

[LD 1013]

OCTOBER 2013

Sub. Code: 2861

M.Sc NON-MEDICAL DEGREE EXAMINATION

FIRST YEAR

BRANCH II - BIOSTATISTICS

PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code : 282861

Time : 3 hours

Maximum : 100 marks

I. Elaborate on :

(2X20=40)

1. (a) Derive the marginal and conditional distribution of X and Y in a Bivariate Normal distribution.
(b) Find mean, median and mode for lognormal distribution and prove lognormal distribution is positively skewed.
2. (a). Define expectation. State and prove all properties of expectation.
(b). The joint p.d.f of (X,Y) is given by
$$f(X,Y) = k(4 - x - y), \quad 0 \leq x, y \leq 2, \quad f(X,Y) = 0 \text{ elsewhere}$$

Find the constant k. Also $\text{Var}(X)$, $\text{Var}(Y)$ and $\text{Cov}(X,Y)$.

II. Write notes on :

(10X6=60)

1. Give an example to show that $E(X,Y) = E(X)E(Y)$, then X and Y need not be independent.
2. List the properties of distribution function.
3. Define moment generating function. Also state and prove any two important properties of M.G.F.
4. State and prove Inversion formula.
5. Define Hypergeometric distribution and find its mean and variance.
6. State and prove the interrelation between t, F and chi-square.
7. Explain memory less property and prove that Geometric distribution has this property.
8. Find the moment generating function of Normal distribution.
9. Define partial correlation. Also derive the expression of partial correlation coefficient for trivariate distribution.
10. State Cochran's theorem. Explain its application in Biostatistics.

[LF 1014]

OCTOBER 2014

Sub. Code: 2861

**M.Sc NON-MEDICAL DEGREE EXAMINATION
FIRST YEAR
(New Regulation)
BRANCH II - BIOSTATISTICS
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code : 282861

Time : Three hours

Maximum : 100 marks

I. Elaborate on : **(2 x 20 = 40)**

1. Addition and Multiplication theorem on Expectation of Random variables.
2. Any two applications of Chi-Square distribution.

II. Write notes on : **(10 x 6 = 60)**

1. Distribution function of a random variable
2. Chebychev's inequality
3. Convergence in probability. Give an example
4. Moment generating function of Binomial distribution
5. Any two properties of Moment generating function
6. Mean and Variance of Poisson Distribution
7. Any five properties of Normal distribution
8. Multivariate Normal distribution and its mean vector and its Variance – Covariance matrix
9. Differentiate Partial and Multiple correlation coefficients
10. Mahalanobis D^2 statistic and its application

[LH 0415]

OCTOBER 2015

Sub. Code: 2861

**M.Sc., NON – MEDICAL DEGREE COURSES
BRANCH II - BIOSTATISTICS
FIRST YEAR
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Maximum: 100 marks

I. Elaborate on:

(2 x 20 = 40)

1. Sample space and random variables.
2. Jensen's and Minkowski's inequality.

II. Write notes on:

(10 x 6 = 60)

1. Probability density function. Give examples.
2. Moment generating function of a Random variable.
3. Almost sure Convergence. Give an example.
4. Moment generating function of Binomial distribution.
5. Any two properties of characteristics function.
6. Mean and variance of Geometric distribution.
7. Lognormal distribution.
8. Estimation of covariance matrix.
9. Conditional and Marginal distributions.
10. Distribution of quadratic forms.

[LI 0416]

APRIL 2016

Sub. Code: 2861

**M.Sc., NON – MEDICAL DEGREE COURSES
BRANCH II - BIOSTATISTICS
FIRST YEAR
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on:

(2 x 20 = 40)

1. Holder's and Jensen's inequality.
2. Logistic and Log normal Distribution.

II. Write notes on:

(10 x 6 = 60)

1. Applications of Poisson Distribution.
2. Properties of Characteristic function.
3. Conditional and Marginal distribution.
4. Chebychev's Inequality.
5. Properties of Expectation.
6. Gamma and Beta Distribution.
7. Properties of Normal Distribution.
8. Mahalanobis D^2 statistic.
9. Chi Square Distribution.
10. Distribution of Quadratic forms.

[LJ 1016]

OCTOBER 2016

Sub. Code: 2861

**M.Sc. BIOSTATISTICS EXAMS
FIRST YEAR
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on: **(2 x 20 = 40)**

1. Convergence in probability, almost sure convergence and convergence in distribution.
2. Applications of t-distribution.

