High-Dimensional Multivariate Volatility Models

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Multivariate volatility has many important applications in finance, including asset allocation and risk management. Estimating multivariate volatility, however, is not straightforward because of two major difficulties. The first difficulty is the curse of dimensionality. For k assets, there are k(k+1)/2 volatility and cross-correlation series. In addition, the commonly used volatility models often have many parameters, making them impractical for real application. The second difficulty is that the conditional covariance matrix must be positive definite for all time points. This is not easy to maintain when the dimension is high.

In this paper, we develop a new approach to modeling multivariate volatility. Our approach is very flexible. The dimension of the asset is expandable and the computation can be carried out via parallel processing. In addition, the resulting volatility matrix is positive definite for every time index. This is achieved by using Cholesky Decomposition and time-varying coefficient regressions. Properties of the resulting models are discussed. For demonstration, we apply the new approach to several examples, including daily returns of the 30 components of Dow-Jones Industrial Index and a portfolio that consists of returns from hundreds of components of the Standard and Poor 500 index. (Joint work with Hedibert Lopes and Robert McCulloch)

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