Likelihood-based estimation for Gaussian MRFs

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Abstract

Markov random fields (MRFs) express spatial dependence through conditional distributions, although their stochastic behavior is defined by their joint distribution. These joint distributions are typically difficult to obtain in closed form, the problem being a normalizing constant that is a function of unknown parameters. The Gaussian MRF (or conditional autoregressive model) is one case where the normalizing constant is available in closed form; however, when sample sizes are moderate to large (thousands to tens of thousands), and beyond, its computation can be problematic. Because the conditional autoregressive (CAR) model is often used for spatial-data modeling, we develop likelihood-inference methodology for this model in situations where the sample size is too large for its normalizing constant to be computed directly. In particular, we use simulation methodology to obtain maximum likelihood estimators of mean, variance, and spatial-depencence parameters (including their asymptotic variances and covariances) of CAR models.