Minimal Repair Processes under a Failure Rate based Step-Stress Test

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Abstract

The sequence of failure times of a technical system, in the sense of minimal repair, is considered. With respect to just one component, in case of failure, this component will instantaneously be repaired, being put into the condition immediately prior to its failure while the repair times are considered to be neglected. Minimal repair times acquire the same joint distribution as corresponding record values, and epoch times of some non-homogeneous Poisson process (NHPP) (s. Gupta and Kirmani, 1988). Minimal repair may also be interpreted by saying that, successively, the failed component is replaced by a component of equal age in contrast to the model of a renewal process (cf. Ascher and Feingold, 1984). Alternatively, a minimal repair process can be defined by considering iterations of the so-called relevation transform (see Krakowski, 1973). Thus, the model of record values, the analysis of occurrence times of some NHPP, the iterative use of the relevation transform, and the minimal repair model are all distributionally equivalent. Therefore, results for any of these models may be applied for the problem under consideration. In the NHPP setting and for successive repairs of a system having only a very small fraction of components either repaired or replaced by new components, it is reasonable to assume that, upon restart, the reliability of the (complex) system after some (minimal) repair is approximately the same as it was immediately prior to its failure (s. Ascher and Feingold, 1984). We consider a minimal repair process under a Type-II censored simple step-stress accelerated life testing (SSALT) experiment (for SSALT cf. Bagdonavicius and Nikulin, 2002; Balakrishnan, 2009). Targeting at inferential procedures of higher precision, we combine different step-stress experiments, which might have been conducted at different locations or at different times or even under different testing conditions. By assuming an underlying failure rate based model (s. Kateri and Kamps, 2015, 2017), we discuss parameter estimation in the one- and the multi-sample situation, and show some properties of respective estimators, expanding results of Balakrishnan et al. (2009) for an underlying cumulative exposure model.

References

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