

# Semiparametric Model for Bivariate Survival Data Subject to Biased Sampling

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**Abstract:** To better understand the relationship between patient characteristics and their residual survival after an intermediate event such as the local cancer recurrence, it is of interest to identify patients with the intermediate event and then analyze their residual survival data. One challenge in analyzing such data is that the observed residual survival times tend to be longer than those in the target population, since patients who die before experiencing the intermediate event are excluded from the identified cohort. We propose to jointly model the ordered bivariate survival data using a copula model and appropriately adjusting for the sampling bias.

We develop an estimating procedure to simultaneously estimate the parameters for the marginal survival functions and the association parameter in the copula model, and use a two-stage expectation-maximization algorithm. Using empirical process theory, we prove that the estimators have strong consistency and asymptotic normality. We conduct simulation studies to evaluate the finite sample performance of the proposed method. We apply the proposed method to two cohort studies to evaluate the association between patient characteristics and residual survival.