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Seismic Indicators Based Earthquake Magnitude Prediction for Bangladesh Using Machine Learning Algorithms

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Introduction

Earthquakes are the most unanticipated and catastrophic natural disasters. Due to its complex nature, it is challenging to predict earthquakes early. But the prediction of the time of occurrence, magnitude, and epicentral location of future earthquakes has been the subject of study in recent years. The use of the machine learning process has recently started in the field of Earthquake Engineering [1]. It offers advantages in handling complex problems and facilitates decision making which may evolve shortly [2, 3, 4].

Methodology

In this study, Bangladesh has been selected for the prediction of earthquakes. The earthquake catalog has been obtained from USGS [5] for the period from January 1974 to July 2020; using a cut-off magnitude of 2.5. The outcome is formulated as a binary classification task and predictions are made for the magnitude greater than or equal to 5.0. Seismic parameters are calculated based upon well-known geophysical facts and the famous Gutenberg–Richter law [1]. The parameters are mean magnitude, probability of earthquake occurrence, total recurrence time, a and b value of Gutenberg-Richter law, seismic energy release, magnitude deficit, time of n events. Logistic Regression (LR) and Support Vector Machine (SVM) algorithms have been applied for the earthquake magnitude prediction model.

Results

To ascertain the practicability of LR-SVM model, a computational test was conducted in LR and SVM algorithms separately. For LR, the accuracy of the training and testing dataset was 0.892 and 0.893 respectively and Precision, recall, and f-score was found 0.8928571428571429, representing 89.2% of positive class prediction. Similarly, for the radial basis function (RBF) kernel of SVM, the accuracy of the training and testing dataset was 0.862 and 0.857 respectively and Precision, recall, and f-score was found 0.8571428571428571, showing 85.71% of positive class predictions. Finally, for the polynomial kernel of SVM, the accuracy of the training and testing dataset was 0.723 and 0.714 respectively and Precision, recall, and f-score was 0.7142857142857143 indicating 71.4% of positive class predictions.

Discussion

The study shows better results for LR compared to SVM in terms of accuracy, precision, recall, and f-score. The proposed model has shown consistent performance in terms of the parameter value. However, due to the short data set of Bangladesh, precision, recall, and f-score represent identical values. Besides, the accuracy of the model can be increased by adding other parameters. It is also mentionable that, training and testing data set showing approximately similar results indicating the accuracy of the model. This model can also be tested against the data-rich earthquake region for practicability.

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