Asymptotic methods for portfolio risk management

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Abstract

We present new results regarding the tail behavior of the sum of dependent positive random variables.

This problem has received considerable attention in the literature, but mainly in the insurance context, where the random variables represent losses from individual claims, and one is interested in the right tail asymptotics of their sum. By contrast, we focus on the finance context, where the random variables represent the prices of individual assets, and to estimate the probability of a very large loss, one needs to focus on the left tail asymptotics of their sum. Owing to the positivity of the variables, these asymtotics turn out to be very different from those of the right tail. In particular, the dependence and diversification effects play a major role.

In the talk, we shall discuss logarithmic "large deviations" asymptotics for the distribution function of the sum of positive random variables in a general case, as well as sharp asymptotic results in specific cases. These results have a wide range of applications in risk analysis of long only portfolios. Among other issues, we shall consider
- Variance reduction methods for precise estimation of tail event probabilities by Monte Carlo.
- Asymptotic formulas for implied volatility of basket options.
- Behavior of long only portfolios under market downturns and systematic design of stress tests for such portfolios.