Probabilistic Estimation of Characteristic Earthquake Occurrence by Bayesian Approach

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I statistically discuss the method for estimating the probability of the next characteristic earthquake occurrence in the time interval from the data on date of several earthquakes in past by using lognormal distribution model, based on the Bayesian approach.

Suppose that n+1 events have occurred on a fault or a source area are separated by n time interval, and its logarithm denoted as X, follows a normal distribution with mean Mp and S2 which are unknown a priori to us. The distribution of them are calculated by Bayes theorem from a prior distribution and data of X. The prior distribution is considered to be uniform for mean Mp and reversal gamma for variance S2.

It is shown that the random variable

(X-m)*SQRT(n+2p-1)/SQRT{(n+1)*(2z+nv)}

follows t-distribution with freedom of degrees of n+2p-1. Here the p- and z- values are the shape and scale parameters of the reversal gamma distribution for the prior, respectively, of which parameters are newly estimated as p=4 and z=0.12 from the distribution of unbiased variance for many earthquake sequences in and near Japan reported by the Committee of Earthquake Research of Japan, CERJ, and Hasegawa, etc.

The probability of characteristic event occurrence off Miyagi prefecture in 30 years is estimated about 76 %, which is much smaller than that of CERJ, 99 %, and a little less than 80 % given by the author in 2004.