Goodness-of-fit methods for right-censored data: theory, implementation in R, and a potential application in accelerated failure time models.

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Goodness-of-fit techniques are an important tool to test the validity of parametric models and to provide indications that the modeling assumptions are reasonable. No general asymptotic optimality theory exists for this very difficult problem. Goodness-of-fit tests have been developed for complete data. However, for censored data, fewer papers can be found in the literature. Preliminary extensions to account for right-censored data were proposed by Barr and Davidson (1973), who modified Kolmogorov-Smirnov statistics for censored or truncated data. Koziol and Green (1976) developed Cramer-von Mises type statistics based on the product-limit empirical distribution function.

We present a set of goodness-of-fit methods for right-censored data and their implementation in the R package `GofCens`. This package contains: 1) Goodness-of-fit tests for complete and right-censored data. Kolmogorov-Smirnov, Cramér-von Mises, and Anderson-Darling tests, which utilize the empirical distribution function for complete data and are extended to handle right-censored data. Bootstrapping methods are used in order to derive p-values. 2) Graphical tools, such as probability and cumulative hazard plots, to help guide decisions about the most appropriate parametric model for the data.

Moreover, the p-value distribution under the null hypothesis has been studied for those GOF tests for right-censored data developed and implemented in `GofCens`. Interesting results have been obtained showing that, even when assuming non-informative censoring, the distribution of censoring times plays an important role in the p-value distribution. A discussion on the p-value distribution in our tests will be presented.

An application of the methods to the accelerated failure time model (AFTM), a commonly used model in survival analysis, will be presented. A critical aspect of AFTMs is the choice of the underlying distribution for the survival times. We propose a simple approach that utilizes standardized residuals along with the methods outlined earlier to create GOF tools for AFTMs. The implementation of these tools has been done in R.

Keywords: Goodness of fit, survival analysis, censored data, p-values, accelerated failure time models.