

Minimal Repair Processes Under a Step-Stress Test

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ABSTRACT

We consider the sequence of failure times of a technical system in the sense of minimal repair. In such a scheme, with respect to just one component, upon failure, this component will instantaneously be repaired, and by this, put into the condition immediately prior to its failure. The times to repair are considered to be low and so are neglected. Minimal repair times possess the same joint distribution as corresponding record values as well as epoch times of some non-homogeneous Poisson process (NHPP) (see Gupta and Kirmani (1988)). Another interpretation of minimal repair consists of 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)). A different way of viewing a minimal repair process is to consider iterations of the so-called relevation transform (see Krakowski (1973) and Cramer and Kamps (2003)). Hence, the model of record values, the analysis of occurrence times of some NHPP, the iterative use of the relevation transform as well as the minimal repair model are all distributionally equivalent. Results derived for any of these models may therefore be used for the situation under consideration. Considering successive minimal repair of just one particular component within a system may not be a practical situation. In the NHPP-setting, a modelling may be appropriate when considering successive repairs of a system when only a very small fraction of components is either repaired or replaced by new components. In these cases, 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 (see Ascher and Feingold (1984)). We consider a minimal repair process under a simple step-stress experiment in order to reduce experimental time; a single experiment is terminated as soon as the r -th failure is observed for some r . For step-stress experiments we refer, e.g., to Bagdonavicius and Nikulin (2002) and Balakrishnan (2009). Moreover, aiming at increasing precision of inferential procedures, 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 cumulative exposure model or a tampered failure rate model, we discuss parameter estimation in the one- and the multi-sample situation, and show some properties of respective estimators (see Balakrishnan et al. (2009), Kateri and Kamps (2015)).

References

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