Robust statistical modeling of the failure rate using the Birnbaum-Saunders-t distribution

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Abstract

The hazard or failure rate function is an important statistical indicator employed in lifetime analysis. The Birnbaum-Saunders (BS) model is a useful life distribution originated from a problem of material fatigue that has been largely applied to reliability and fatigue studies. The BS distribution relates the total time until the failure to some type of cumulative damage normally distributed. The generalized BS (GBS) distribution is a new class of positively skewed models with lighter and heavier tails than the classic BS distribution. One of the most important property of the GBS model is the robust estimation of its parameters, particularly when the BS-t distribution is used in the modeling. In this paper, we propose robust statistical modeling of the hazard rate by the BS-t distribution and estimate this rate and its change point using likelihood methods and the EM algorithm. Specifically, the aims of this work are (i) to produce a mathematical study of the shape of the BS-t hazard rate; (ii) to develop inference for this rate and evaluate its performance using Monte Carlo methods; (iii) to show the robustness of such a procedure; and (iv) to illustrate the obtained results by real data.

Keywords

Change point, EM algorithm, Generalized Birnbaum-Saunders distribution, Hazard rate, Lifetime data, Likelihood methods, Robustness, R language.

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