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Bayesian Analysis of Misclassified Generalized Power Series Distributions Under Different Loss Functions

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ABSTRACT

In certain experimental investigations involving discrete distributions external factors may induce measurement error in the form of misclassification. For instance, a situation may arise where certain values are erroneously reported; such a situation termed as modified or misclassified has been studied by many researchers. Cohen (J. Am. Stat. Assoc. 55 (1960), 139–143; Ann. Inst. Stat. Math. 9 (1960), 189–193; Technometrics. 2 (1960), 109–113) studied misclassification in Poisson and the binomial random variables. In this paper, we discuss misclassification in the most general class of discrete distributions, the generalized power series distributions (GPSDs), where some of the observations corresponding to $x = c+1$; $c \geq 0$ are erroneously observed or at least reported as being $x = c$ with probability α. This class includes among others the binomial, negative binomial, logarithmic series and Poisson distributions. We derive the Bayes estimators of functions of parameters of the misclassified GPSD under different loss functions. The results obtained for misclassified GPSD are then applied to its particular cases like negative binomial, logarithmic series and Poisson distributions. Finally, few numerical examples are provided to illustrate the results.

1. INTRODUCTION

Binomial, negative binomial, Poisson and logarithmic series distributions, some well-known examples of generalized power series (GPS) distributions, are widely used for modeling count data. Modality and divisibility properties of these distributions are known in the literature. Stochastic ordering comparison between these distributions and their mixtures has also been recently of interest by Misra *et al.* [1], Alamatsaz and Abbasi [2], Aghababaei Jazi and Alamatsaz [3], Abbasi *et al.* [4] and Aghababaei Jazi *et al.* [5].

In certain experimental investigations involving discrete distributions external factors may induce measurement error in the form of misclassification. For instance, a situation may arise where certain values are erroneously reported; e.g., when defective item is inspected wrongly as nondefective item and vice versa. Such a situation termed as modified or misclassified has been studied by many researchers. Cohen [6–8] studied misclassification in Poisson and the binomial random variables. Cohen [6] with a suitable alteration of the data to reflect the misplacement of ones to zeroes, used Bortkiewicz's [9] classical example of deaths from the kick of a horse per army corps per year, for ten Prussian army corps for twenty years (1875–1894). For the purpose of this paper, Cohen assumed that twenty of the records which should have shown one death were in error by reporting no deaths.

Jani and Shah [10] studied misclassification in modified power series distributions (MPSDs) and Patel and Patel [11] in case of generalized power series distribution (GPSD), where some of the values of one are sometimes reported as zero. Hassan and Ahmad [12] studied misclassification in size-biased modified power series distributions (SBMPSDs), where some of the observations corresponding to $x = 2$ are misclassified as $x = 1$. Patel and Patel [13] also studied misclassification in MPSD and Hassan and Ahmad [14] in SBMPSD for a more general situation where sometimes the value $(c + 1)$ is reported erroneously to c. In all these five papers the authors studied the structural properties of the respective distributions.

Our aim is to give Bayes estimators of functions of parameters under squared error loss function (SELF) and weighted square error loss function (WSELF) of misclassified generalized power series distribution (MGPSD) where some of the observations corresponding to $x = c + 1$; $c \geq 0$ are erroneously observed or at least reported as being $x = c$ with probability α. This class includes among others the binomial, negative binomial, logarithmic series and Poisson distributions (PD).

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