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ACCOUNTING FOR TRONCATION EFFECTS IN THE ESTIMATION OF PGA ATTENUATION

The estimation of empirical attenuation laws with standard regression techniques commonly assumes the lognormal distribution of the response variable (e.g., peak ground acceleration, PGA) for fixed values of the predictor variables (e.g., magnitude and distance from the source). Such an assumption may be invalidated by restrictions on the available sample induced by the acquisition system or imposed by the analyst, so that bias may be introduced in the estimation of regression parameters.

In this work I analyze the distortion from lognormality due to station triggering. I propose a technique based on truncated regression analysis that does not require a knowledge of which stations did not trigger. Furthermore, I introduce randomly truncated regression analysis to deal with thresholds that change randomly over time. This technique is adopted for stations that trigger based on the ratio between a short and long-term average of the signal (STA/LTA ratio).

I apply all these techniques to the estimation of PGA attenuation relations for both synthetic and real data sets. Real applications refer to strong motion data from the European area and to weak motion data collected by various networks in the Friuli-Venezia Giulia and Veneto regions (N.E. Italy). The usefulness of such techniques depends on the extent of truncation, which in turn is a function of the magnitude range, distances considered, type of soil and type of recording instrumentation. For the available strong motion data, truncation has relevant effect for rock sites (Fig. 1). In the case of weak motion data (Fig. 2), truncated regression helps to model magnitude-dependent attenuation.

![Fig. 1 - Attenuation curves obtained for European strong motion data restricted to rock sites, epicentral distance lower than 80 km and magnitude greater than 4.5. They are shown the curves obtained using standard and truncated regression assuming truncation at 0.01g (dotted and continuous lines respectively).](image-url)
Fig. 2 - Attenuation curves obtained for weak motion data collected in north-eastern Italy and restricted to epicentral distance lower than 80 km and magnitude between 2.5 and 4.5.