17th Symposium on Earthquake Engineering
November 14-17, 2022
IIT Roorkee, India
Paper No. 422

Application of Regression Techniques for Preparing a Homogenous Earthquake Catalog - An Overview

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Abstract

Standard Least-Squares Regression (SLR) and General Orthogonal Regression (GOR) address different questions and make different assumptions about measurement errors in one or both of the variables. SLR minimizes the sum of squares of the vertical deviations and provides estimation of the dependent variable (Y). It assumes that the independent variable (X) is an observed value which is known without error, and only the dependent variable (Y) suffers from measurement error.

GOR, on the other hand, yields a linear relationship ($Y_t = \beta_0 + \beta_1 X_t$) between the dependent (Y_t) and the independent (X_t) variables based on observed data (X, Y) having measurement errors in both the variables involved. Therefore, it is mathematically incorrect to use observed value X in place of X_t in the equation $Y_t = \beta_0 + \beta_1 X_t$ and thus, if done so (as in the conventional GOR method), this procedure will produce biased estimates.

The present study is an overview of different methodologies used for preparing a homogeneous earthquake catalog for different seismic environments. The error variance ratio (η) used in GOR has not been addressed in seismological literature and this overview will address this critical issue as well. This study will also suggest a guideline for the use of regression methods for preparing a homogeneous earthquake database which is an important input to obtain improved seismic hazard assessment.

Keywords: Regression analysis, Orthogonal regression, Homogenous earthquake catalog, b-value