

Article

Mathematical Formalization and Applications to Data with Excess of Zeros and Ones of the Unit-Proportional Hazard Inflated Models

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Abstract: In this study, we model the rate or proportion of a specific phenomenon using a set of known covariates. To fit the regression model, which explains the phenomenon within the intervals $(0, 1)$, $[0, 1)$, $(0, 1]$, or $[0, 1]$, we employ a logit link function. This approach ensures that the model's predictions remain within the appropriate range of zero to one. In cases of inflation at zero, one, or both, the logit link function is similarly applied to model the dichotomous Bernoulli-type variable with a multinomial response. The findings demonstrate that the model yields a non-singular information matrix, ensuring valid statistical inference. This ensures the invertibility of the information matrix, allowing for hypothesis testing based on likelihood statistics regarding the parameters in the model. This is not possible with other asymmetric models, such as those derived from the skew-normal distribution, which has a singular information matrix at the boundary of the skewness parameter. Finally, empirical results show the model's effectiveness in analyzing proportion data with inflation at zero and one, proving its robustness and practicality for analyzing bounded data in various fields of research.

Keywords: unit proportional hazard distribution; censoring; proportion data; truncation; zero-one inflation

MSC: 62J05; 62E15



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1. Introduction

In recent years, probability distributions have seen significant advancements, particularly through the creation of new families derived from extensions or generalizations of classical distributions. These innovations aim to overcome the limitations of traditional models and provide greater flexibility to better fit the complex phenomena observed in various fields of knowledge. Examples of these distributions include those based on transformations such as the generalized beta distribution by Eugene et al. [1], the family of generalized distributions based on the Kumaraswamy distribution, referred to as Kw-distributions and introduced by Cordeiro and De Castro [2] (Kw-normal, Kw-Weibull, Kw-gamma, Kw-Gumbel, and Kw-inverse Gaussian distribution); and the beta modified Weibull distribution of Silva et al. [3]. These new distributions not only better capture data characteristics like skewness and kurtosis but also improve accuracy in modeling extreme events or phenomena with heavy tails. Furthermore, their implementation has proven useful in fields such as biomedicine, economics, and engineering, where classical models fail to adequately describe the reality of the data.

In parallel, truncated distributions have emerged as another essential tool, particularly when the data are bounded within a specific range. These distributions are modifications of classical ones, where values outside a certain interval are truncated, improving the

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