

Khulna University

School: SET

Discipline: Statistics

Program: B.Sc. (Hon's)

Year: 2nd

Term: I

Examination Year: 2026

Session: 2024-2025

Course Code: 0542 20 Stat-2101

Course Title: Continuous Probability Distributions

Total Marks: 60

Time: 3 Hours

Credit: 3.0

Section-A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Marks

1. a) Define the following terms with an example: (i) Variable; (ii) Random variable; (iii) Continuous variable. [L1; CLO1] 03
- b) Discuss the major characteristics of Continuous Uniform Distribution. [L6; CLO1] 02
- c) A continuous random variable $X \sim \text{Uniform}(1,9)$. Determine-
 - i. $P(X > 5)$ 05
 - ii. $P(2 < X < 6)$
 - iii. Mean and Standard deviation. [L1,5; CLO2]
2. a) Let X follows one parameter exponential distribution with mean θ . Find (i) the pdf of X; (ii) the cdf of X; (iii) variance & standard deviation. [L4; CLO2] 04
- b) Show that the median and mean deviation from mean of exponential distribution are $\theta \log_e 2$ and $\frac{2\theta}{e}$ respectively. [L3,4; CLO2] 03
- c) In a switch board call comes in an interval T minutes. The random variable T follows exponential distribution with parameter $\theta = 2$. Find the probability that on a particular day (i) time between first and second calls will be at least one minute; (ii) on that day for the first five calls time difference for each call will be at least one minute. [L4,5; CLO2] 03
3. a) Distinguish between Beta and Gamma Distributions. [L4; CLO1] 02
- b) Identify the mean and variance of Beta (type-1) distribution. [L3; CLO2] 03
- c) If X follows Gamma distribution with parameters $\alpha = 3$ and $\beta = 2$. Determine the mean and variance. [L6; CLO2] 02
- d) Identify the median of log-normal distribution. [L3; CLO2] 03
4. a) List down the important properties of normal distribution. [L1; CLO2] 02
- b) Elaborate the process of standardization of normal distribution. [L6; CLO1] 01

- c) Show that mean and variance doesn't exist for Cauchy distribution with parameter λ and θ . [L2; CLO2] 04
- d) Show that the total area under normal distribution is one. [L2; CLO2] 03

Section-B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. a) What do you mean by convergence in term of statistics? List down different model of convergence. [L1; CLO3] 05
- b) State the central limit theorem. [L1,6; CLO3] 02
- c) How does weak law of large number differ from strong law of large number? [L1,6; CLO3] 03
6. a) Suppose X follows Weibull distribution with scale parameter α and shape parameters β . Find (i) the pdf and cdf of X; (ii) mean & median of this distribution. [L1,3,4; CLO2] 04
- b) In which conditions, exponential distribution is a special case of Weibull distribution. [L3,4; CLO2] 02
- c) If $X \sim \text{weibull}(k, \lambda)$, show that $E(X) = \lambda \Gamma\left(1 + \frac{1}{k}\right)$. [L2; CLO1] 04
7. a) Define Bivariate Normal Distribution. Write some uses of this distribution. [L1; CLO2] 03
- b) Given a mixture distribution: 02
- $$f(x) = 0.4 f_1(x) + 0.6 f_2(x)$$
- If, $E(X | f_1) = 2$, and $E(X | f_2) = 5$
- Identify $E(X)$. [L3; CLO2]
- c) State and prove Chebyshev's Inequality for law of large number. [L5; CLO3] 05
8. a) What is meant by truncation and mixture distribution? [L1; CLO1] 02
- b) Explain the covariance and correlation of a Bivariate distribution with proper mathematical notations. [L2; CLO1] 03
- c) Given the joint p.d.f 03
- $$f(x, y) = 2, \quad 0 < x < 1, \quad 0 < y < x$$
- Identify the marginal p.d.f $f_X(x)$. [L3; CLO2]
- d) List down the application of pareto distribution. [L1; CLO2] 02

The End

[Question of Term Final Examination]

Khulna University



School: SET

Discipline: Statistics

Program: B. Sc (Hons)

