

U.G. 4th Semester Examination - 2025**STATISTICS****[MINOR]****Course Code : STAT-MN-T-2****(Basic Probability and Probability Distributions)****[NEP-2020]****Full Marks : 35(25+10)****Time : 2 Hours***The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.**Notations and symbols have their usual meaning.*

1. Answer any five questions : 1×5=5
- a) A coin and a die are thrown simultaneously.
Write down the sample space.
 - b) Write down the statistical definition of probability.
 - c) Define conditional probability.
 - d) Define cumulative distribution function of a random variable. If $F(x)$ and $f(x)$ denote respectively, the cumulative distribution function and probability density function of a continuous random variable X , then how are they related?

[Turn over]

- e) Write down the p.m.f. of a hypergeometric distribution.
- f) Write down the m.g.f. of a binomial distribution with parameters n and p ($0 < p < 1$).
- g) Write down the p.d.f. of a normal distribution with mean 0 and variance σ^2 and show that it is symmetric about 0.
- h) State Markov's inequality.

2. Answer any two questions : 5×2=10

- a) i) Write down the theorem of total probability.
- ii) The probabilities of germination of three seeds are $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{5}$. If they are sowed independently, what is the probability that exactly two of them germinate? 2+3
- b) Derive the m.g.f. of a normal distribution with mean 0 and variance unity. Hence write down the m.g.f. of X distributed as $N(\mu, \sigma^2)$.
- c) State and prove Chebyshev's inequality and mention one use of it.

- d) Write down the p.d.f. of a beta distribution with parameters m and n and derive its mean and variance.

3. Answer any one question: 10×1=10

- a) i) It is estimated that 50% of emails are spam mails. Some software has been applied to filter these spam emails before they reach the inbox. A certain brand of software claims that it can detect 99% of spam emails, and the probability that a non-spam email is detected as spam is 5%. If an email is detected as spam, what is the probability that it is in fact a non-spam email?
- ii) Give an example to show that correlation between two random variables is zero does not necessarily imply that they are independent. 6+4
- b) i) Two continuous random variables X_1 and X_2 have joint non-singular trinomial distribution with parameters n , p_1 and p_2 . Write down the joint p.m.f. and derive the marginal distribution of X_1 .

- ii) Write a note on the lack of memory property of geometric distribution.

6+4

[Internal Assessment: 10]