II. Write notes on: **(10 x 6 = 60)**

1. Definition of probability and discrete probability space.
2. Addition property of characteristic function.
3. Hypergeometric distribution with its mean and variance.
4. Moment generating function and its properties.
5. Central limit theorem.
6. Characteristic function and inversion theorem.
7. Logistic and lognormal distribution.
8. Memory less property of exponential distribution.
9. Additive property of bivariate normal distribution.
10. Distributions of quadratic forms.

[LL 1017]

OCTOBER 2017

Sub. Code: 2861

M.Sc. BIOSTATISTICS EXAMS
FIRST YEAR
(New Regulation)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on: **(2 x 20 = 40)**

1. a) A husband and wife appear in an interview for two vacancies in the same post. The probability of husband's selection is $\frac{1}{7}$ and that wife's selection is $\frac{1}{5}$. What is the probability that?
 - i) Both of them will be selected
 - ii) Only one of them will be selected and
 - iii) None of them will be selected.
- b) Explain the concept of convergence in probability and almost surely convergence.
2. a) Define discrete random variable. Explain with example how it is applied to health professionals.
- b) State central limit theorem and its application.

II. Write notes on: **(10 x 6 = 60)**

1. Inverse formula.
2. Expectation and its properties.
3. Jensen's Inequality.
4. Hyper-geometric distribution and its characteristics.
5. Prove the reproductive property of independent poisson random variable.
6. The concept of convergence in probability and almost surely convergence.
7. State and prove the interrelation between t, F and chi-square.
8. Explain memory less property and prove that geometric distribution has this property.
9. Properties of normal distribution.
10. Gamma and beta distribution.

[LM 0518]

MAY 2018

Sub. Code: 2861

M.Sc. BIOSTATISTICS EXAMS
FIRST YEAR
(New Regulation)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on: **(2 x 20 = 40)**

1. a) Derive the marginal and conditional distribution of X and Y in a bivariate normal distribution.
b) Define expectation. State and prove all properties of expectation.
2. Eight coins are tossed at a time 256 times. Number of heads observed at each throw is recorded and the results are given below. Find the expected frequencies. What are 17 40 20 the theoretical values of mean and standard deviation? Calculate also the mean and SD of observed frequencies. No. of heads at throw:
0 1 2 3 4 5 6 7 8 Frequency : 2 6 30 52 67 56 32 10 1.

II. Write notes on: **(10 x 6 = 60)**

1. Bivariate and multivariate normal distribution.
2. Mahalanobis D² statistic.
3. Cochran's theorem.
4. Logistic distribution.
5. Holders Inequality.
6. Characteristic functions.
7. If X and Y are independent random variables show that g(x) and h(y) function of X and Y is also independent. Is the converse true.
8. Mahalanobis D² and its relation with T² statistic.
9. Mean and variance of Hypergeometric distribution.
10. Minkowski inequalities.

[LN 1018]

OCTOBER 2018

Sub. Code: 2861

M.Sc. BIOSTATISTICS EXAMS
FIRST YEAR
(New Regulation)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on: **(2 x 20 = 40)**

1. a) Define random variable.
b) Define distribution function of a random variable and prove any two of its properties.
c) State and prove Addition theorem of expectation.
2. a) Calculate mean, standard deviation, moment coefficient of skewness and coefficient of kurtosis of a binomial distribution if the number of trials is 18 and probability of success is $1/3$.
b) Obtain the inter relationship between t.F.Chi-square distribution.

II. Write notes on: **(10 x 6 = 60)**

1. Tchebechev's inequality.
2. Convergence in probability.
3. Inversion formula.
4. Mean and variance of Geometric distribution.
5. Characteristics of Normal distribution.
6. Multivariate normal distribution.
7. Partial and multiple correlation coefficients.
8. Cochran's theorem.
9. Wishart distribution and generalized T^2 statistic.
10. Application of poisson distribution in the field of Bio-statistics.

[LP 1019]

OCTOBER 2019

Sub. Code: 2861

M.Sc. BIOSTATISTICS EXAMS
FIRST YEAR
(New Regulation)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code: 282861

Time: Three hours

Maximum: 100 Marks

I. Elaborate on: **(2 x 20 = 40)**

1. a) State and prove any three important properties of moment generating function.
b) Jeinson's and Minkowski inequalities.
2. a) Logistic and normal distribution.
b) Addition properties of Bivariate and Multivariate normal distribution.

II. Write notes on: **(10 x 6 = 60)**

1. Define Probability density function. Give examples.
2. Central limit theorem.
3. Holder's Inequality.
4. General probability space.
5. Properties of Chi-square distribution.
6. Define Quadratic forms.
7. Prove that Geometric distribution has memory less property.
8. Conditional and marginal distribution.
9. Partial correlation.
10. Multiplication properties of random variables.

