Computational Statistics and Data Analysis 54 (2010) 1017–1035

Contents lists available at ScienceDirect

Computational Statistics and Data Analysis

journal homepage: www.elsevier.com/locate/csda

The log-exponentiated Weibull regression model for interval-censored data

Elizabeth M. Hashimoto [a], Edwin M.M. Ortega [b,*], Vicente G. Cancho [c], Gauss M. Cordeiro [d]

[a] ESALQ, Universidade de São Paulo, Piracicaba, Brazil
[b] Universidade de São Paulo, Brazil
[c] ICMC, Universidade de São Paulo, São Carlos, Brazil
[d] Universidade Federal Rural de Pernambuco, Recife, Brazil

ARTICLE INFO

Article history:
Received 17 December 2008
Received in revised form 1 October 2009
Accepted 2 October 2009
Available online 20 October 2009

ABSTRACT

In interval-censored survival data, the event of interest is not observed exactly but is only known to occur within some time interval. Such data appear very frequently. In this paper, we are concerned only with parametric forms, and so a location-scale regression model based on the exponentiated Weibull distribution is proposed for modeling interval-censored data. We show that the proposed log-exponentiated Weibull regression model for interval-censored data represents a parametric family of models that include other regression models that are broadly used in lifetime data analysis. Assuming the use of interval-censored data, we employ a frequentist analysis, a jackknife estimator, a parametric bootstrap and a Bayesian analysis for the parameters of the proposed model. We derive the appropriate matrices for assessing local influences on the parameter estimates under different perturbation schemes and present some ways to assess global influences. Furthermore, for different parameter settings, sample sizes and censoring percentages, various simulations are performed; in addition, the empirical distribution of some modified residuals are displayed and compared with the standard normal distribution. These studies suggest that the residual analysis usually performed in normal linear regression models can be straightforwardly extended to a modified deviance residual in log-exponentiated Weibull regression models for interval-censored data.

1. Introduction

In several studies, the survival response can be interval-censored such that the event of interest is not observed exactly but is only known to occur within time intervals that may overlap and vary in length. The literature presents many applications of survival models for interval-censored data with respect to the Weibull family of distributions (Lawless, 2003). This family is very suitable for situations in which the failure rate function is constant or monotone. However, it is not suitable in situations in which the failure rate function presents a bathtub or unimodal shape. For example, according to Zimmer et al. (1998) and Silva et al. (2008), the failure rate function of the Burr XII distribution can be decreased or unimodal. To cope with these situations, several distributions derived from the Weibull distribution that exhibit bathtub-shaped or unimodal failure rate functions were developed, one of which is the exponentiated Weibull (EW) distribution proposed by Mudholkar et al. (1995).

* Corresponding address: Departamento de Ciências Exatas, USP, Av. Pádua Dias 11-Caixa Postal 9, 13418-900 Piracicaba, São Paulo, Brazil. Tel.: +55 11 19 34294127; fax: +55 11 19 34294468.
E-mail addresses: emhashim@esalq.usp.br (E.M. Hashimoto), edwin@esalq.usp.br (E.M.M. Ortega), garibay@icmc.usp.br (V.G. Cancho), gausscordeiro@uol.com.br (G.M. Cordeiro).

0167-9473/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.csda.2009.10.014