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Rethinking fatal shock models: using stochastic processes as mixture

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Fatal shock models have been thoroughly studied and applied in different fields (e.g., finance, hydrology, insurance, and reliability). In their classical stochastic representation, distinct shocks hit combinations of components of a d-dimensional vector. While this is convenient to interpret (and use) in low dimensions, the number of involved shocks increases exponentially in d, preventing such models from being applicable even in moderate dimensions. In many cases, however, the same distribution can be constructed using an alternative stochastic model that can be interpreted as a de Finetti-type construction, where the conditioning sigma-algebra corresponds to that of a suitable increasing stochastic process. On a theoretical basis, this provides an interesting link between classes of distributions and the corresponding classes of stochastic processes. It links the Marshall–Olkin distribution and Lévy subordinators, certain shock models and Sato processes, and the Dirichlet process with the implicit copula behind a certain Bayesian assumption. For applications, such alternative constructions simplify the handling of high-dimensional distributions in many cases. Moreover, hierarchical constructions are immediate.

The talk is based on joint work with German Bernhart, Jan-Frederik Mai, and Steffen Schenk.

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