A Two-Stage Adaptive Method for Estimating Large Covariance and Precision Matrices.

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- **Abstract:** In high dimensional statistics, estimating large population covariance and precision matrices (inverse covariance matrices) has become the most noticeable topic because of its vast range of applications. Estimating such matrix is always challenging because of its high dimensional complexities and burdensome in computations. Several methods of estimating such matrices have been proposed. These include formulating principal component analysis (PCA), regression-based derivation, and tapering a matrix. However, these estimators are not always guaranteed to be positive definite. We have proposed an adaptive two-stage procedures of estimating such matrices based on Cholesky decomposition. Our main purpose of this research study is to come up with the procedure that maintains the positive definiteness of the resultant matrix (estimator) of the given covariance and precision matrix. In the first stage, we fix the bandwidth and estimate the banded version of Cholesky factors of the given matrix and its associated regression coefficient matrix. In the second stage, we estimate the off-band entries of the associated regression coefficient matrix. We have investigated the theoretical properties of these proposed estimators for large varieties of classes of covariance matrices. In the simulation studies, we have carried out the studies into certain classes of covariance matrices such as autoregressive, moving average, and long-range dependent matrices. Furthermore, we have shown the comparisons of estimation-errors for different bandwidths under Frobenius norm and applied our proposed method to analyze some financial data such as S&P 500 index and IBM stock returns.

- **Keywords:** high dimensional complexities, Cholesky decomposition, regression coefficient matrix, IBM stock returns