Assignment 2

Statistical and Mathematical Methods for Data Science

Deadline: Monday November 30, 2020

Instructions:

- You are required to solve all the problems and upload your solution as a single PDF file on the classroom.
- You can either combine legible handwritten images of your solution in a single PDF file or use latex (overleaf).
- The name of the PDF file must be your roll number eg. MSDS20XXX.PDF

Late submissions will not be accepted as the solution will be uploaded on Tuesday December 1.

Q1. Careem cargo company receives 2 orders on average in 1 hour. What is the probability that they will receive 6 orders in 2 hours? [5]

Q2. If the probability that an accident will occur on a given day is 0.1, find the probability that only 1 accident will occur at most in 10 days. [5]

Q3. The probability that your dart hits the target is 0.05 from a distance of 50m. What is the probability that you need to throw 5 darts to hit the target from the same distance? [6]

Q4. The probability that a startup will succeed is 0.25.
(a) What is the probability that an angel investor invests in 10 startups and 1 startup succeeds?
(b) What is the probability that an angel investor will go bankrupt if he has to invest in 10 startups before getting any profit?
(c) What is the probability that the investor will get profit from the 11th startup? [6]

Q5. The probability that a customer will select an item from the top shelf is 0.2222, from the middle shelf is 0.6111 and from the bottom shelf is 0.1667 of a rack in a supermarket. What is the probability that the customer who has bought 6 items would get 2 items from the top shelf, 3 items from the middle shelf and 1 item from the bottom shelf? [8]

Q6. There are 3 coins C_1, C_2, C_3 in a bag. A person randomly selects a coin and flips it. The probability of getting a head for C_1 is 0.01, for C_2 is 0.03 and for C_3 is 0.02. The probability of selecting C_1 is 0.3, selecting C_2 is 0.2 and selecting C_3 is 0.5. If he gets a head, what coin is the most probable to be selected? [10]

Q7. The probability of selecting a point from a line is given by normal distribution (mean = 0, variance = 1).
a) Find the probability that a point greater than 1.84 is selected.
b) Find the probability that a point between −1.97 and 0.86 is selected. [4]

Q8. A dozen eggs contains 5 rotten ones. If a restaurant serves you 5 from the dozen eggs, find the probability that 2 of them are rotten. [6]

Q9. A list of suitable candidates for a job have 5 ITU graduates and 4 PUCIT graduates. If 3 candidates are chosen from the list at random then find the probability that all of them are ITU graduates. [10]

Q10. Consider a group of 10 people containing 3 children, 4 adults and 3 seniors. What is the probability that a random sample of 5 will contain 1 child, 2 adults and 2 seniors? [5]

Q11. The probability of purchasing a faulty headphone is 0.1. If you buy 10 headphones what is the probability that at least 9 will work correctly? [5]

Q12. BioNTech company has prepared a vaccine serum of coronavirus and wants to assess its quality. Batches of serum are processed by three different departments having rejection rates of 0.10, 0.08, and 0.12, respectively. The inspections by the three departments are sequential and independent.
(a) What is the probability that a batch of serum survives the first departmental inspection but is rejected by the second department?
(b) What is the probability that a batch of serum is rejected by the third department? [8]

Q13. For married couples living in DHA, the probability that the husband will vote for TLP is 0.21, the probability that the wife will vote for TLP is 0.28, and the probability that both the husband and the wife will vote is 0.15. What is the probability that:
(a) at least one member of a married couple will vote for TLP?
(b) a wife will vote, given that her husband will vote for TLP?
(c) a husband will vote for TLP, given that his wife will not vote for TLP? [6]

Q14. The probability that an LED will be defective is 0.05 and the probability that a device will classify it as defective is 0.78. If the probability that the device will classify a working LED as defective is 0.06 then find the probability that the device will classify a random LED as defective. [10]

Q15. The probability that a student will make a mistake on his or her paper is 0.1. Find the probability that
(a) four totally unrelated students each make a mistake;
(b) Tania and Hania both make mistakes, while Ibtisam and Gulfam do not make a mistake. [6]