A Novel Approach for Modeling Zero-Modified Spatiotemporal Data Based on Generalized Estimating Equations

Kuo-Chuan Chang（張果全）
國立高雄大學統計學研究所

Abstract

In contemporary statistical modeling, various techniques are available for analyzing zero-inflated count data, among which zero-inflated models are commonly used. However, hurdle models offer greater flexibility, especially in scenarios with low zero proportions. Thus, we adopt the assumption that the marginal distribution of the response follows a hurdle binomial distribution, accommodating both zero-inflated and zero-deflated situations. Additionally, to address spatiotemporal correlations resulting from repeated measurements within specific regions, we employ Generalized Estimating Equations (GEE) for estimating the regression coefficients. Notably, GEE demonstrates robustness, making it suitable even when the underlying distribution is unknown. Furthermore, we incorporate an iteratively nonparametric technique to update the working correlation matrix and utilize the jackknife approach to approximate the estimation variance of GEE, resulting in more effective and reliable estimates. In the simulation results, our proposed methodology proves to be promising for analyzing complex spatiotemporal datasets with zero-modified characteristics. Additionally, a series of comparative analyses with alternative hurdle models employing different parameter estimation methods are conducted. The results demonstrate the advantage of our approach over the alternatives based on mean squared error measurements.

Keywords: Generalized Estimating Equations, Jackknife resampling, Spatiotemporal correlations, Zero-inflated, Zero-deflated.