Semiparametric Heteroscedastic Transformation Cure Models

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Abstract

In biomedical the survival analysis is a very common statistical method to evaluate the efficiency of a treatment and the typical models assume that the events will occur eventually for all subjects such that everyone has a finite failure time. But in the recent two decades the cure models receive more attention to consider the problem in which some people are cured permanently to have no failure times but the other are not. The cure models can extend to deal with non-susceptible problems, such as age onset problems in which some people are susceptible for a disease but some are not. In the recent research the distributions of the event times of the susceptible in the cure models are considered as typical survival models, for example, Cox's PH model and accelerated failure time model. All of which do not consider the heteroscedasticity.

This dissertation proposes more general failure models, semiparametric heteroscedastic transformation cure models, by fitting the binary random variable for the cures as logistic regression and the event time of the susceptible as a heteroscedastic transformation model. Our model is motivated from Lu and Ying (2003) and Hsieh (2001). The heteroscedastic transformation model can explain the phenomenon of crossing of the survival curves. Then the proposed cure model can not only describe the cured data more flexibly but also distinguish the cause of the crossing due to the different proportions of the cure or due to the heteroscedasticity of the survival times of the susceptible patients.

The principle of constructing estimating equations for the parameters are motivated from nonparametric maximum likelihood estimates. The relevant statistical properties of the estimators from the estimating equations include consistency, asymptotically normal distribution and the closed form for the asymptotical variance-covariance matrix. The simulation validates the large sample properties.

Keywords: Transformation models; Cure models; Cox's model; Heteroscedastic hazards regression model; Martingale processes; Estimating equations