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Negative Binomial-Reciprocal Inverse Gaussian Distribution: Statistical Properties with Applications in Count Data

Anwar Hassan [a], Ishfaq Shah*[a] and Bilal Peer [b]
[a] Department of Statistics, University of Kashmir, Srinagar, Jammu&Kashmir, India.
[b] Department of Mathematical Sciences, Islamic University of Science and Technology, Pulwama, Jammu&Kashmir, India.
*Corresponding author; e-mail: peerishfaq007@gmail.com

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Abstract

In this paper, a new count distribution has been introduced by mixing negative binomial with reciprocal inverse Guassian distribution. This model is tractable with some important properties not only limited to actuarial science but in other fields as well where over-dispersion pattern is seen. A recurrence relation for the probabilities of the new distribution and an integral equation for the probability density function of the compound version, when the claim severities are absolutely continuous, are derived. Brief idea about its respective multivariate version are also given. Parameters involved in the proposed model have been estimated by maximum likelihood estimation technique. Finally, applications of the model to real data sets are presented and compared with the fit attained by some other well-known one and two-parameter distributions.

Keywords: Over-dispersion, goodness of fit, aggregate loss, maximum likelihood estimation.

1. Introduction

The classical Poisson distribution is one of the prominent distribution to model count data. However, due to the presence of over-dispersion phenomenon in count data, one has to look for such models which relaxes over-dispersion restriction of the Poisson distribution. Negative binomial (NB) model takes care of the over-dispersion pattern. Keeping the wide applications of NB in context, there has been significant development in the extension of NB distribution, like the negative binomial-inverse Gaussian distributions (Déniz et al. 2008), the negative binomial-Beta exponential distribution (Pudprommarat et al. 2012) and the negative binomial-Erlang distribution (Kongrod et al. 2014).

Mixture approach is one of the prominent method of obtaining new probability distributions in the applied field of probability and statistics, mainly because of its simplicity and unambiguous interpretation of the unobserved heterogeneity that is likely to occur in most of practical situations. In this article a NB mixture model that includes as mixing distribution the reciprocal inverse Gaussian ($\mathcal{RIG}$) distribution is proposed by taking $\theta = exp(-\omega)$, (where θ is negative binomial parameter) assuming that ω is distributed according to a $\mathcal{RIG}$ distribution, obtaining the negative binomial-reciprocal inverse Gaussian distribution, denoted by $\mathcal{NBRIG}$, which can be viewed as a competitive model to Poisson-reciprocal inverse Gaussian ($\mathcal{PRIG}$), NB and Poisson distributions.