Probabilistic estimation of large earthquake occurrence and prior distribution of parameters in the renewal model

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A Bayesian method is discussed for estimating the probability of the next characteristic earthquake occurrence in the time interval from the data on date of several events in past using the renewal model with lognormal distribution.

Suppose that n+1 events occurred on a fault or in a source area are separated by n time intervals, and the logarithm of interval length, denoted with X, follow a normal distribution. The mean and variance of variable X are not unknown to us a priori. The prior distribution of parameters is considered at first to be uniform for the parameter of mean and reversal gamma with the shape- and scale- parameters for the variance of normal distribution. Comparing the theoretical distribution of unbiased variance of samples with the observed one of 33 sequences consisting of five or more events in the world which have been reported by the Committee of Earthquake Research of Japan, and Nishenko(1991), etc., I regarded the values of p=3 and z=0.3 as the shape- and scale-parameters for prior distribution.

The random variable given by

(X-m)∗sqrt(n+2p-1)/sqrt((n+1)∗2(z+nv))

hold for t-distribution with freedom of (n+2p-1), where v is variance of samples. The probability of characteristic earthquake occurrence is given by the conditional probability and they are 0.90, 0.43 and 0.90 for the events off Miyagi prefecture in 30 years since 2005,.along Nankai trough in 50 years since 2005, and at Park Field in 20 years since the prediction by Bakun and Lindh (1985), respectively. It is pointed out that the ambiguity of parameters in the distribution has so large to have significant effects on the probability in prediction for a sequence of several earthquakes.