

## **New estimating equation approaches with application in lifetime data analysis**

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Received: 16 January 2012 / Revised: 8 August 2012 / Published online: 11 November 2012  
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**Abstract** Estimating equation approaches have been widely used in statistics inference. Important examples of estimating equations are the likelihood equations. Since its introduction by Sir R. A. Fisher almost a century ago, maximum likelihood estimation (MLE) is still the most popular estimation method used for fitting probability distribution to data, including fitting lifetime distributions with censored data. However, MLE may produce substantial bias and even fail to obtain valid confidence intervals when data size is not large enough or there is censoring data. In this paper, based on nonlinear combinations of order statistics, we propose new estimation equation approaches for a class of probability distributions, which are particularly effective for skewed distributions with small sample sizes and censored data. The proposed approaches may possess a number of attractive properties such as consistency, sufficiency and uniqueness. Asymptotic normality of these new estimators is derived. The construction of new estimation equations and their numerical performance under different censored schemes are detailed via Weibull distribution and generalized exponential distribution.

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### **Keywords**

Estimation equation · Nonlinear combination of order statistics ·  
Asymptotic normality · Weibull distribution ·  
Generalized exponential distribution