



LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – STATISTICS

FIRST SEMESTER – NOVEMBER 2024



UST 1502 – PROBABILITY AND DISCRETE DISTRIBUTIONS

Date: 13-11-2024

Dept. No.

Max. : 100 Marks

Time: 09:00 am-12:00 pm

SECTION A - K1 (CO1)

	Answer ALL the Questions	(10 x 1 = 10)
1.	Define the following	
a)	Mutually exclusive events.	
b)	Multiplication theorem of probability.	
c)	Distribution function.	
d)	Mathematical expectation.	
e)	Bernoulli distribution.	
2.	Fill in the blanks	
a)	The result of a random experiment will be called _____.	
b)	In conditional probability, the formula for calculating $P(A B) = \frac{P(A \cap B)}{P(B)}$.	
c)	The probability density function $f(x)$ cannot exceed _____.	
d)	If X is a random variable and c is constant, then $E(cX) = cE(X)$.	
e)	The mean of a geometric distribution is _____.	

SECTION A - K2 (CO1)

	Answer ALL the Questions	(10 x 1 = 10)
3.	Match the following	
a)	Sample Space - λ	
b)	Posterior Probability - Arithmetic Mean	
c)	Discrete random variable - Revised probability	
d)	$E(X)$ - Countable number of distinct values	
e)	Mean of Poisson distribution - Set of all possible outcomes	
4.	True or False	
a)	If two events are independent, the occurrence of one event affects the probability of the other event.	
b)	Compound probability refers to the probability of the occurrence of two or more events at the same time.	

c)	The cumulative distribution function (CDF) for a random variable is always a non-decreasing function.
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d)	The expectation of the sum of two random variables X and Y is equal to the sum of their expectations.
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e)	The expected value of a Geometric distribution is always less than 1
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SECTION B - K3 (CO2)

Answer any TWO of the following	(2 x 10 = 20)
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5.	An urn contains 6 white, 4 red and 9 black balls. If 3 balls are drawn at random find the probability that: a) two of the balls drawn are white, b) one is of each colour, c) none is read, d) at least one is white.
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6.	State and prove the addition theorem for two events A and B. Then, extend the results to three events A, B, and C.
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7.	Three groups of children contain respectively 3 girls and 1 boy, 2 girls and 2 boys, and 1 girl and 3 boys. One child is selected at random from each group. Show that the chance that the three selected consist of 1 girl and 2 boys is $\frac{13}{32}$.
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8. A random variable X has the following probability mass function:

x	0	1	2	3	4	5	6	7	8
p(x)	k	3k	5k	7k	9k	11k	13k	15k	17k

a) Find k.

b) Evaluate $P(X < 3), P(X \geq 3), \wedge P(0 < X < 5)$.

SECTION C – K4 (CO3)

Answer any TWO of the following	(2 x 10 = 20)
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9.	Four cards are drawn at random from a pack of 52 cards. Find the probability that a) They are a king, a queen, a jack and an ace. b) Two are kings and two are queens c) Two are black and two are red. d) There are two cards of hearts and two cards of diamonds.
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10.	a) Explain Conditional probability with illustration. b) If A and B are independent events, then prove that (i) $A \wedge \bar{B}$ (ii) $\bar{A} \wedge B$ (iii) $\bar{A} \wedge \bar{B}$, are also independent
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11	State and prove addition and multiplication theorem of expectations.
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12	a) Ten coins are thrown simultaneously. Find the probability getting at least seven heads.
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b) State the formulas for the mean and variance of the hypergeometric distribution

SECTION D – K5 (CO4)

Answer any ONE of the following

(1 x 20 = 20)

- 13
- a) State and Prove Bayes theorem.
- b) In 2025 there will be three candidates for the position of principal – Dr. Chatterji, Dr. Ayangar and Dr. Singh - whose chances of getting the appointment are in the proportion 4:2:3 respectively. The probability that Dr. Chatterji if selected would introduce co-education in the college is 0.3. The probabilities of Dr. Ayangar and Dr. Singh doing the same are respectively $0.5 \wedge 0.8$.
- i. What is probability that there will be co-education in the college in 2025?
- ii. If there is co-education in the college in 2025, what is the probability that Dr. Singh is the principal?
- 14
- Derive the moment generating function (MGF) of the binomial distribution with parameters n (number of trials) and p (probability of success).

SECTION E – K6 (CO5)

Answer any ONE of the following

(1 x 20 = 20)

- 15
- a) A variable X is distributed at random between the values 0 and 4 and its probability density function is given by : $f(x) = kx^3(4-x)^2, (0 \leq x \leq 4)$.
Find the value of k , the mean and standard deviation of the distribution.
- b) State and prove Chebyshev's Inequality.
- 16
- Derive the expressions for the μ_1 and μ_2 of the Poisson Distribution.

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