MTH 371: Assignment I

September 11, 2019

Instructions

- Use statistical software R for your codes.
- Only basic built-in functions available in R are allowed.
- Due date is September 30, 2019 (6 p.m. IST). No late assignments will be accepted.
- Submit all of your work which include the codes, results, graphs and reports.

1. (15 points) There are various ways that HIV virus could be transmitted and one of them is by blood transfusion. A study is conducted on the patients who had undergone transfusion in last one year. Suppose that at every instance of transfusion there is a possibility p that the virus will be transferred and each transfusion is independent of the other. Answer the following questions

   (a) For a patient with $p = 0.8$, generate the process and provide a scatter plot for finite time t. .

   (b) Plot the distribution of the first interarrival time till time 30.

   (c) In the above question what will happen to the interarrival if the time is 1000.

   (d) If there are three independent patients with same probability, p of getting HIV transferred describe how can we study their combined effect. Plot the total number of transfusions in 50 occurrences for $p = 0.4, 0.5, 0.6, 0.7, 0.8$. What do you observe.

2. (20 points) Suppose in the institute the internet is down on an average 2 times a day. We are interested in studying number of failures in a long run. Let's assume we start studying the process from midnight September 1, 2019 and the interarrival failure times are exponentially distributed. Answer the following questions

(a) Assuming that each interval is 24 hours long, simulate and plot the distribution of number of failures from September 1, 2019 to September 10, 2019.

(b) Simulate the density and cumulative distribution function of first interarrival time. Provide the related graphs.

(c) Let's assume the institute decides to test a new internet server and run both the servers independent of each other in independent areas. If the failure rate of the new server is 1.75 per day. Answer the following

   i. Compare the number of failures of both the processes and state which process is better and why.

   ii. Explain how can we study the processes as a combined process.

   iii. Simulate and plot the density of the total number of failures in a month.

   iv. Simulate and plot the density of the first interarrival times of the combined process.