Ann Inst Stat Math (2012) 64:715–736
DOI 10.1007/s10463-011-0330-0

Optimal inferences for proportional hazards model with parametric covariate transformations

Chunpeng Fan · Jason P. Fine · Jong-Hyeon Jeong

Received: 10 June 2010 / Revised: 16 November 2010 / Published online: 12 March 2011

Abstract The traditional Cox model assumes a log-linear relationship between covariates and the underlying hazard function. However, the linearity may be invalid in real data. We study a Cox model which employs unknown parametric covariate transformations. This model is applicable to observational studies or randomized trials when a treatment effect is investigated after controlling for a confounding variable that may have non-log-linear relationship with the underlying hazard function. While the proposed generalization is simple, the inferential issues are challenging due to the loss of identifiability under no effects of transformed covariates. Optimal tests are derived for certain alternatives. Rigorous parametric inference is established under regularity conditions and non-zero transformed covariate effects. The estimates perform well in simulation studies with realistic sample size, and the proposed tests are more powerful than the usual partial likelihood ratio test, which is no longer optimal. Data from a breast cancer trial are used to illustrate the model building strategy and the better fit of the proposed model, comparing to the traditional Cox model.

Keywords Cox proportional hazards model · Optimal test · Semi-parametric model