

**PONDICHERRY UNIVERSITY**  
**Department of Computer Science**  
**CSSC 432 Probability and Statistics**  
**END SEMESTER EXAM - FEBRUARY 2024**

**Marks: 60**  
**Time : 3 hours**  
**6 x 10 = 60**

**I. Answer any 6**

1. A. State Addition and Multiplication principles of counting (2)  
B. List all the formulae of Permutation and Combination under with and without replacement (3)  
C. If eight persons are having dinner together, in how many different ways can three order chicken, four order steak, and one order lobster? (5)
2. A. The probability of hitting a target in any shot is 0.2. If 10 shots are fired, find the probability that the target will be hit at least twice. (2)  
B. Ten numbered cards are there from 1 to 15, and two cards are chosen at random such that the sum of the numbers on both cards is even. Find the probability that the chosen cards are odd-numbered. (3)  
C. State Baye's Theorem (2)  
D. Suppose a medical test for a certain disease is 99% accurate. That is, if a person has the disease, the test result will be positive 99% of the time, and if a person does not have the disease, the test result will be negative 99% of the time. Further, suppose that the disease affects 1% of the population. Now, if a person tests positive for the disease, what is the probability that the person actually has the disease? (3)  
$$\frac{100 \times 99}{100 \times 99 + 1 \times 1}$$
3. A. State Central Limit Theorem (2)  
B. Suppose we have the following information. There is a 60% chance that it will rain today, 50% chance that it will rain tomorrow and 30% chance that it will not rain today or tomorrow. Find the probability that
  - i. It will rain today or tomorrow (2)
  - ii. It will rain today and tomorrow  $60 + 50 - 70 = 40$  (2)
- C. Let  $X$  be a discrete random variable with the following PMF
$$\begin{aligned}P_x(x) &= 0.1 \text{ for } x = 0.2, \\P_x(x) &= 0.2 \text{ for } x = 0.4 \\P_x(x) &= 0.2 \text{ for } x = 0.5 \\P_x(x) &= 0.3 \text{ for } x = 0.8 \\P_x(x) &= 0.2 \text{ for } x = 1 \\P_x(x) &= 0 \text{ otherwise}\end{aligned}$$
  
Find  $P(0.25 < X < 0.75)$  and  $P(X=0.2 | X < 0.6)$  (4)
4. A. Let  $X$  be a continuous random variable with the PDF given by:
$$\begin{aligned}f(x) &= x; 0 < x < 1, \\f(x) &= 2-x; 1 < x < 2, \\f(x) &= 0; x > 2\end{aligned}$$
  
Find  $P(0.5 < x < 1.5)$ . (4)  
B. Discuss the difference between joint probability, marginal probability (2)

C. If the joint probability density of X and Y is given by

$$f(x,y) = \frac{1}{4}(2x+y) \quad \text{for } 0 < x < 1, 0 < y < 2$$

$$f(x,y) = 0; \quad \text{elsewhere}$$

i. Find the marginal density of X (2)

ii. Find the conditional density of Y given  $X = \frac{1}{4}$  (2)

5. A. Write brief notes on Geometric distribution (2)
- B. A light bulb manufacturing factory finds 3 in every 60 bulbs defective. Calculate the probability that the first defective light bulb will be found when the 6th one is tested. (2)
- C. A bank is interested in studying the number of people using an ATM located outside its office late at night. On average 1.6 customers walk up to the ATM during any 10 minutes interval between 9.00 p.m. and midnight.
- a. What is the probability of exactly 3 customers using the ATM during any 10 minutes interval ? (5)
- b. What is the probability of 3 or fewer people using the ATM ? (5)
6. A. Let  $X \sim N(2,4)$  and  $Y = 3 - 2X$ . Find  $P(X > 1)$  and  $P(-2 < Y < 1)$  (5)
- B. Ten percent of the tools produced in a certain manufacturing process turn out to be defective. Find the probability that in a sample of 10 tools chosen at random, exactly 2 will be defective, by using the Poisson approximation to the binomial distribution (5)
7. A. Find the variance of a continuous random variable X whose PDF is given by  $f_X(x) = 2e^{-2x}; x \geq 0$  (5)
- B. Find the expected value of a discrete random variable K whose PMF is given by
- $$p_K(k) = (5^k e^{-5}) / k!; k = 0, 1, 2, \dots$$
- (5)
8. A. In 16- one hour test runs, the gas consumption of an engine averaged 16.4 gallons with a Standard Deviation of 2.1 gallons. Test the claim that the average gas consumption of this engine is 12.0 gallons per hour  $\alpha = 0.05$  (5)
- B. A new drug is proposed to lower total cholesterol. A randomized controlled experiment is designed to evaluate the efficiency of the medication in lowering cholesterol. 30 participants are enrolled in the trial and are randomly assigned to receive the new drug. The participant do not know which treatment they are assigned. At the end of 6 weeks, each patients total cholesterol level is measured and sample statistics as follows.

Treatment	Sample Size	Mean	Standard Deviation
New Drug	15	195.9	28.7
Old drug	15	227.4	30.3

Is the new drug effective than the old drug in lowering cholesterol?

(5)