Cholesky Stochastic Volatility Models for High-Dimensional Time Series

Abstract

Multivariate time-varying 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 p time series, there are p(p+1)/2 volatility and cross-correlation series. 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 order to simply maintain positive definiteness, we model the Cholesky root of the time varying p x p covariance matrix. Our approach is Bayesian and we propose prior distributions that allow us to search for simplifying structure without placing hard restrictions on the parameter space. Our modeling approach is chosen to allow for parallel computation and we show how to optimally distribute the computations across processors. We illustrate our approach by a number of real and synthetic examples, including a real application with 94 components (p=94) of the S&P 100 index.