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On Zero-Inflated Poisson Garima Distribution and its Applications to Count Data

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Abstract

Excessive zero counts are one of the causes of over-dispersion in count data that is often observed in different fields. In this paper, we propose a new zero-inflated model namely 'the zero-inflated Poisson Garima distribution' to handle excessive zero counts. Various structural properties including reliability characteristics, generating functions, moments, etc. are obtained. Also, the parametric estimation of the proposed model is obtained using maximum likelihood method of estimation. Furthermore, a simulation study is carried out to check the behaviour of maximum likelihood estimators. Moreover, the proposed model and the baseline model are distinguished using two different test procedures. Finally, two real-life data sets taken from different domains are considered to validate the empirical applications of the proposed model.

Keywords: Poisson Garima distribution, zero-inflated distribution, maximum likelihood estimation, goodness of fit, testing of hypothesis.

1. Introduction

We require a robust class of discrete probability distributions in addition to the traditional discrete distributions in order to model real-world data. Recent years have seen the introduction of numerous generalized discrete distributions in this regard. Zero-inflated discrete distributions are effective at capturing situations where there is an excess of zeros and over-dispersion. The problem of zero inflation becomes prominent in count data modelling due to the large occurrence of zeros than that admitted by the conventional Poisson distribution. Zero-inflated count models provide an important framework to model this type of situation. For instance, Lambert (1992) used zero-inflated Poisson (ZIP) distribution to handle count data with excess of zeros. Neyman (1939), Cohen (1960), and Singh (1962) used zero-inflated Poisson distribution to analyse various types of zero-inflated count data sets. Gupta et al. (1996) developed a generalized version of zero-inflated Poisson model called as zero adjusted generalized Poisson model. Also, some useful models were employed by Ridout et al. (1998) for fitting discrete data with excess zeros. da Silva et al. (2018) introduced zero-modified Poisson-Sujata distribution for explaining count data exhibiting inflation or deflation of zeros. They took into consideration data sets from the biological sciences to explain the real-life applicability of the devised model. Johnson et al. (2015) proposed a Chi-Square statistic for comparing proportions of zeros among zero-inflated distributions. The proposed test-statistic can be used for both discrete as well as continuous type of data. Bar-Lev and Ridder (2023) examined two groups of exponential