On dimension reduction for vector autoregressive (VAR(P)) models via spatial quantile regression

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Abstract

We propose frameworks for dimension reduction in high-dimensional Vector Autoregressive (VAR) models using Spatial Quantile Regression (SQR). By incorporating adaptive Lasso and SCAD regularization, our methods enable robust inference under heavy-tailed or non-Gaussian errors while performing automatic variable selection. To further address over-parameterization, we develop a tensor-based approach –Multilinear Low-Rank Spatial Quantile Regression (MLRSQR)– which restructures VAR transition matrices into low-rank tensors for simultaneous parameter reduction and quantile-wise modeling. Additionally, we introduce the Sparse Higher-Order Reduced-Rank SQR (SHORRSQR) estimator, integrating Lasso penalties for sparsity, and design efficient ADMM-based algorithms.

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