

Efficient estimation for large data in semiparametric spatial zero-inflated models

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Spatial two-component mixture models offer a robust framework for analyzing spatially correlated data with zero inflation. To circumvent potential biases introduced by assuming a specific distribution for the response variables, we employ a semiparametric spatial zero-inflated model. Despite its flexibility, this model poses significant computational challenges, particularly with large datasets, due to the high dimensionality of spatially dependent latent variables, the complexity of matrix operations, and the slow convergence of estimation procedures. To overcome these challenges, we propose a projection-based approach that reduces the dimensionality of the problem by projecting spatially dependent latent variables onto a lower-dimensional space defined by a selected set of basis functions. We further develop an efficient iterative algorithm for parameter estimation, incorporating a generalized estimating equation (GEE) framework. The optimal number of basis functions is determined using Akaike's information criterion (AIC), and the stability of the parameter estimates is assessed using the block jackknife method. The proposed method is validated through a comprehensive simulation study and applied to the analysis of Taiwan's daily rainfall data for 2016, demonstrating its practical utility and effectiveness.