

CIVL 7012/8012
Probabilistic Methods for Engineers
Homework 2
Due: February 25, 2019

(Note: You can do all questions by hand if you wish, or you can use any software to help you)

1. Strong earthquakes occur according to a Poisson process in a metropolitan area with a mean rate of once in 50 yr. There are three bridges in the metropolitan area. When a strong earthquake occurs, there is a probability of 0.3 that a given bridge will collapse. Assume the events of collapse between bridges during a strong earthquake are statistically independent; also, the events of bridge collapse between earthquakes are also statistically independent.
 - a) What is the probability of at most one strong earthquake occurring in this metropolitan area within the next 20 yr?
 - b) During a strong earthquake, what is the probability that exactly one of the three bridges will collapse?
 - c) What is the probability of "no bridge collapse from strong earthquakes" during the next 20 yr?
2. A country is subject to natural hazards such as floods, earthquakes, and tornadoes. Suppose earthquakes occur according to a Poisson process with a mean rate of 1 in 10 years; tornado occurrences are also Poisson-distributed with a mean rate of 0.3 per year. There can be either one or no flood each year, hence the occurrence of a flood each year follows a Bernoulli sequence, and the mean return period of floods is 5 years. Assume floods, earthquakes, and tornadoes can occur independently.
 - a) If no hazards occur during a given year, it is termed a "good" year. What is the probability of a "good" year?
 - b) What is the probability that 2 of the next 5 years will be "good" years?
 - c) What is the probability of only one incidence of natural hazard in a given year?
3. The total load, X (in tons) on the roof of a building has the following PDF:

$$f_x = \begin{cases} \frac{24}{x^3} & 3 \leq x \leq 6 \\ 0 & \text{Otherwise} \end{cases}$$

- a) Determine and plot CDF of X .
- b) What is the expected total load?
- c) Suppose the roof can carry only 5.6 tons before collapse. What is the probability that the roof will collapse?

CIVL 8012 Students:

In addition to the above problems, do the following

4. The time between severe earthquakes in a given region follows a lognormal distribution with a coefficient of variation of 40%. The expected time between severe earthquakes is 80 yr.
 - a) Determine the parameters of this lognormally distributed recurrence time, T .
 - b) Determine the probability that a severe earthquake will occur within 20 years from the previous one.