Bias Correction for the Distribution of Aftershocks Within Short-Term Period Immediately After Large Main Shock

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The main shock of a large earthquake often makes it difficult to identify a number of subsequent aftershocks. Knowing the distribution of magnitudes and arrival times of the aftershocks is essential to figure out the characteristics of the sequence of earthquakes, which enables us to predict the frequency of earthquakes depending on space and time. Such the distribution of aftershocks should be estimated within a couple of days eventually since most of the large aftershocks occur within one day from the main shock. However, an exact count of all aftershocks right after a main shock is very hard due to large signal-to-noise ratio, so that an estimated distribution of the aftershocks is usually biased.

An adoption of a likelihood that incorporates models of the detection rate of aftershocks can be a solution to correct the bias, but the simultaneous dependency on both magnitudes and arrival times of the aftershocks makes this difficult. Thus using nonparametric models for the detection rate is unrealistic though misspecification of the model may lead to a severe biased estimator.

In this study, we propose two detection rate models that are individually conditional on the magnitudes and the arrival times. The Generalized Moments of Methods (GMM)-type estimator overcomes the difficulty in estimation due to the imcompletely defined joint distribution. With the use of prior information, the distribution of the aftershocks can be effectively estimated within short-time period.

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