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A general multivariate lifetime model with a multivariate additive process as conditional hazard rate increment process

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SUMMARY

The object of the present paper is the study of the joint lifetime of d components subject to a common stressful external environment. Out of the stressing environment, the components are independent and the lifetime of each component is characterized by its failure (hazard) rate function. The impact of the external environment is modelled through an increase in the individual failure rates of the components. The failure rate increments due to the environment increase over time and they are dependent among components. The evolution of the joint failure rate increments is modelled by a non negative multivariate additive process, which include Lévy processes and non-homogeneous compound Poisson processes, hence encompassing several models from the previous literature. A full form expression is provided for the multivariate survival function with respect to the intensity measure of a general additive process, using the construction of an additive process from a Poisson random measure (or Poisson point process). The results are next specialized to Lévy processes and other additive processes (time-scaled Lévy processes, extended Lévy processes and shock models), thus providing simple and easily computable expressions. All results are provided under the assumption that the additive process has bounded variations, but it is possible to relax this assumption by means of approximation procedures, as is shown for the last model of this paper.

Keywords: Reliability, Multivariate survival function, Multivariate covariate process, Multivariate additive process, Multivariate Lévy process, Poisson random measure

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