Failure processes driven by a selfcorrecting model. Application to earthquake sequences.

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Abstract

Earthquake occurrence is usually modelled by point processes. The longterm recurrence of strong earthquakes is often modelled by Poisson process or selfcorrecting point processes with nondecreasing hazard. In a shortterm time scale, selfexciting point processes with nonincreasing hazard are especially suitable to describe the general tendency to occur in clusters. In order to provide a unified framework for analyzing earthquake catalogs, we consider a seismic sequence as the union of two disjoint subsets of events, hereinafter named the leaders and the subordinates. Based on the empirical evidence that earthquakes are typically clustered in time, leaders correspond to main events with magnitude exceeding a threshold magnitude which characterizes destructive quakes in Italy. The remaining events are labelled as subordinates. We introduce a new point process aimed to jointly model the evolution over time of these two components of the earthquake process. The leaders are assumed to be generated according to a selfcorrecting point process and, conditionally to the occurrence of the leaders, the subordinates follow a failure process which admits a bathtub hazard function. Specifically, we consider the generalized Weibull distributions, a wide family of distributions having hazard functions that admit different shapes (e.g. increasing, decreasing, bathtubshaped, upsidedown bathtubshaped). We analyze some Italian sequences of earthquakes drawn from the new Parametric Catalogue of Italian Earthquakes (CPTI15).