Small Sample Confidence Intervals for the Kaplan-Meier Estimators under the Proportional Hazards Model

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We develop a saddlepoint-based method for generating small sample confidence bands for the population survival function from the Kaplan-Meier (KM) estimators, under the proportional hazards model. In the process, we derive the exact distribution of this estimator and develop mid-population tolerance bands for saddlepoint estimators. Our method depends upon the Mellin transform of the zero-truncated survival estimator. This transform is inverted via saddlepoint approximation to yield a highly accurate approximation to the cumulative distribution function of the respective cumulative hazard function. This distribution function is then inverted to produce our saddlepoint confidence bands. Then we compare our saddlepoint confidence bands with those obtained from competing large sample methods as well as with those obtained from the exact distribution. In our simulation study, we found that the saddlepoint confidence bands are very close to the confidence bands derived from the exact distribution. In addition being close, it is easier to compute, and it outperforms the large sample methods in terms probability convergence.