COMSATS University Islamabad

Terminal Examination – Semester SP 23

Course Title:	Statistics and Probability Theory	Course	MTH262	Credit Hours: 3(3,0)
Course Instructor/s:	Dr. Tajammal Hussain, Dr. M. Bilal, Dr. Tanveer Akhlaq, Dr. Saima Khan, & Mr. Nasir Anayat	Program:	BCS & BSE	
Semester: 3rd & 4th	Batch:	Section:	Date: June 27, 2023	
Time Allowed: 03 Hour			Maximum Marks: 50	
Student's Name:			Reg. CII	

Important Instructions / Guidelines: Attempt all questions.

Question 1:   (6)

Police plan to enforce speed limits by using radar traps at four different locations within the city limits. The radar traps at each of the locations $L1$, $L2$, $L3$, and $L4$ will be operated 40%, 30%, 20%, and 30% of the time. If a person who is speeding on her way to work has probabilities of 0.2, 0.1, 0.5, and 0.2, respectively, of passing through these locations,

a) what is the probability that she will receive a speeding ticket?

b) If the person received a speeding ticket on her way to work, what is the probability that she passed through the radar trap located at $L2$?

Question 2:   (6)

A candy company distributes boxes of chocolates with a mixture of creams, toffees, and nuts coated in both light and dark chocolate. For a randomly selected box, let X and Y, respectively, be the proportion of the light and dark chocolates that are creams and suppose that the joint distribution function is

$$f(x,y) = \begin{cases} \frac{6-X-Y}{8} & \text{for } 0 < x < 2, \\ & 2 < Y < 4 \\ 0 & \text{elsewhere} \end{cases}$$

i) Prove that $f(x,y)$ is a valid joint probability density function.
ii) Are X and Y independent of each other?
iii) Find $P(0 < X < 1 \ / Y = 3)$

Question 3:   (6)

The surface of a circular dart board has a small Centre circle called the bull's-eye and 20 pie-shaped regions numbered from 1 to 20. Each of the pie-shaped regions is further divided into three parts such that person throwing a dart that lands in a specific region scores the value of the number, doubles the number, or triples the number, depending on which of the three parts the dart hits. If a person hits the bull's eye with probability of 0.01, hits a double with probability 0.10, hits a triple with a probability of 0.05, and misses the dart board with a probability of 0.02. What is the probability that 7 throws will result in no bull's-eyes, no triples, a double twice, and a complete miss once?

Question 4: (6)

A manufacturing company uses an acceptance scheme on items from a production line before they are shipped. The plan is a two-stage one. Boxes of 25 items are readied for shipment, and a sample of 3 items is tested for defectives. The entire box is sent back for 100% screening if any defectives are found. If no defectives are found, the box is shipped.

a) What is the probability that a box containing 3 defectives will be shipped?

b) What is the probability that a box containing only 1 defective will be sent back for screening?

Question 5: (4+4)

(a) An automobile manufacturer is concerned about a fault in the braking mechanism of a particular model. The fault can, on rare occasions, cause a catastrophe at high speed. The distribution of the number of cars per year that will experience the catastrophe is a Poisson random variable with $\mu=5$. What is the probability that at least 2 cars per year will experience a catastrophe?

(b) Oil drilling company ventures into various locations, and their success or failure is independent from one location to another. Suppose the probability of successful oil exploration at a specific location is 0.45. What is the probability that for 3 successful drillings at most 6 attempts are required?

Question 6: (6)

In a human factor experimental project, it has been determined that the reaction time of a pilot to a visual stimulus is normally distributed with a mean of 0.50 seconds and a standard deviation of 0.40.

a) What is the probability that a reaction from the pilot takes from 0.2 to 0.7 seconds?

b) What reaction time is that which is exceeded 95% of the time?

Question 7: (6)

The life, in years, of a certain type of electrical switch has an exponential distribution with an average life $\beta=2$. If 10 of these switches are installed in different systems, what is the probability that at most 3 fail during the first year?

Question 8: (6)

The grades of a class of 9 students on a midterm report (x) and on the final examination (y) are:

X	77	50	71	72	81	94	96	99	67
Y	82	66	78	34	47	85	99	99	68

a) Estimate the linear regression line $Y= \beta_0 + \beta_1 x$ for Y against X.

b) Estimate the final examination grade of a student who received a grade of 85 on the midterm report.

Good Luck

Some Values from Normal Probability Distribution Table

Z-value	-2.00	-1.00	0.00	0.25	0.50	.75	1.00	1.645	1.96
P-value	0.022750	0.15866	0.50000	0.59871	0.69146	0.77337	0.84134	0.9500	0.9750