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

[AHS 0321]

MARCH 2021

Sub. Code: 2861

(OCTOBER 2020 EXAM SESSION)

M.Sc. BIostatistics

FIRST YEAR (From 2011-2012 onwards)

PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code : 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate notes on:

(2 x 20 = 40)

1. a) If $\{X_n\}$ be a sequence of binomial variables with parameters (n, p) , then prove binomial variables converge to standard normal variable.
b) List out properties of characteristic function.
2. a) Write a lack of memory property of geometric distribution and how can use this property in Medicine.
b) If $X_1, X_2, \dots, X_n$ be mutually independent $N(\mu, \sigma^2)$ variables. Prove that $\bar{X}$ is statistically

independent of $Q = \sum_{i=1}^n \frac{(X_i - \bar{X})^2}{\sigma^2}$ and $Q \sim \chi^2_{(n-1)}$

II. Write Short Notes on:

(10x6 = 60)

1. If X be a continuous r.v. with p.d.f given by

$$f(x) = \begin{cases} ax, & 0 \leq x \leq 1 \\ a, & 1 \leq x \leq 2 \\ -ax + 3a, & 2 \leq x \leq 3 \\ 0, & 3 < x \end{cases}$$

Determine a and $F(x)$.

2. If $X \sim U(a, b)$ then find $E(X), V(X)$.
3. Find mean and variance from moments for Poisson distribution.
4. Write a Lindeberg-Levy central limit theorem and its importance.
5. Write a Cauchy criterion for almost sure convergence.
6. Why Exponential distribution is preferable to estimate population growth?
7. How can perform Binomial probability distribution in medicine give examples.
8. Write characteristic function of Wishart Distribution.
9. Give properties of conditional expectations.
10. Show that $\rho_{1.23} \geq \rho_{12}$.

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

[AHS 0222]

FEBRUARY 2022
(OCTOBER 2021 EXAM SESSION)

Sub. Code: 2861

M.Sc. BIOSTATISTICS
FIRST YEAR (From 2011-2012 onwards)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY
Q.P. Code : 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate notes on:

(2 x 20 = 40)

- a) If X is a continuous r.v. with p.d.f. $f(x) = Ce^{-x/\sigma}$, $x \geq 0, \sigma > 0$. Find its mean, median and Quartile deviation.
b) List out properties of moment generating function.
- a) If X_1, X_2 be two independent poisson variates with parameters λ_1 and λ_2 respectively. Show that the conditional distribution of $X_1 | X_1 + X_2$ is binomial.
b) State and prove Cochran's theorem.

II. Write Short Notes on:

(10x6 = 60)

1. If a random variable X possesses the following function.

x	3	2	1	0	-1	-2	-3
P(x)	0.1	0.2	3k	k	2k	0	0.1

Then determine the value of k , mean and variance.

2. Define and discuss mathematical expectation.
3. If $(x_1, x_2, \dots, x_n), (y_1, y_2, \dots, y_n)$ be two sets of non-negative real numbers then prove
$$\left(\sum_{i=1}^n x_i^p\right)^{1/p} \cdot \left(\sum_{i=1}^n y_i^q\right)^{1/q} \geq \sum_{i=1}^n x_i y_i$$
4. Differentiate between moment generating function and characteristic function.
5. Give properties of conditional expectations.
6. What are important characteristics of normal distribution?
7. Explain relationship between normal and chi-square distribution.
8. Explain hypergeometric distribution and its properties.
9. If $f(x, y) = 1$; $-x \leq y \leq x, 0 \leq x \leq 1 = 0$; otherwise then, find the marginal density function.
10. Write properties of bivariate normal distribution.

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[AHS 1022]

OCTOBER 2022

Sub. Code: 2861

M.Sc. BIOSTATISTICS
FIRST YEAR (From 2011-2012 onwards)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY

Q.P. Code : 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate notes on:

(2 x 20 = 40)

1. (a). Define expectation. State and prove all properties of expectation.

(b). The joint p.d.f of (X,Y) is given by

$$f(X,Y) = K(4-x-y), \quad 0 \leq X, Y \leq 2, \quad f(X,Y) = 0 \text{ elsewhere}$$

Find the constant k. Also $\text{Var}(X)$, $\text{Var}(Y)$ and $\text{Cov}(X,Y)$

2. a) State and prove Jensen's and Minkowski's inequality.

b) Explain Almost sure Convergence with an example.

