Saddlepoint-Based Bootstrap Inference for Spatial Dependence in the Lattice Process

A. Alexandre Trindade

Department of Mathematics and Statistics, Texas Tech University

Robert L. Paige

Department of Mathematics and Statistics, Missouri University of Science and Technology

Pratheepa Jeganathan

Department of Mathematics and Statistics, Texas Tech University

We present a saddlepoint-based bootstrap (SPBB) method to make inference for spatial dependence parameter in the spatial lattice models such as simultaneous autoregressive (SAR), conditional autoregressive (CAR) and simultaneous moving average models (SMA). The inference based on these parametric models is generally more powerful than the non-parametric Morans'I based approaches which tend to dominate due to ease of computation. The SPBB method works with the root of a monotone quadratic estimating equation (QEE) of which the maximum likelihood estimator (MLE) for spatial dependence parameter is the unique solution. Under the normality, this QEE has a closed-form expression for moment generating function (MGF) which is then inverted via SPBB to produce an approximation to the cumulative density function (CDF) of the MLE. This approximate CDF is then pivoted to form a confidence interval for spatial dependence parameter in the lattice models. Simulation studies show that SPBB confidence intervals outperform the standard asymptotic-based ones in terms of coverage probability and length, both in small as well as large sample size settings.

Key words: Saddlepoint-based bootstrap approximation, quadratic estimating equation, maximum likelihood estimator, spatial lattice models