Geophysical Research Abstracts
Vol. 16, EGU2014-1831-4, 2014
EGU General Assembly 2014

New Least-Squares Estimators of Seismicity Parameters

Myunghyun Noh
Korea Institute of Nuclear Safety, Korea, Republic Of (mhnoh@kins.re.kr)

New least-squares estimators (nLSE) were developed for seismicity parameters: Richter-b and annual rate of earthquakes. The estimators are derived by minimizing the sum of squared errors,

$$SSE = \sum_{i=1}^{I} (n_i - \omega_i)^2,$$

where I is the number of magnitude intervals in $[m_{\min}, m_{\max}]$,n_i is the number of earthquakes in the i-th magnitude interval, m_i, and $\omega_i = \nu t_i p_i$ is the expectation of n_i where ν, t_i, and p_i are the mean annual rate of earthquakes with magnitude larger than $m_{\min}$, the period of completeness, and the probability of m_i, respectively. For the doubly-truncated exponential distribution of magnitude, the probability is given by

$$p_j = \exp(-\beta m_j) / \sum_{i=1}^{I} \exp(-\beta m_i), \quad \beta = b \ln(10).$$

Unlike the conventional least-squares estimators (cLSE), the nLSE does not violate the assumption of independency of data because the nLSE uses the interval frequency. Moreover, the nLSE can accommodate the period of completeness, the maximum magnitude, and the effect of magnitude grouping with a finite interval width. The accuracy of the nLSE, the cLSE, and the maximum likelihood estimators (MLE) were compared by using the ensemble of simulated earthquake catalogs. The comparison revealed that the sample means of the three estimators are comparable, while the sample standard deviations show large differences; the sample standard deviation of MLE is smallest and that of cLSE largest.

The reason why we don't discard the LSE is that there are some applications where the MLE is not efficient. An example is the analysis of minimum magnitude above which an earthquake catalog is complete.