Year: 2nd

Term: 1st

Examination Year: 2026

Session: 2024-25

Course Code: 0542 20 Stat 2103

Course Title: Sampling Technique-I

Total Marks: 60

Time: 3 Hours

Credit: 3.00

Section-A

There are **FOUR** questions in this section. Answer any **THREE** questions

- 1 a) Distinguish between the following terms 04
 - i) Sample survey and Census
 - ii) Sampling error and non-sampling error [L1; CLO1,2]
- b) What is a pilot survey? What are the characteristics of a good sample? [L2; CLO2] 03
- c) Discuss any one method of non-probability sampling. Explain its advantages and limitations. [L3,4; CLO1,4] 03
2. a) Define simple random sampling with a real-life example. Why is it considered a fundamental sampling technique? [L1; CLO2,3] 03
- b) Show that in the SRS of n elements without replacement (WOR), s^2 is an unbiased estimator of S^2 . [L1,3,4; CLO2,3] 03
- c) In a population with $N = 4$, the values of y_i are 3, 8, 4 and 7. Calculate the sample mean $\bar{y}$ for all possible SRS of size 2. Verify that $\bar{y}$ is an unbiased estimate of $\bar{Y}$. [L3; CLO2] 04
3. a) Briefly discuss the various methods of allocating sample sizes across different strata in stratified sampling. [L2; CLO2,3] 05
- b) If terms $\frac{n_i}{N_i}$ and $\frac{n}{N}$ are ignored show that $V_R \geq V_p \geq V_o$ [L4,5; CLO3] 05
4. a) Define stratified random sampling. In what circumstances would you use stratified sampling? [L1,4; CLO3,4] 02
- b) Determine the variance of $\bar{y}_{st}$ under stratified random sampling when the samples are drawn independently in different strata and each strata mean is unbiased. [L5, CLO3] 05
- c) A population consists of 30 families divided into two strata, where Stratum I contains 20 families and Stratum II contains 10 families. A stratified random sample is selected from the population such that 8 families are chosen from Stratum I, and 4 families are chosen from Stratum II as follows:

Stratum I	5	8	4	7	3	9	8	6
Stratum II	2	3	11	6				

*Levels of Bloom's cognitive domain:

[L1=Remember; L2=Understand; L3=Apply; L4=Analyze; L5=Evaluate; L6=Create]

Using the given information, estimate the population mean family size and the population total of family size. [L4,5; CLO3,4]

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. a) Define systematic sampling. Distinguish between linear systematic sampling and circular systematic sampling with a suitable example. [L1,3; CLO2,4] 04
 b) Proof that the mean of a systematic sample is more precise than the mean of a simple random sample if $S_{w(sy)}^2 > S^2$. [L1,5; CLO6] 04
 c) A researcher wants to select 25 households from a village that has 240 households using systematic sampling. Now Calculate the sampling interval (k) and if the random starting point is 6, list the first five households selected. [L4,5; CLO6] 02
6. a) Find an expression for approximate variance of the ratio estimator of the population mean using both separate and combined estimators. [L5, CLO3,4] 05
 b) Show that, an alternative form of the variance of $\bar{y}_{sy}$ is given by the following expression 05

$$V(\bar{y}_{sy}) = \frac{\sigma^2}{n} [1 + (n - 1)\rho_w].$$
 [L2; CLO4]
 7. a) State the condition under which a ratio estimator is BLUE. [L1,5; CLO4] 03
 b) Under what conditions is the ratio estimator preferred over the unbiased estimator in simple random sampling? [L2,4; CLO2,4] 02
 c) In simple random sampling, the approximate variance of the ratio estimator r is given by: $V(r) = \left(\frac{1-f}{n}\right) R^2 (C_y^2 + C_x^2 - 2\rho_{xy}C_xC_y)$ [L4,5; CLO5] 05
8. a) Compare ratio estimator and product estimator with a suitable example. 03
 b) Define the bias of the ratio estimator. Show that the approximate relative bias of the ratio estimator is

$$\frac{B(r)}{R} = \frac{(1-f)}{n\bar{X}\bar{Y}} (RS_x^2 - \rho_{xy}S_yS_x)$$

 c) In a sample survey of 10 households, the total income (Y) and expenditure (X) are found to be 500 and 400, respectively. If the total expenditure of all households in the population is 2000, estimate the total income using ratio estimation. 03

**** THE END ****

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[Question of Term Final Examination]

Khulna University

School: SET

Discipline: Statistics

Program: B.Sc. (Hons)

Year: 2nd

Term: I

Examination Year: 2026 Session: 2024-25

Course Code: 0542 20 Stat 2105

Course Title: Sampling distribution

Total Marks: 60

Time: 3 hours

Credit: 03

Instructions (if any):

Comments/Remarks (if any):

Section A

There are **04 questions** in this section. Answer any **03 questions**.

