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The Non-Stationary BINARMA(1,1) Process with Poisson Innovations: An Application on Accident Data

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Abstract : This paper considers the modelling of a non-stationary bivariate integer-valued autoregressive moving average of order one (BINARMA(1,1)) with correlated Poisson innovations. The BINARMA(1,1) model is specified using the binomial thinning operator and by assuming that the cross-correlation between the two series is induced by the innovation terms only. Based on these assumptions, the non-stationary marginal and joint moments of the BINARMA(1,1) are derived iteratively by using some initial stationary moments. As regards to the estimation of parameters of the proposed model, the conditional maximum likelihood (CML) estimation method is derived based on thinning and convolution properties. The forecasting equations of the BINARMA(1,1) model are also derived. A simulation study is also proposed where BINARMA(1,1) count data are generated using a multivariate Poisson R code for the innovation terms. The performance of the BINARMA(1,1) model is then assessed through a simulation experiment and the mean estimates of the model parameters obtained are all efficient, based on their standard errors. The proposed model is then used to analyse a real-life accident data on the motorway in Mauritius, based on some covariates: policemen, daily patrol, speed cameras, traffic lights and roundabouts. The BINARMA(1,1) model is applied on the accident data and the CML estimates clearly indicate a significant impact of the covariates on the number of accidents on the motorway in Mauritius. The forecasting equations also provide reliable one-step ahead forecasts.

Keywords : non-stationary, BINARMA(1,1) model, Poisson innovations, conditional maximum likelihood, CML
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