Dimension Reduction in Survival Regressions with Censored Data via an Imputed Spline Approach

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Abstract

Dimension reduction methods have been proposed for regression analysis with predictors of high dimension, but has not received much attention on the problems with censored data. In this article, we present an iterative imputed spline approach based on principal Hessian directions (PHD) for censored survival data in order to reduce the dimension of predictors without requiring a prespecified parametric model. Our proposal is to replace the right-censored survival time with its conditional expectation for adjusting the censoring effect by using the Kaplan-Meier estimator and an adaptive polynomial spline regression in the residual imputation. A sparse estimation strategy is incorporated in our approach to enhance the interpretation of variable selection. This approach can be implemented in not only PHD, but also other methods developed for estimating the central mean subspace. Simulation studies with right censored data are conducted for the imputed spline approach to PHD (IS-PHD) in comparison with two methods of sliced inverse regression, minimum average variance estimation, and naive PHD in ignorance of censoring. The results demonstrate that the proposed IS-PHD method is particularly useful for survival time responses approximating symmetric or bending structures. Illustrative applications to two real datasets are also presented.

Keywords: Kaplan-Meier estimator; Principal Hessian directions; Shrinkage sparse estimator; Sliced inverse regression; Survival analysis.