Bayesian modelling integer-valued transfer function models

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Abstract

External events commonly known as interventions often affect times series of counts. This research introduces a class of transfer function models that include four different types of interventions on integer-valued time series: abrupt start and abrupt decay (additive outlier), abrupt start and gradual decay (transient shift), abrupt start and permanent effect (level shift), and gradual start and permanent effect. We propose integer-valued transfer function models incorporating a generalized Poisson, log-linear generalized Poisson or negative binomial to estimate and detect these four types of interventions in a time series of counts. Utilizing Bayesian methods, which are adaptive Markov chain Monte Carlo (MCMC) methods to obtain the estimation and prediction, we further employ deviance information criterion (DIC) and mean squared standardized residual for model comparisons. As an illustration, this study evaluates the effectiveness of our methods through a simulation study and application to crime data in Albury City, New South Wales Australia. Simulation results show that the MCMC procedure is reasonably effective. The empirical outcome also reveals that the proposed models are able to successfully detect the location and type of interventions.

Keywords: Intervention analysis, generalized Poisson, integer-valued GARCH model, Markov chain Monte Carlo method, transfer function.