THE UNIVERSITY OF CHICAGO | DEPARTMENT OF STATISTICS

Master's Thesis Presentation

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"Sparse Inverse–Cholesky Estimation under Model Misspecification"

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Abstract

Estimating structured precision matrices is fundamental in high-dimensional statistics and spatiotemporal modeling. We revisit sparse Cholesky-based parametrizations of the precision matrix, which offer both computational tractability and interpretability by encoding conditional independencies row by row. Taking a maximum-likelihood perspective, we show that for any fixed sparsity pattern, the population MLE coincides with the Kullback–Leibler–optimal Vecchia factorization studied by Owhadi et al.\ (2021), unifying information-theoretic, regression-based, and likelihood-based viewpoints. We derive closed-form expressions for the sparse Cholesky estimator and characterize its asymptotic variance using Z-estimation theory and the delta method. We further establish a finite-pattern stability result showing that the pseudo--true parameters converge to their full Cholesky counterparts as the sparsity pattern expands, with errors controlled by the size of omitted covariance blocks and the conditioning of the associated Schur complements. Numerical experiments confirm the theoretical predictions, demonstrating the stability and efficiency of the proposed estimator across sample sizes and sparsity levels.

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