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Efficient Estimation for the Cox Proportional Hazards Cure Model

Authors : Khandoker Akib Mohammad

Abstract : While analyzing time-to-event data, it is possible that a certain fraction of subjects will never experience the event of interest, and they are said to be cured. When this feature of survival models is taken into account, the models are commonly referred to as cure models. In the presence of covariates, the conditional survival function of the population can be modelled by using the cure model, which depends on the probability of being uncured (incidence) and the conditional survival function of the uncured subjects (latency), and a combination of logistic regression and Cox proportional hazards (PH) regression is used to model the incidence and latency respectively. In this paper, we have shown the asymptotic normality of the profile likelihood estimator via asymptotic expansion of the profile likelihood and obtain the explicit form of the variance estimator with an implicit function in the profile likelihood. We have also shown the efficient score function based on projection theory and the profile likelihood score function are equal. Our contribution in this paper is that we have expressed the efficient information matrix as the variance of the profile likelihood score function. A simulation study suggests that the estimated standard errors from bootstrap samples (SMCURE package) and the profile likelihood score function (our approach) are providing similar and comparable results. The numerical result of our proposed method is also shown by using the melanoma data from SMCURE R-package, and we compare the results with the output obtained from the SMCURE package.

Keywords : Cox PH model, cure model, efficient score function, EM algorithm, implicit function, profile likelihood
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