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Research Paper

Comparison of some one sample confidence intervals for estimating the mean of the weibull distribution

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ABSTRACT : In this article, an attempt has been made to review existing interval estimators for Weibull mean and compare them under the same simulation condition. A comparison of the performance of the CI estimators has been made with respect to simulated average widths and average coverage probabilities. A comparative study revealed that the performances of the estimators differ significantly when the sample sizes are small and shape parameter is small *i e.* data are from a highly skewed Weibull distribution. Results are illustrated with a real data set for practitioners. Based on the simulation study, good interval estimators have been recommended for use in practice.

KEY WORDS : Confidence interval, Weibull mean, Comparative study

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INTRODUCTION

Weibull distribution is widely used in reliability and survival analysis due to its flexible shape and ability to model a wide range of failure rates. It can be derived theoretically as a form of extreme value distribution, governing the time to occurrence of the "weakest link" of many competing failure processes. Its special case with shape parameter $b = 2$ is the Rayleigh distribution which is commonly used for modeling the magnitude of radial error when x and y coordinate errors are independent normal variables with zero mean and the same standard deviation, while the case $b = 1$ corresponds to the widely used exponential distribution.

Let X follows a weibull distribution with scale parameter a and shape parameter b. The probability density function (pdf) of X is given by:

$$f_X(x;a,b) = \begin{cases} \frac{b}{a}\left(\frac{x}{a}\right)^{b-1} \exp\left(-\left(\frac{x}{a}\right)^{b}\right); x>0, a>0, b>0; \\ 0 \qquad\qquad\qquad\qquad\qquad\qquad ; otherwise \end{cases}$$

The mean of the Weibull distribution is given by $\mu = a\,\Gamma(1+(1/b))$

where, $\Gamma(k) = \int_0^\infty m^{k-1} \exp(-m)\,dm$ is the Gamma function. The problem of interval estimation for the mean m when both parameters a and b are unknown has been less attended in the literature. Colosimo and Ho (1999) obtained CI for m using asymptotic-normal theory and it is usually called Wald CI. Yang *et al.* (2007) proposed CI for Weibull mean from type-II censored data based on a Chi-square distributed pivotal quantity given by Lawless (1982), involving modified maximum likelihood estimator (MMLE) of b in the resulting CI and is referred to as naïve CI. An adjustment is suggested to the Chi-square quantile for obtaining more refined results. Krishnamoorthy *et al.* (2009) utilized generalized variable (GV) approach for developing confidence limits for Weibull mean μ and studied coverages of the corresponding one sided confidence limits and compared with coverages of the Wald confidence limits based on log transformed variable.

In this paper, we reviewed and compared the CIs proposed