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Title: Bayesian Hazard Change-point Analysis with Unknown Change-point Numbers

Abstract:

There are a variety of applications for which statistical models assess how the parameters underlying the data generating process change over time. One such function which is subject to change is the hazard rate in survival analysis for which the number of change-points is in practice unknown. Both frequentist and Bayesian methods exist for change-point analysis of hazard functions, however, approaches using frequentist methods cannot readily accommodate parametric uncertainty, while Bayesian approaches typically consider inference on a fixed number of change-points. We present two novel Bayesian approaches for determining the location and number of change-points for a hazard function. Inference is performed using an MCMC scheme. Either the number of change-points is held fixed, and competing models compared using the model marginal likelihood, or the model parameters can be integrated out of the model and the number of change-points can be sampled as part of the MCMC scheme. Model parameters for the latter approach can be estimated using a post-hoc routine. Our approaches are attractive because we can estimate both the uncertainty in the change-point locations for a given change-point model and obtain a probabilistic interpretation for the number of change-points. We evaluate these approaches in a simulation study and on two data sets that record time from remission induction to relapse for patients with acute nonlymphoblastic leukemia, and time to death of Glioblastoma patients.