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Full likelihood inferences in the Cox model: an empirical likelihood approach

Jian-Jian Ren · Mai Zhou

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Abstract For the regression parameter β_0 in the Cox model, there have been several estimators constructed based on various types of approximated likelihood, but none of them has demonstrated small-sample advantage over Cox's partial likelihood estimator. In this article, we derive the full likelihood function for (β_0, F_0), where F_0 is the baseline distribution in the Cox model. Using the empirical likelihood parameterization, we explicitly profile out nuisance parameter F_0 to obtain the full-profile likelihood function for β_0 and the maximum likelihood estimator (MLE) for (β_0, F_0). The relation between the MLE and Cox's partial likelihood estimator for β_0 is made clear by showing that Taylor's expansion gives Cox's partial likelihood estimating function as the leading term of the full-profile likelihood estimating function. We show that the log full-likelihood ratio has an asymptotic chi-squared distribution, while the simulation studies indicate that for small or moderate sample sizes, the MLE performs favorably over Cox's partial likelihood estimator. In a real dataset example, our full likelihood ratio test and Cox's partial likelihood ratio test lead to statistically different conclusions.

Keywords Right censored data · Empirical likelihood · Maximum likelihood estimator · Partial likelihood · Profile likelihood