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Variable Selection and Dimension Reduction in Partially Linear Single-Index AFT Models

Xuewen Lu[1]
[1]University of Calgary
2500 University Drive NW, Calgary, Canada
xlu@ucalgary.ca

Extended Abstract

Objectives: This work investigates the broken adaptive ridge (BAR) regression method for variable selection in partially linear single-index accelerated failure time (PLISI-AFT) models with right-censored data. The study addresses two challenges: (1) selecting high-dimensional covariates (e.g., gene expressions) via BAR penalties, and (2) reducing dimensionality for low-dimensional covariates (e.g., clinical measurements) using a single-index component.

Scope: BAR regression, an approximation of L0-penalized regression, has demonstrated computational efficiency and theoretical robustness in survival models [1]–[6]. Its grouping effect property is particularly advantageous for high-correlation covariates, such as gene pathways. However, its application to PLISI-AFT models remains unexplored. Our model combines a parametric component (high-dimensional covariates) with BAR-based selection and a nonparametric single-index component (low-dimensional covariates) estimated via local linear kernel regression, avoiding the "curse of dimensionality."

Results: We establish the oracle property and selection consistency for the BAR estimator. Simulations and real-data analyses confirm the method's efficacy in simultaneous variable selection and dimension reduction. For instance, in biomedical studies with censored outcomes, the model reliably identifies significant gene expressions while summarizing clinical covariates via the single-index term.

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