SURVIVAL ANALYSIS WITH MISMEASURED COVARIATES

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This project was motivated by a time-to-event analysis where the covariate of interest was measured at the wrong time. We show that the problem can be formulated as a special case of survival analysis with heterogeneous covariate measurement error, and develop a general analytic framework. We study the asymptotic behavior of the naive partial likelihood estimates and analytically demonstrate that, under the heterogeneous measurement error structure and the assumption that all components of the covariate vector and the measurement error vector combined are mutually independent, these naive estimates will shrink toward zero, and that the degree of attenuation increases as the measurement error increases. We also give counter examples for reverse-attenuation when the independence conditions are violated.

We use our analytical results to derive a simple bias correcting estimator, which performs well in simulations for small and moderate amounts of measurement error. Our framework can be used to provide insight into the behavior of the commonly used partial likelihood score test for testing no association between a failure outcome and an exposure, for example in the presence of measurement error or mistiming error. In particular, we derive the asymptotic distribution of the naive partial likelihood score test under a series of local alternatives, and discuss the asymptotic relative efficiency. As a result, a simple sample size formula to account for the contamination of covariates is obtained.