St. Claret College

Autonomous, Bengaluru

Roll No:
Date:

UG END SEMESTER EXAMINATION-MAY 2025

13

B.Sc. STATISTICS II SEMESTER

ST 224: Probability and Probability Distributions

TIME: 3 hours. **MAX. MARKS: 80**

This paper contains THREE printed pages and FOUR parts

Instructions:

1. **Verify and ensure that the question paper is completely printed.**
2. **Any discrepancies or questions about the exam paper must be reported to the COE within 1 hour after the examination.**
3. **Students must check the course title and course code before answering the questions.**

PART-A

Answer ALL questions. Each answer carries ONE mark. **[1 x 10 = 10]**

1. Which of the following best describes a deterministic experiment?
   a) An experiment that gives the same outcome every time under the same conditions
   b) An experiment where outcomes are uncertain
   c) An experiment involving probabilities
   d) An experiment that depends on external factors
2. According to Bayes' Theorem, the probability of an event occurring given that another event has already occurred is called:
   a) Independent probability
   b) Dependent probability
   c) Conditional probability
   d) Sample space probability
3. Which of the following statements is true about a discrete random variable?
   a) It can take infinitely many values within an interval.
   b) It takes countable, distinct values.
   c) It is always continuous.
   d) It is always normally distributed.
4. Which of the following correctly defines the Moment Generating Function (MGF)?
   a) A function that generates the probability mass function (PMF)
   b) A function used to determine all moments of a probability distribution
   c) A function that determines the mode of a distribution
   d) A function that finds the probability of independent events

5. The marginal probability distribution of a variable is obtained by:
   a) Taking the ratio of the joint probability distribution
   b) Summing (or integrating) the joint probability distribution over the other variable
   c) Differentiating the cumulative distribution function (CDF)
   d) Finding the conditional probability
6. Which of the following is a property of a bivariate random variable's Moment Generating Function (MGF)?
   a) It uniquely determines the joint distribution
   b) It is always equal to 1
   c) It is only defined for discrete random variables
   d) It is independent of expectations
7. The Negative Binomial distribution is a generalization of which other discrete distribution?
   a) Poisson distribution
   b) Geometric distribution
   c) Hypergeometric distribution
   d) Discrete uniform distribution
8. The standard deviation of a Binomial distribution with parameters n (number of trials) and p (probability of success) is given by:
   a) $np(1-p)$ b) np c) n^2p d) $\sqrt{np(1-p)}$
9. Which of the following is a property of a Uniform (Rectangular) distribution over [a,b]?
   a) Probability density function (PDF) is constant.
   b) Mean is always zero.
   c) Variance is always equal to the mean.
   d) It is only defined for discrete variables.
10. The probability density function (pdf) of the Exponential distribution is given by $f(x) = \lambda e^{-\lambda x}, x > 0$.What is its mean?
   a) λ b) $\frac{1}{\lambda}$ c) λ^2 d) $\frac{1}{\lambda^2}$

PART-B

Answer any TEN questions. Each answer carries TWO marks. **[2 x 10 = 20]**

11. Distinguish between mutually exclusive events and exhaustive events.
12. State the addition theorem of probability for two events.
13. Define conditional probability.
14. Define the distribution function and mention its properties.
15. Distinguish between the probability mass function and the probability density function.

16. Define variance of a probability distribution. How is standard deviation related to variance?
17. How do we obtain the marginal probability distribution from a joint probability distribution?
18. What is the moment generating function of the sum of two random variables if the variables are independent?
19. If X and Y are independent, how does this affect the expectation of their sum?
20. Define hypergeometric distribution
21. Define beta distribution of the second kind.
22. Obtain the MGF of a rectangular distribution.

PART-C

Answer any FOUR questions. Each answer carries FIVE marks. **[4 x 5 = 20]**

23. For any three events A, B and C, show that $P(A \cup B \mid C) = P(A \mid C) + P(B \mid C) - P(A \cap B \mid C)$
24. Explain skewness and kurtosis of a probability distribution.
25. Explain the probability distribution and the cumulative distribution function and their properties in the case of a discrete random variable.
26. Show that the expected value of the sum of two random variables X and Y is the sum of the respective expectations.
27. Explain how the joint PDF can be obtained from the marginal and conditional distributions.
28. Show that the mean and variance of a Poisson distribution coincide.

PART-D

Answer any THREE questions. Each answer carries TEN marks. **[3 x 10 = 30]**

29. a) State the total probability law.

    b) State and prove Bayes' theorem. [3+7]
30. Explain the important moments of a probability distribution. [10]
31. Discuss covariance and correlation coefficient and explain their properties. [10]
32. Derive the mean, variance, and moment generating function of a binomial distribution with parameters n and p. [3+4+3]
33. Derive the moment generating function of a normal distribution with parameters μ and σ. [10]

****