JOURNAL OF APPLIED STATISTICS
https://doi.org/10.1080/02664763.2023.2301321

Comparison of estimation and prediction methods for a zero-inflated geometric INAR(1) process with random coefficients

R. Nasirzadeh[a] and H. Bakouch[b,c]

[a]Department of Statistics, Faculty of Science, Fasa University, Fasa, Iran; [b]Department of Mathematics, College of Science, Qassim University, Buraydah, Saudi Arabia ; [c]Department of Mathematics, Faculty of Science, Tanta University, Tanta, Egypt

ABSTRACT

This study explores zero-inflated count time series models used to analyze data sets with characteristics such as overdispersion, excess zeros, and autocorrelation. Specifically, we investigate the ZIGINAR$_{RC}(1)$ process, a first-order stationary integer-valued autoregressive model with random coefficients and a zero-inflated geometric marginal distribution. Our focus is on examining various estimation and prediction techniques for this model. We employ estimation methods, including Whittle, Taper Spectral Whittle, Maximum Empirical Likelihood, and Sieve Bootstrap estimators for parameter estimation. Additionally, we propose forecasting approaches, such as median, Bayesian, and Sieve Bootstrap methods, to predict future values of the series. We assess the performance of these methods through simulation studies and real-world data analysis, finding that all methods perform well, providing 95% highest predicted probability intervals that encompass the observed data. While Bayesian and Bootstrap methods require more time for execution, their superior predictive accuracy justifies their use in forecasting.

ARTICLE HISTORY
Received 11 October 2023
Accepted 24 December 2023

KEYWORDS
Count time series; prediction; Whittle estimation; Bayesian; Sieve bootstrap

1. Introduction

Time series analysis of counts or integer-valued time series, as a distinguished statistical technique, has been widely used in many fields, including, the number of daily transactions in the stock markets [7], the weekly number of patients in a hospital infeeted by influenza [8], the annual severe hurricane counts in the North Atlantic [18], etc. A distinctive feature of this data type is its discrete integer-valued nature, which challenges the suitability of conventional autoregressive models designed for continuous variables, thereby hindering their effective adaptation to this sort of data.

Since the late 1970s, various models have been introduced for modeling count time series, often relying on predefined marginal distributions. Notably, the binomial thinning operator-based method, as explored by [36], addresses this issue. The binomial thinning operator '$\circ$' is defined as $\alpha \circ X := \sum_{j=1}^{X} B_j$, where B_j is a sequence of i.i.d Bernoulli random

CONTACT R. Nasirzadeh nasirzadeh_roya@yahoo.com Faculty of Science, Fasa University, Bahman Beigi Square, Fasa, Fars Province, Iran, IR