Question No.	Question Description	Marks
1.	a) State the Law of Large Numbers and mention its importance in Statistics. [L2; CLO2]	04
	b) State and prove the Central Limit Theorem. Also mention its importance in Statistics. [L2; CLO2]	06
2.	a) Define sampling distribution and state its necessities. How does it differ from a probability distribution? [L1; CLO1]	03
	b) What are the methods of deriving sampling distributions. Describe the characteristic function method for finding the sampling distribution of a random variable. [L5; CLO1]	04
	c) If X has a beta density with parameters α and β . Find the pdf of $Y = -2 \log_e X$. [L4; CLO1]	03
3.	a) What do you mean by the transformation of a statistic? Explain its uses and mention the key transformations. [L2; CLO2]	03
	b) Discuss the practical significance of square root and sine inverse transformations in real-world data analysis. [L4; CLO2]	03
	c) State and explain Fisher–Cochran’s theorem. [L4; CLO3]	04
4.	a) If x_1 and x_2 have the joint density function $f(x_1, x_2) = \frac{6}{(1+x_1+x_2)^2}; x_1, x_2 > 0$ then find the distribution of $u = x_1 + x_2$. [L4; CLO3]	05

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[Question of Term Final Examination]

Khulna University

School: SET	Discipline: Statistics	Program: B.Sc. (Hons)
Year: 2nd	Term: I	Examination Year: 2026 Session: 2024-25
Course Code: 0542 20 Stat 2105	Course Title: Sampling distribution	
Total Marks: 60	Time: 3 hours	Credit: 03

Instructions (if any):

Comments/Remarks (if any):

b) Let x and y be standard normal variates with a correlation coefficient ρ . Show that $u = x + y$ and $v = x - y$ are independent. [L5; CLO3]

05

Section B

There are **04 questions** in this section. Answer any **03 questions**.

Question No.	Question Description	Marks
5.	a) Define Chi-Square variate. Derive the pdf of Chi-Square distribution. [L1,3; CLO4]	05
	b) State and prove Fisher's approximation for χ^2 to normality. Write the applications of χ^2 distribution. [L2; CLO5]	05
6.	a) Define central and non-central distributions with suitable examples. Mention their importance in statistical analysis. [L1,2; CLO4]	04
	b) Derive the probability density function of the chi-square distribution with $(n - 1)$ degrees of freedom. Also find its mean and variance. [L1,5; CLO5]	06
7.	a) What is the pdf of the F-distribution? Find the mode of this distribution. [L4; CLO5]	04
	b) State and prove the reciprocal property of F-distribution. [L4; CLO5]	03
	c) Show that, F distribution is positively skewed. [L5; CLO5]	03
8.	a) If χ_1^2 and χ_2^2 are two independent χ^2 variates with n_1 and n_2 d.f., then find the distribution of $Z = \frac{\chi_1^2}{(\chi_1^2 + \chi_2^2)}$. [L5; CLO5]	05
	b) Obtain the characteristic function of the chi-square distribution and discuss its significance. [L5; CLO6]	05

*****Best of Luck*****

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[Question of Term Final Examination]

Khulna University

School: SET

Discipline: Statistics

Program: B.Sc. (Hons)

Year: 2nd

Term: I

Examination Year: 2026 Session: 2024-25

Course Code: 0542 20 Stat 2107

Course Title: Order Statistics and Noncentral Distribution

Total Marks: 60

Time: 3 hours

Credit: 03.00

Instructions (if any):

Comments/Remarks (if any):

Section A

There are **04 questions** in this section. Answer any **03 questions**.

Question No.	Question Description	Marks
1.	a) What is meant by order statistics? Describe the roles of order statistics in inferential statistics. [L1; CLO1]	05
	b) Derive the joint pdf of i^{th} and j^{th} order statistics. [L4; CLO1,3]	05
2.	a) Explain the following terms: Sample mid-range and Sample Median. [L1,2; CLO7]	02
	b) Find the marginal pdf of $X_{n:n}$, the largest order statistics.	04
	c) For sample size 5, find out the joint pdf of $X_{(2)}$ and $X_{(4)}$ for $U(0,1)$ distribution. [L2; CLO2]	04
3.	a) Derive the distribution of sample median for even and odd number of observations. [L1; CLO2]	06
	b) Explain the single moment of i^{th} order statistics, hence find out the mean and variance. [L2; CLO2]	04
4.	a) What do you mean by large sample approximation and exact moment. [L4,5; CLO7]	02
	b) Find out mean and variance of large sample approximation. [L6; CLO1]	04
	c) Show that exact moment about origin follows beta distribution. [L4; CLO2]	04

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[Question of Term Final Examination]

Khulna University

School: SET

Discipline: Statistics

Program: B.Sc. (Hons)

Year: 2nd

Term: I

Examination Year: 2026 Session: 2024-25

Course Code: 0542 20 Stat 2107

Course Title: Order Statistics and Noncentral Distribution

Total Marks: 60

Time: 3 hours

Credit: 03.00

Instructions (if any):

Comments/Remarks (if any):

Section B

There are **04 questions** in this section. Answer any **03 questions**.

