Adaptive log-linear zero-inflated generalized Poisson autoregressive model with applications to crime counts

Xiaofei Xu

National University Of Singapore
E-mail: xu.xiaofei@u.nus.edu

Abstract: This research proposes a comprehensive ALG model (Adaptive Log-linear zero-inflated Generalized Poisson integer-valued GARCH) to describe the dynamics of integer-valued time series of criminal incidents with the features of autocorrelation, heteroscedasticity, over-dispersion, and excessive number of zero observations. The proposed ALG model captures time-varying nonlinear dependence and simultaneously incorporates the impact of exogenous variables in a unified modeling framework. We use an adaptive approach to automatically detect subsamples of local homogeneity, over which the time-dependent parameters are estimated through an adaptive Bayesian Markov chain Monte Carlo sampling scheme. A simulation study shows stable and accurate finite sample performances of the ALG model under various scenarios. When implemented with the crime incidents data in Byron, Australia, the ALG model delivers a persuasive estimation of the stochastic intensity of criminals and provides insightful interpretations on both the structural breaks of intensity and the temperature impacts on different criminal categories. The findings show that the temperature effect is insignificant to ``malicious damage to property", ``breach bail conditions", and ``arson", yet is positively relevant for ``non-domestic violence related assault", ``steal from person", and ``liquor offenses". This is a joint work with Cathy Chen, Ying Chen and Xiancheng Lin.