

## A general transformation class of semiparametric cure rate frailty models

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**Abstract** We consider a class of cure rate frailty models for multivariate failure time data with a survival fraction. This class is formulated through a transformation on the unknown population survival function. It incorporates random effects to account for the underlying correlation, and includes the mixture cure model and the proportional hazards cure model as two special cases. We develop efficient likelihood-based estimation and inference procedures. We show that the nonparametric maximum likelihood estimators for the parameters of these models are consistent and asymptotically normal, and that the limiting variances achieve the semiparametric efficiency bounds. Simulation studies demonstrate that the proposed methods perform well in finite samples. We provide an application of the proposed methods to the data of the age at onset of alcohol dependence, from the Collaborative Study on the Genetics of Alcoholism.

**Keywords** Box-Cox transformation · Cure fraction · Empirical process · Mixture cure model · NPMLE · Proportional hazards cure model · Semiparametric efficiency