

# High Dimensional Covariance Matrix Estimation Using a Factor Model

**Jinchi Lv** (Joint with Jianqing Fan and Yingying Fan)  
(Princeton University)

**Date :** October 27, 2006      **Time :** 12-1 PM (EDT)

## Abstract

High dimensionality comparable to sample size is common in many statistical problems. We examine covariance matrix estimation in the asymptotic framework that the dimensionality  $p$  tends to infinity as the sample size  $n$  increases. Motivated by the Arbitrage Pricing Theory in finance, a multi-factor model is employed to reduce dimensionality and to estimate the covariance matrix. The factors are observable and the number of factors  $K$  is allowed to grow with  $p$ . We investigate impact of  $p$  and  $K$  on the performance of the model-based covariance matrix estimator. Under mild assumptions, we have established convergence rates and asymptotic normality of the model-based estimator. Its performance is compared with that of the sample covariance matrix. We identify situations under which the factor approach increases performance substantially or marginally. The impacts of covariance matrix estimation on portfolio allocation and risk management are studied. The asymptotic results are supported by a thorough simulation study.