Robust portfolio optimization

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Keywords: Black-Scholes model, robust portfolio optimization, Markowitz' problem, $1/n$ strategy, ranks.

AMS: 60H30,62P05

Abstract

It is widely recognized that when classical optimal strategies are used with parameters estimated from data, the resulting portfolio weights are remarkably volatile and unstable over time. The predominant explanation for this is the difficulty to estimate expected returns accurately. We propose to parameterize an n stock Black-Scholes model as an n factor Arbitrage Pricing Theory model where each factor has the same expected return. Hence the non-unique volatility matrix determines both the covariance matrix and the expected returns. This enables the investor to impose views on the future performance of the assets in the model. We derive an explicit strategy π^* which solves Markowitz' continuous time portfolio problem in our framework. The optimal strategy is to implicitly keep $1/n$ of the wealth invested in stocks in each of the n underlying factors. To illustrate the long-term performance of π^*, we apply it out-of-sample to a large data set. We find that it is stable over time and outperforms all the underlying market assets in terms of Sharpe ratios. Further, π^* had a significantly higher Sharpe ratio than the classical $1/n$ strategy.