Change-Point Problems
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ESTIMATION IN CHANGE-POINT HAZARD RATE MODELS WITH RANDOM CENSORSHIP

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Hazard rate models with a change-point allowing for random censorship are considered. An estimator of the change-point is proposed by examining a functional of Nelson-Aalen type estimator in the context of counting processes. Consistency and asymptotic distribution of the proposed estimator are established by martingale inequalities and Poisson approximation respectively. The performance of the proposed estimator is compared with that of a constrained maximum likelihood estimator using simulations. Robustness of the proposed estimator is also discussed.

1. Introduction. Let X be a random variable representing the time to some event, for example, the time-to-relapse after remission for leukemia patients. Several authors considered a model for the distribution of X specified by the hazard rate

$$\lambda(x) = \beta + \theta 1_{[\tau,\infty)}(x), \tag{1.1}$$

where 1_S is the indicator function of a set $S, \beta \geq 0, \beta + \theta > 0$ and τ is a change-point parameter.

In particular, Matthews and Farewell (1982) and Matthews, Farewell and Pyke (1985) studied the problem of testing for a constant hazard rate against alternatives with hazard rates involving a single change-point. The former presented a likelihood ratio test, and the latter proposed tests based on maximal score statistics and derived the asymptotic significance levels. Recently, Henderson (1990) suggested some modified likelihood ratio tests and presented an extensive literature review. Loader (1991) derived large deviation approximations to the significance level of the likelihood ratio test by a random change of time scale for the empirical process.

As for the problem of estimation, Nguyen, Rogers and Walker (1984) observed that the likelihood function is unbounded when τ is just before the largest observation and proposed a consistent estimator of the change-point by

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