K25U 1338

Reg. No.:

II Semester B.Sc. Degree (C.B.C.S.S. - O.B.E. - Supplementary/ Improvement) Examination, April 2025 (2019 to 2023 Admissions)

COMPLEMENTARY ELECTIVE COURSE IN STATISTICS/COMPUTER SCIENCE WITH AI AND ML

2C02STA: Probability Theory and Random Variables

Time: 3 Hours

Max. Marks: 40

Instruction: Use of calculators and statistical tables are permitted.

PART - A

Short Answer. Answer all 6 questions. Define random experiment.

 $(6 \times 1 = 6)$

- 2. State addition theorem on 2 events.
- Find P(A ∩ B) if the two events A and B are mutually exclusive.

For any two arbitrary events A and B with P(A/B) = 0.4, find P(A^c/B).

- Define mutual independence.
- Define continuous random variable.
- PART B

Short Essay. Answer any 6 questions.

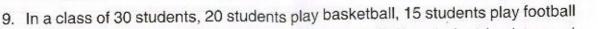
7. Define sample space and write the sample space for the random experiment

 $(6 \times 2 = 12)$

- of throwing two fair six sided dice. 8. Let A and B be two events associated with an experiment and suppose P(A) = 0.5
- while P(A or B) = 0.8. Let P(B) = p. For what value of p are A and B mutually exclusive?

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- and 10 students play both basketball and football. If a student is chosen at random from the class, what is the probability that the student plays football given that the student plays basketball? Prove that A^c and B^c are independent if A and B are independent.
- 11. Define distribution function of a random variable.
- 12. Given the probability density function of X as $f(x) = 2e^{-x}$, x > 0. Find the density of Y = 2X - 5.
- 13. Find c such that the following is a probability density function of a random variable X
- $f(x) = \begin{cases} cx^2 + \frac{4}{9}x, & 1 < x < 2 \\ 0, & \text{otherwise} \end{cases}$

PART - C

14. What are the properties of joint probability mass function of (X, Y) ?

Essay. Answer any 4 questions.

 $(4 \times 3 = 12)$

15. Given two events A and B where P(A) = 0.3 and P(B) = 0.5. Use Boole's inequality to find the upper bound for $P(A \cup B)$ and $P(A \cap B)$.

16. Explain the frequency definition of probability and give an example.

the probabilities of choosing: i) 2 red balls

17. A box contains 6 red and 4 blue balls. 2 balls are drawn at random. Calculate

- ii) 2 blue balls
- 18. State and prove multiplication theorem on probability for any two events A and B.

iii) 1 red ball and 1 blue ball.

 $P(X = 0, Y = 1) = \frac{1}{3}, P(X = 1, Y = -1) = \frac{1}{3}, P(X = 1, Y = 1) = 1/3.$

 $f(x) = a + bx, 0 \le x \le 1.$

i) Describe axiomatic definition of probability explaining the terms sigma

20. The joint probability distribution of two random variables X and Y is given by,

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 $(2 \times 5 = 10)$

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 Find marginal distributions of X and Y. ii) Find the conditional probability distribution of X given Y = 1. PART - D

A continuous random variable X has the probability density function

field and probability space. ii) Prove that $P(\phi) = 0$.

Long Essay. Answer any 2 questions.

If the mean of the distribution is 1/2, find a and b.

i) State and prove theorem on total probability. ii) A purse contains 2 silver coins and 4 copper coins and a second purse

- contains 4 silver coins and 3 copper coins. If a coin is selected at random form one of the purse. What is the probability that it is a silver coin? 23. The diameter, say X, of an electric cable, is assumed to be a continuous
 - random variable with probability density function f(x) = 6x(1-x), $0 \le x \le 1$ Obtain the distribution function of X. ii) Compute $P\left(X \le \frac{1}{2} / \frac{1}{3} \le x \le \frac{2}{3}\right)$.
- iii) Determine the number k such that P(X < k) = P(X > k). 24. Given the joint probability density function of two random variables X and Y as;
 - $f(x) = \begin{cases} c(2x+y), & 2 < x < 6, & 0 < y < 5 \\ 0, & \text{otherwise} \end{cases}$

Find:

22.

- i) c ii) P(3 < X < 4, Y > 2)
- iii) fx/y(x/y).