

QP CODE: 25050808



Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION, DECEMBER 2025

First Semester

MSc Statistics with Data Science

Core Courses - ST040102 - THEORY OF PROBABILITY DISTRIBUTIONS

2020 Admission Onwards

55D6B0DB

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Define mgf of a random variable X . Hence find the mgf of $\frac{X-\mu}{\sigma}$.
2. Define geometric distribution.
3. Show that Negative Binomial distribution is a particular case of power series distribution.
4. Define uniform distribution. Obtain its moment generating function and hence find the mean and variance.
5. If $X \sim N(0, 1)$, obtain the density of $|X|$.
6. Determine distribution of the mean of n independent standard Cauchy variable.
7. Explain the concept of transformation of one-dimensional and two-dimensional random variable.
8. Define compound distribution.
9. If X has $N(0, 1)$ distribution and Y is an independent variable having $\chi^2_{(n)}$ distribution, derive the distribution of $\frac{X}{\sqrt{\frac{Y}{n}}}$.
10. Find the expression for the pdf of r^{th} order statistic if a random sample of size n is taken from an exponential distribution with mean θ .

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

11. Derive the recurrence relation for central moments of a Binomial distribution and hence find the moments.
12. Obtain Poisson distribution as a limiting case of Negative binomial distribution.





13. Let $X_i, i = 1, 2, \dots, n$ be independent random variables having an exponential distribution with parameter $\theta_i; i = 1, 2, \dots, n$. Find the distribution of $Z = \min(X_1, X_2, \dots, X_n)$.
14. Obtain the beta distribution of the 1st kind from beta distribution of 2nd kind.
15. If X and Y are independent continuous random variables, then show that the pdf of $U = X + Y$ is $h(u) = \int_{-\infty}^{\infty} f_x(v)f_y(u-v)dv$.
16. If X_1 and X_2 are independent rectangular variates on $[0, 1]$, find the distributions of (i) $\frac{X_1}{X_2}$ (ii) $X_1 + X_2$.
17. Discuss the limiting form of Chi square distribution.
18. Discuss on the advantages and steps in the construction of QQ plot.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight **5** each.

19. If X is a positive integral valued variable, such that $P(X = n) = p_n, n = 0, 1, 2, \dots$. If $P(s)$ is the probability generating function, prove that $E(X) = P'(1)$ and $Var(X) = P''(1) + P'(1) - (P'(1))^2$.
20. (a) Transform a log normal distribution to a standard log normal distribution.
(b) Find the mean and variance of a log normal distribution.
21. If X_1 and X_2 are independent rectangular variates on $[0, 1]$, find the distributions of (i) $\frac{X_1}{X_2}$ (ii) $X_1 X_2$
(iii) $X_1 + X_2$ (iv) $X_1 - X_2$.
22. Mention any two statistics following student's t distribution and obtain their distributions.

(2×5=10 weightage)

