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APPLYING SEMI-MARKOV MODELS FOR FORECASTING THE TRIPLE DIMENSIONS OF NEXT EARTHQUAKE OCCURRENCES

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Abstract. Generally every earthquake is specified with the three temporal, spatial, and magnitudinal dimensions. Earthquakes can be investigated not only physically but also mathematically. One of the subsections of mathematics that can be applied in the mathematical investigation and analysis of earthquake occurrences is the stochastic processes method. In this article, the Semi-Markov Model, a rather novel method in investigating stochastic processes, will be applied to analyze and forecast the occurrence of future earthquakes based on the previous earthquakes' data. To investigate each process, for each Semi-Markov model some states should be defined. In the present paper, the intended region, Iran, is divided into some parts, each part is considered one zone, and each zone is taken into account as one of the Semi-Markov Model states. Later on, several methods to determine the amount of forecasting error are introduced and applied to the intended area. The results of the application of Semi-Markov Model in investigating and forecasting the occurrence of future earthquake are obtained and analyzed mathematically. Based on the obtained results, using Semi-Markov model technique to investigate and forecast the future earthquakes can be considered useful and practical. However, the zoning method of the intended area and the number of zones can influence the ultimate results either positively or negatively.

Keywords. Semi-Markov Model, Probabilistic Forecasting, Deterministic Forecasting, Forecasting Error, Karakaisis zoning, Region to Region Transition, Magnitude to Magnitude Transition

1 Introduction

Earthquakes can be inspected both mathematically and physically [19]. One of the subsections of mathematics that can be applied in the probabilistic investigation of phenomenon is the stochastic processes method. One of the stochastic processes models, frequently applied during the recent years, is Markov model and especially Semi-Markov model. Semi-Markov model belongs to the models that can model the events just in case of their having relationship with the previous events. [7, 12, 17, 20] For the analysis of the three temporal, spatial, magnitudinal dimensions of earthquakes, Markov