Frailty Models with a Cure Fraction for Modeling Clustered Discrete Survival Data

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Abstract

Clustered survival data with a cure fraction (long term survivors) arise naturally from biomedicine, econometrics and sociology studies. The mixture cure rate models have been well developed for univariate or multivariate (or clustered) continuous right-censored data. In the literature, two approaches have been proposed for multivariate or clustered continuous right-censored data. One is referred to as marginal regression approach and this approach is useful if a covariate's population average effect is of primary interest and the correlation structure is not of interest. For example, Peng et al. (2007) extended univariate mixture cure rate models for multivariate continuous survival data by modeling the marginal distribution as a proportional hazards model with logistic regression for cure fraction. Another is long-term survivor mixture model with frailty or random effect to take into account for the correlation within each cluster. For example, Chatterjee and Shih (2002) and Wienke et al. (2003) considered the shared frailty model and correlated frailty model, respectively, without covariates for bivariate continuous survival data.

However, a straightforward application of these statistical methods to clustered current status data is not appropriate. When the joint survival distribution is obtained from a frailty model, the random effect frailty model is more appropriate to capture the association between the correlated survival times. Therefore, frailty is introduced in this paper to characterize the correlation between survival times within clusters. In particular, the positive association between survival times is incorporated by imposing a common gamma frailty effect for clustered survival data. The accuracy of the estimators of the parameters in the mixture cure gamma frailty model is examined by simulation. In addition, the implementation of the mixture cure gamma frailty model to a dental implant study is presented.

Keywords: Clustered survival data; Mixture cure frailty model; Cure rate; Discrete-time survival data.