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ASYMPTOTIC PROPERTIES OF AALEN-JOHANSEN INTEGRALS FOR COMPETING RISKS DATA

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Abstract: This paper considers the competing risks problem with randomly right-censored data. Let $F^{(j)}(t)$ be the cause-specific cumulative incidence function of a cause j , which is the probability of death due to a cause j by time t in the presence of other acting causes. The Aalen-Johansen estimator $F_n^{(j)}$ is a nonparametric maximum likelihood estimator of $F^{(j)}$. Under the assumption that all $F^{(j)}$'s and a censoring distribution are continuous, asymptotic properties of the Aalen-Johansen integral $s_n^{(j)} = \int \varphi dF_n^{(j)}$ are investigated. Let F be the overall lifetime distribution. We show that for any F -integrable function φ , the Aalen-Johansen integral $s_n^{(j)}$ converges almost surely as $n \rightarrow \infty$. It is also shown that under some mild integrability assumptions for φ , the joint distribution of $\sqrt{n} s_n^{(j)}$'s for all causes is asymptotically multivariate normal.

Key words: Aalen-Johansen estimator, cumulative incidence function, Kaplan-Meier integral

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