II. Write Short Notes on:

(10x6 = 60)

1. Mean and variance of Poisson Distribution.
2. Memory less property of Geometric Distribution.
3. Brief Partial and multiple correlation coefficients.
4. State Cochran's theorem and its application
5. Conditional and marginal distribution
6. Properties of Chi-square distribution.
7. Write a Lindeberg-Levy central limit theorem and its importance.
8. Application of Binomial probability distribution in Health research give examples.
9. If a random variable X possesses the following function.

X	3	2	1	0	-1	-2	-3
P(X)	0.1	0.2	3k	K	2k	0	0.1

Then determine the value of k, mean and variance.

10. Give properties of conditional expectations.

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[AHS 1023]

OCTOBER 2023

Sub. Code: 2861

**M.Sc. BIOSTATISTICS
FIRST YEAR (From 2011-2012 onwards)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate notes on:

(2 x 20 = 40)

1. a) State and Prove Chebyshev's inequality.
b) Suppose that we extract an individual at random from a population whose members have an average income of Rs.40000 with a standard deviation of Rs 20,000. What is the probability of extracting an individual whose income is either less than Rs.10000 or greater than Rs.70000?
2. a) Derive the marginal and conditional distribution of X and Y in a bivariate normal distribution.
b) Define expectation. State and prove all properties of expectation.

II. Write Short Notes on:

(10x6 = 60)

1. Mean and variance of Hypergeometric distribution.
2. If X and Y are independent random variables show that g(x) and h(y) function of X and Y is also independent. Is the converse true?
3. Convergence in probability.
4. Inversion formula.
5. If $X \sim \text{Binomial}(n, p)$ then find an upper bound on $P(X \geq \alpha n) p < \alpha < 1$. Evaluate the bound for $p=1/2$ and $\alpha=3/4$ using Markov's inequality.
6. Discuss the difference between moment generating function and characteristic function.
7. State and prove Cochran's theorem.
8. Write a Cauchy criterion for almost sure convergence.
9. Mahalanobis D^2 statistic.
10. Find the moment generating function of Normal distribution.

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

[AHS 1024]

OCTOBER 2024

Sub. Code: 2861

**M.Sc. BIOSTATISTICS
FIRST YEAR (From 2011-2012 onwards)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate on:

(2 x 20 = 40)

1. Two Students A and B from the same university appear in an interview for two vacancies in the same post. The probability of A's selection is $\frac{1}{7}$ and that B's selection is $\frac{1}{5}$.

What is the probability that?

- i) Both of them will be selected.
 - ii) Only one of them will be selected and
 - iii) None of them will be selected.
- b) Explain the concept of convergence in probability and almost surely convergence.

2. State and Prove:

- a) Chebyshev's inequality
- b) Cochran's theorem

II. Write Short Notes on:

(10x6 = 60)

1. If a random variable X possesses the following function.

x	3	2	1	0	-1	-2	-3
P(x)	0.1	0.2	3k	k	2k	0	0.1

Then determine the value of k, mean and variance.

- 2. Importance of Lindeberg-Levy central limit theorem and its importance.
- 3. State and prove the properties of expectation.
- 4. Jensen's inequality.
- 5. Moment generating function of Binomial distribution.
- 6. Distribution of quadratic forms.
- 7. Mahalanobis D² statistic.
- 8. Memory less property of exponential distribution.
- 9. If X and Y are independent random variables show that g(x) and h(y) function of X and Y is also independent Show Whether the converse true.
- 10. Wishart distribution and its uses.

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

[AHS 1025]

OCTOBER 2025

Sub. Code: 2861

**M.Sc. BIOSTATISTICS
FIRST YEAR (From 2011-2012)
PAPER I – PROBABILITY AND DISTRIBUTION THEORY**

Q.P. Code: 282861

Time: Three hours

Answer ALL Questions

Maximum: 100 Marks

I. Elaborate on:

(2 x 20 = 40)

1. Prove key properties including uniqueness and inversion formula for the CF. Geometric distribution and its distribution function, its mean, variance and moment generating function (MGF). Explain at least two real-world applications in biostatistics.
2. State central limit theorem and its applications.

II. Write Short Notes on:

(10x6 = 60)

1. Expectation of a random variable.
2. Standard normal distribution.
3. Beta distribution with an example.
4. Memory less property.
5. Moment generating function.
6. Multivariate normal distribution and its properties.
7. Wishart distribution.
8. Cochran's theorem.
9. Bivariate normal distribution.
10. Convergence in probability.
