

Causal Estimation for the Left-Truncation Adjusted Time-Varying Covariates under the Semiparametric Transformation Models of a Survival Time

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Abstract : In biomedical researches and randomized clinical trials, the most commonly interested outcomes are time-to-event so-called survival data. The importance of robust models in this context is to compare the effect of randomly controlled experimental groups that have a sense of causality. Causal estimation is the scientific concept of comparing the pragmatic effect of treatments conditional to the given covariates rather than assessing the simple association of response and predictors. Hence, the causal effect based semiparametric transformation model was proposed to estimate the effect of treatment with the presence of possibly time-varying covariates. Due to its high flexibility and robustness, the semiparametric transformation model which shall be applied in this paper has been given much more attention for estimation of a causal effect in modeling left-truncated and right censored survival data. Despite its wide applications and popularity in estimating unknown parameters, the maximum likelihood estimation technique is quite complex and burdensome in estimating unknown parameters and unspecified transformation function in the presence of possibly time-varying covariates. Thus, to ease the complexity we proposed the modified estimating equations. After intuitive estimation procedures, the consistency and asymptotic properties of the estimators were derived and the characteristics of the estimators in the finite sample performance of the proposed model were illustrated via simulation studies and Stanford heart transplant real data example. To sum up the study, the bias of covariates was adjusted via estimating the density function for truncation variable which was also incorporated in the model as a covariate in order to relax the independence assumption of failure time and truncation time. Moreover, the expectation-maximization (EM) algorithm was described for the estimation of iterative unknown parameters and unspecified transformation function. In addition, the causal effect was derived by the ratio of the cumulative hazard function of active and passive experiments after adjusting for bias raised in the model due to the truncation variable.

Keywords : causal estimation, EM algorithm, semiparametric transformation models, time-to-event outcomes, time-varying covariate

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