A GEE-Based Hurdle Framework for Zero-Modified Spatiotemporal Count Data with Environmental Applications

Yang, Hong-Ding

Department of Applied Mathematics, National Chiayi University

Abstract

We propose a generalized estimating equation (GEE) framework for analyzing zero-modified spatiotemporal count data, where excessive or reduced zeros coexist with correlation across space and time. A hurdle model allows us to separately model the probability of zeros and the mean of positive counts, capturing flexible covariate effects. In the estimation procedure, we update the working correlation matrix via a semiparametric approach and employ a block jackknife for reliable variance estimation. Simulation studies demonstrate that the proposed approach provides accurate slope estimation and satisfactory coverage rate of interval estimation under both zero-inflated and zero-deflated scenarios. We further illustrate the method using extreme rainfall data from Northern Taiwan, where temperature and precipitation are shown to significantly influence the occurrence of extremely heavy rain. This combined methodological and applied contribution points out the practical value of GEE-based inference in complex environmental settings. (This is a joint work with Dr. Shen, Chung-Wei and Dr. Chen, Chun-Shu.)

Keyword: hurdle model; spatiotemporal correlation; generalized estimating equations; block jackknife; environmental application