

Neighborhood-Based Earthquake Risk Prediction: An Integrated Machine Learning

Research Area: Earthquake Risk Modeling, Disaster Management, Machine Learning, Spatial Statistics

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Abstract:

This project introduces a data-driven approach to earthquake risk assessment in Turkey, shifting from static administrative boundaries to dynamic “Seismic Neighborhoods.” Using more than 19,000 earthquake records from USGS and AFAD (1990–2025), we applied DBSCAN clustering to identify active seismic zones and then used Voronoi Tessellation to model regional risk partitions. Each region was assigned a risk score based on seismic intensity and event frequency. Kernel Density Estimation (KDE) was additionally used to predict future earthquake probability distributions. The results reveal that seismic risk is highly localized and that neighborhood-level early warning systems may offer more actionable insights than province-level alerts. This research provides a rigorous, data-driven framework to support more precise, scientifically informed disaster preparedness strategies.

