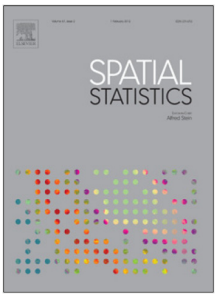

Fast and scalable variational Bayes estimation of spatial econometric models for Gaussian data

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Fast and Scalable Variational Bayes Estimation of Spatial Econometric Models for Gaussian Data

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Abstract

Spatial econometric models have been widely used for analyzing cross-sectional data in which spatial dependence is of primary interest. Although proven successful, Bayesian estimation via Markov chain Monte Carlo (MCMC) for spatial econometric models can be computationally demanding as the size of data and complexity of models grow. This paper proposes two variational Bayes methods that are more scalable and computationally faster in estimating general spatial autoregressive and matrix exponential spatial specification models: the hybrid mean-field variational Bayes (MFVB) method and the integrated nonfactorized variational Bayes (INFVB) method. The hybrid MFVB method assumes posterior independence and, when applicable, can yield accurate results but tends to underestimate posterior variances. In comparison, the INFVB method provides more robust results by accounting for posterior dependence and is computationally appealing due to parallelization. We demonstrate that variational Bayesian inference can be a faster and more scalable alternative to the MCMC approach for Bayesian spatial econometric modeling. The effectiveness of our proposed methods for spatial econometric models is demonstrated through simulated examples and a real-world data application.

KEY WORDS: Big Data, Markov Chain Monte Carlo, Spatial Econometrics, Variational Bayesian Inference

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