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A random shock model with competing and dependent failure modes of different kinds

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SUMMARY

This presentation is devoted to the survival analysis of a system subject to competing failure modes within an external stressing environment. Stress classically arrives through shocks according to a non-homogeneous Poisson process [1]. Each shock may result in the system immediate failure through a Bernoulli trial, independent of the system intrinsic behaviour; otherwise, a non fatal shock induces some random deterioration and aging of the system, leading to some shock model with mixed effects [3]. More specifically, apart from shocks, the lifetime of the system is the result of some competition between some accumulative deterioration (with a given failure threshold) and a random variable characterized by a failure rate. Each non fatal shock results in a simultaneous increment of both deterioration level and failure rate. The model takes into account some possible dependence between the increments of the deterioration level and of the failure rate at each shock. Also, following [2], the probability for a shock to be fatal is assumed to depend on the shock arrival time, which induces another type of dependence.

The lifetime of the system is studied and its reliability is calculated through several different methods. Sufficient conditions are provided, under which the system lifetime is proved to be New Better than Used. The influence of various parameters of the shocks environment on the system lifetime is studied, such as the rate of shocks arrival, the probability for a shock to be fatal and the dependence between the increments of the two components characteristics.

Keywords: Reliability, Bivariate non homogeneous compound Poisson process, Hazard rate process, Poisson random measure, Stochastic order, Ageing properties

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