability under a mild assumption of the return distribution. These bounds are motivated by the so-called generalization error bounds, which is developed in the area of statistical learning. Based on the bounds, two fractional programs are posed for constructing portfolios, where the numerator of the ratio to be minimized includes the value-at-risk (VaR) or the conditional value-at-risk (CVaR) while the denominator is a norm of the portfolio vector. Interestingly, this also implies that the short-sale constraint brings a theoretical underpinning to the out-of-sample performance of the ordinary VaR/CVaR minimization. Some computational experiments are conducted on randomly generated data and real stock market data, demonstrating the promising performance.