Bulletin of the
Seismological Society of America

Vol. 64 October 1974 No. 5

IS THE SEQUENCE OF EARTHQUAKES IN SOUTHERN CALIFORNIA, WITH AFTERSHOCKS REMOVED, POISSONIAN?

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Abstract

Yes.

Early attempts to determine whether or not earthquake events were Poisson-distributed led to the conclusion that main sequence events were significantly non-Poissonian, whether worldwide catalogs (Aki, 1956), or local catalogs (Knopoff, 1964) were considered. Such a conclusion is of importance in earthquake prediction; a demonstration of nonrandomness in earthquake catalogs gives rise to the hope that a basis for prediction of occurrence times can be found by decoding the sequential message in the list of events. Conversely, if earthquakes are random events in time, no hope exists for finding order in earthquake catalogs and, hence, attempts to predict times of occurrence based on studies of catalog sequences are very likely doomed. Nevertheless, a result which shows that earthquake sequences are Poissonian can be of use in estimating seismic risk (Molchan, *et al.*, 1970) by virtue of the simple statistical models which result; we assume that more complicated statistical models will make the analytical procedures more complicated, although such analyses have not been carried out in detail.

Aftershocks are earthquake events which are causally connected with a parent event which is usually large. Typical earthquake catalogs must be non-Poissonian if they are mixtures of two populations, aftershock clusters which are not Poissonian, and main-sequence events which may or may not be. Interest in randomness or nonrandomness of earthquake sequences centers on main-sequence events. Immediately after a large earthquake, numerous aftershocks occur on a short time scale. Later in aftershock sequences, the time interval between earthquakes becomes longer. The clustering property implies short-term predictability.

The success of any attempt to study the randomness of main-sequence events depends on the skill with which aftershocks are identified and removed from catalog listings. If this is not done skillfully, the residual is certain to be non-Poissonian. In one of the first attempts to delete aftershocks from an earthquake catalog (Knopoff, 1964), it was found that successively more realistic definitions of aftershocks led to main-sequence catalogs which were successively more Poissonian. Nevertheless, after the best attempt to remove aftershocks was made, a significantly non-Poissonian residual catalog remained. The result of this early investigation left the basic question unresolved: Was the non-Poissonian result the consequence of a still incomplete identification of aftershocks, or is there a genuine non-Poissonian character to a catalog of main-sequence earthquakes (i.e., was the removal of aftershocks the best that could be done)? We describe an empirical method of culling aftershocks from an earthquake catalog, which is an alternative to the earlier (Knopoff, 1964) procedure. The main-sequence list that remains