MTH 371: Assignment I

September 30, 2022

Instructions

- Use statistical software R for your codes.
- Only basic built-in functions available in R are allowed.
- Due date is October 9, 2022 (11.59 p.m. IST). No late assignments will be accepted.
- Submit all of your work which include the codes, results, graphs and reports.

1. (10 points) The magnitude of various earthquakes for a site (fixed latitude and fixed longitude) are recorded. The data is from 2000-2022. The researchers are interested in the earthquakes of magnitude ≥ 6. It is assumed that occurrence of each earthquake is independent of each other. Further, each earthquake of magnitude ≥ 6 occurs with same probability p. Answer the following questions

   (a) A random variable $Z_k = 1$ if there is an earthquake of magnitude ≥ 6 while $Z_k = 0$, otherwise. Use $p = 0.4$ and simulate the process for a finite t and provide the corresponding scatter plot.

   (b) Plot the cumulative distribution of first inter-arrival time for time t.

   (c) A random variable N_k, is defined as number of earthquakes of magnitude ≥ 6 till time k. Study and compare the change in behavior of N_k for $p = 0.4$ and $p = 0.9$.

2. (10 points) Assume a website receives an average of 10 visitors per hour. We are interested in studying the number of visitors in time interval $(0, t]$ (t is considered to be continuous). Let us suppose we can model it as a Poisson process. Answer the following questions

(a) Simulate the density of number of arrivals until time t. Provide the related graphs.

(b) Simulate the density of number of arrivals until time t for $\lambda = 20$ and compare the results with (a) (when $\lambda = 10$).

(c) Consider another independent website. The rate of arrival of the visitors is 5 visitors per hour on the website. We are interested in studying the total number of visitors on both the websites. Use t and simulate the total number of visitors in time t. Provide the related graph. Further, simulate the first inter-arrival time and plot the corresponding cumulative distribution function.