Statistical inference of semiparametric Cox-Aalen transformation models with failure time data

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Abstract

In this dissertation, we propose a broad class of so-called Cox-Aalen transformation models that incorporate both multiplicative and additive covariate effects on the baseline hazard function through a transformation framework. The proposed model offers a high degree of flexibility and versatility, encompassing the Cox-Aalen model and transformation models as special cases. For right-censored data, we propose an estimating equation approach and devise an Expectation-Solving (ES) algorithm that involves fast and robust calculations. The resulting estimator is shown to be consistent and asymptotically normal via empirical process techniques. Finally, we assess the performance of the proposed procedures by conducting simulation studies and applying them in two randomized, placebo-controlled HIV prevention efficacy trials.

We also consider the regression analysis of the Cox-Aalen transformation models with partly interval-censored data, which comprise exact and interval-censored observations. We construct a set of estimating equations and implement an ES algorithm that ensures stability and fast convergence. Under regularity assumptions, we demonstrate that the estimators obtained are consistent and asymptotically normal, and we propose using weighted bootstrapping techniques to estimate their variance consistently. To evaluate the proposed methods, we perform thorough simulation experiments and apply them to analyze data from a randomized HIV/AIDS trial.

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