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Title: "Doubly Sparse Estimator for High-Dimensional Covariance Matrices"

Abstract: The classical sample covariance estimator lacks desirable properties such as consistency and suffers from eigenvalue spreading in high-dimensional settings. In recent years, improved estimators have been proposed based on the idea of regularization. Namely, so-called rotation-equivariant estimators shrink sample eigenvalues but retain the eigenvectors of the sample covariance estimator. In high dimensions, however, sample eigenvectors are generally strongly inconsistent, rendering eigenvalue shrinkage estimators suboptimal. We develop a Doubly Sparse Covariance Estimator (DSCE) that goes beyond mere eigenvalue shrinkage: a covariance matrix is decomposed into a signal part, where sparse eigenvectors are estimated via truncation, and an idiosyncratic part, estimated via thresholding. The estimator achieves the optimal rate of convergence in terms of spectral norm under reasonable assumptions. DSCE fills the gap for empirical applications that fall in-between fully sparse settings and conditionally sparse settings: DSCE takes advantage of conditional sparsity implied by factor models while allowing only a subset of variables to load on factors, which relaxes pervasiveness assumption of traditional factor models. An empirical application to the constituents of the S&P 1500 illustrates that DSCE-based portfolios outperform competing methods in terms of Sharpe ratio, maximum drawdown, and cumulative return for monthly and daily data.