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Evaluating the seismicity parameters of Tehran, Iran

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The objective of this paper is to evaluate the seismicity parameters of Tehran. These parameters are achieved using the Gutenberg–Richter method, cumulative distribution functions, and the Kijko–Sellevoll approach. First, a catalogue of earthquakes that have occurred within a radius of 200 km of Tehran is collected and processed. Aftershocks and foreshocks are ignored in the earthquake catalogue, and the main seismic events are considered in evaluating the data. In this approach the variable windows in time and location domains are employed, and the earthquakes are supposed to follow Poisson's formulation. Subsequently, the seismicity coefficients for Gutenberg–Richter, cumulative distribution functions, and Kijko–Sellevoll methods are calculated and the magnitude–period graphs are constructed. Comparative analysis of the results shows the best accuracy for the Kijko–Sellevoll method, with the Gutenberg–Richter method providing the least precise results.

NOTATION

a	number of earthquakes greater than zero in Gutenberg–Richter method
B	constant coefficient
b	seismicity coefficient
C	constant coefficient
FD	focal depth
$f(m)$	probability density function of magnitude
G_{I}	Gumbel function Type I
G_{III}	Gumbel function Type III
G_{S}	Gumbel function Type S
M_{a}	earthquake magnitude of turning point
M_{i}	earthquake magnitude
M_{L}	local magnitude
$M_{\max}$	maximum magnitude
$M_{\min}$	minimum magnitude
M_{s}	surface wave magnitude
m, M	earthquake magnitude
m_0	smallest concerned earthquake
m_{b}	body wave magnitude
m_{u}, $m_{\max}$	maximum credible earthquake
N_{c}	cumulative frequency of earthquake
$N(m)$	annual rate of earthquakes $\geqslant m$
p	annual probability of earthquake occurrence
q	annual improbability of earthquake occurrence
q^*	annual exceedence probability of earthquake occurrence
R_{t}	earthquake hazard percentage
T	time span
t	lifetime of structure
T_{R}	earthquake return period
α	constant coefficient
β	seismicity parameter
γ	constant coefficient
λ	seismicity rate

1. INTRODUCTION

Iran is one of the most seismically active countries situated on the Alp-Himalayas belt. To date, many devastations and heavy casualties have been evidenced in this area. Fig. 1 shows a seismicity map of Iran during recent years.[1]

Tehran, the capital of Iran, with a large population of 10 million people is considered to be a political and economic centre. The occurrence of an earthquake in such a densely populated city, with its significant situation, will result in severe consequences. The occurrence of several historical

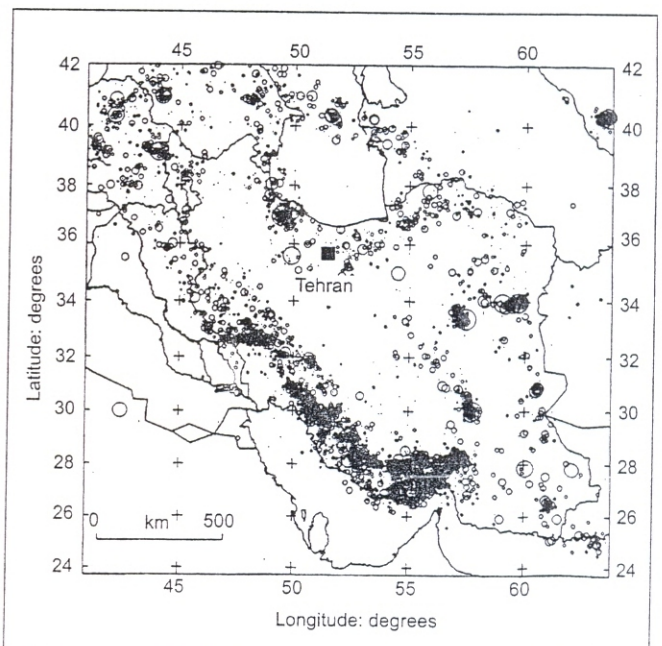

Fig. 1. Seismicity map of Iran in recent years. Earthquake magnitude (Richter scale): ●, < 5; ○, 5–7; ○, > 7