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Title:

High-dimensional multivariate time series with spatial structure

Abstract:

High-dimensional multivariate time series are challenging due to the dependent and high-dimensional nature of the data, but in many applications there is additional structure that can be exploited to reduce computing time along with statistical error. We consider high-dimensional vector autoregressive processes with spatial structure, a simple and common form of additional structure. We propose novel high-dimensional methods that take advantage of such structure without making model assumptions about how distance affects dependence. We provide non-asymptotic bounds on the statistical error of parameter estimators in high-dimensional settings and show that the proposed approach reduces the statistical error. An application to air pollution in the U.S.A. demonstrates that the estimation approach reduces both computing time and prediction error and gives rise to results that are meaningful from a scientific point of view, in contrast to high-dimensional methods that ignore spatial structure. In practice, these high-dimensional methods can be used to decompose high-dimensional multivariate time series into lower-dimensional multivariate time series that can be studied by other methods in more depth.