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The cosine geometric distribution with count data modeling

Christophe Chesneau[a], Hassan S. Bakouch[b], Tassaddaq Hussain[c] and Bilal A. Para[d]

[a]LMNO, University of Caen-Normandie, Caen, France; [b]Department of Mathematics, Faculty of Science, Tanta University, Tanta, Egypt; [c]Department of Mathematics, Mirpur University of Science and Technology (MUST), Mirpur (AJ&K), Pakistan; [d]Department of Statistics, Government Degree College Anantnag (J&K), Anantnag, India

ABSTRACT

In this paper, a new two-parameter discrete distribution is introduced. It belongs to the family of the weighted geometric distribution (GD), with the feature of using a particular trigonometric weight. This configuration adds an oscillating property to the former GD which can be helpful in analyzing the data with over-dispersion, as developed in this study. First, we present the basic statistical properties of the new distribution, including the cumulative distribution function, hazard rate function and moment generating function. Estimation of the related model parameters is investigated using the maximum likelihood method. A simulation study is performed to illustrate the convergence of the estimators. Applications to two practical datasets are given to show that the new model performs at least as well as some competitors.

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1. Introduction

The deep analysis of some practical count data is limited by the use of the standard discrete models. Moreover, in practice, discrete data are easy to collect as compared to continuous data. For these reasons, numerous efforts have been made to propose generalizations of discrete models. We refer to the review by Chakraborty [5] and the references therein. Discretization is the most common method used to construct new discrete distributions from the known continuous distributions. There are two known discretization methods, namely discretization by an infinite series and discretization by survival function, see Refs. [1,3,7]. Another method of constructing discrete distributions is using a weighted version of a standard discrete distribution, which is characterized by a probability mass function (pmf) of the form

$$P(X=k)=\frac{w(k)}{E\left(w(Y)\right)}P(Y=k),\quad k\in Y(\Omega), \tag{1}$$

where Y is a random variable having a standard discrete distribution, $Y(\Omega)$ denotes the support of Y and $w(k)$ denotes a weight function (assuming that $E(w(Y))$ exists). See, for instance, Refs. [9–11] for more details on the weighted distributions. If we focus our

CONTACT Hassan S. Bakouch hnbakouch@yahoo.com