Jackknife empirical likelihood confidence interval for medical cost with censored observation

Jenny Jeyarajah and Gengsheng Qin
Georgia State University

In cost-effectiveness study of treatments, the motivation is often on the average of total medical costs over a certain time period, [0, L] for a given population. Estimating the mean medical cost can be complicated since some patients cost are censored after certain time period, and for those censored patients, their true total costs over [0,L] are unknown.

Since the costs are possibly right-censored, several researchers have tried standard survival techniques to adjust for censoring. However, Lin et al (1997) have shown that this method is not valid, since the patients accumulate their medical cost with the different rate function over time. Thus they proposed a non-parametric consistent estimator for estimating the mean medical cost assuming the censoring time distribution is discrete. Later Bang and Tsiatis (2000) proposed a simple weighted estimator without making Lin et al (1997)'s assumption but using the idea of inverse probability weighting. The simple weighted estimator was shown to be consistent and asymptotically normal. Since the simple weighted estimator only uses the complete cost for each patient, it's not efficient when the percentage of censoring is high. Therefore a more efficient and practical estimator was proposed by Zhao and Tian (2001) based on semi-parametric efficiency theories.

Since the variance estimation with the normal approximation method is complicated for simple weighted estimator and the improved estimator, we have developed a Jackknife empirical likelihood (JEL) method to construct confidence intervals for censored medical cost data. The asymptotic distribution of the Jackknife empirical likelihood ratio statistic is a standard Chi-square distribution. This method allows for construction of confidence interval for mean medical cost without variance estimation. JEL method is a popular non-parametric method for constructing confidence intervals. JEL method has several advantages over normal approximation method in constructing confidence interval. The proposed method does not assume a symmetric shape, instead the shape is determined by the data and it's especially suitable for skewed data. JEL allows for construction of confidence interval without a variance estimator. A simulation study was conducted and the coverage probability and interval length for the proposed confidence intervals are calculated and compared with the normal approximation-based confidence intervals.

The proposed Jackknife empirical likelihood method is observed to have better finite-sample performance, and also outperforms the existing method when the data are highly censored (about 40%). Existing and the proposed methods are illustrated through real examples.

Key words: Censored data, confidence interval, coverage probability, Jackknife Empirical likelihood.