Question No.	Question Description	Marks
5.	a) Describe the purpose of introducing a non-centrality parameter. Differentiate between central and non-central F distributions. [L2; CLO4]	06
	b) Find joint probability mass function of i^{th} and j^{th} Bernouli variables. [L4; CLO4]	04
6.	a) Obtain the BLUE of the scale parameter. [L1; CLO4]	05
	b) Let $X_{1:n} \leq X_{2:n} \leq \dots < X_{n:n}$ be the order statistics from Uniform(0,1) distribution then show that $V_1 = \frac{X_{i:n}}{X_{j:n}}$ and $V_2 = X_{j:n}$, $1 \leq i < j \leq n$ are statistically independent with V_1 and V_2 having $Beta(i, j-i)$ and $Beta(j, n-j+1)$ distributions.. [L5; CLO5]	05
7.	a) Let $X_1, X_2, \dots, X_n$ be a random sample from a distribution having pdf $f(x) = e^{-(x-\theta)}$; $x > \theta > 0$. Find the pdf of $y = \min(X_1, X_2, \dots, X_n)$ with its mean. Also show that y is an unbiased estimator of θ . [L5; CLO5]	06
	b) Find out the CDF of i^{th} order statistics. [L3,4; CLO4,5]	04
8.	a) What is central and non central distribution? [L1; CLO4]	02
	b) When does non central distribution identical to central distribution? [L5; CLO5]	02
	c) Define non central χ^2 distribution. Find its moment generating function. [L4; CLO6]	06

*** The End***

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[Question of Term Final Examination]

Khulna University



School: SET

Discipline: Statistics

Program: B. Sc (Hons)

Year: 2nd

Term: 1st

Examination Year: 2026

Session: 2024-25

Course Code: 0541 20 Math 2151

Course Title: Differential Equation

Total Marks: 60

Time: 3 Hours

Credit: 3.00

Section-A

There are **FOUR** questions in this section. Answer any **THREE** questions

- 1 a) Find all natures of the following differential equations: 04
 - i. $\frac{d^3y}{dx^3} + x \left(\frac{dy}{dx}\right)^2 = \sin x,$
 - ii. $\frac{d^2y}{dx^2} + 2y = e^x,$
 - iii. $\frac{d^4y}{dx^4} + 5\frac{d^2y}{dx^2} + \cos y + \tan x = 0$

If these are non-linear, explain the reasons. [L3,4; CLO3]
- b) Solve $(x + y)^2 \frac{dy}{dx} = a^2$. [L3; CLO3] 02
- c) Find the differential equation of $y = Ax^2 + Be^x + Ce^{-2x}$, where A,B, C are arbitrary constants. [L2; CLO2,3] 04
2. a) Solve $(x^3 + y^3)dx - 3xy^2dy = 0$. [L5; CLO3] 04
- b) Define first order linear differential equation in y. Solve $(x^2 + 1)y' + 4xy = x$. 04
[L1,3; CLO3]
- c) Solve $(2x\cos y + 3x^2y)dx + (x^3 - x^2\sin y - y)dy = 0$. [L2; CLO2] 02
3. a) Solve the differential equation $(2x + 3y - 6)dy = (6x - 2y - 7)dx$. [L3; CLO3] 05
- b) Find the solution of the equation using integrating factor $(x + 2y^3)\frac{dy}{dx} = y$. [L1; 05
CLO3]
4. a) Define oblique trajectories. Find a family of oblique trajectories that intersect the 05
family of circles $x^2 + y^2 = c^2$ at angle 45° . [L1-6; CLO1-7]
- b) Solve the homogeneous equation $(x^3 + y^3)dx - 3xy^2dy = 0$. [L5; CLO3] 05

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Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. a) Write the statement of basic existence theorem. Solve $(x^2 + 1)y'' - 2xy' + 2y = 0$ if $y = x$ is a solution of this equation. [L1-3; CLO 1-2] 05
 b) Solve $y'' + y = \operatorname{cosec} x$ by the method variation of parameters. [L5; CLO4] 05
6. a) Solve by the method of variation of parameters $x^2 D^2 y + x D y - y = x^2 e^x$. [L3; CLO4] 05
 b) Evaluate the system by the matrix method $\frac{dx}{dt} = 4x - y$ and $\frac{dy}{dt} = x + 2y$. [L5; CLO4] 05
7. a) Solve $\begin{cases} (2D + 1)x + (D + 5)y = 4t \\ (D + 2)x + (D + 2)y = 2 \end{cases}; D = \frac{d}{dt}$ by operator method. [L5; CLO3] 07
 b) Find the Laplace transform of $f(t) = \begin{cases} \sin t, & 0 < t < r \\ 0, & r < t < 2r \end{cases}$ [L3; CLO3] 03
8. a) Define Laplace transform and discuss its properties. [L1; CLO6] 03
 b) Prove that (i) $L(\cosh at) = \frac{s}{s^2 - a^2}$ (ii) $L(t) = \frac{1}{s^2}$. [L5; CLO6] 04
 c) Find the Laplace transform of $1 + \cos 2t$. [L1; CLO6] 03

** THE END **

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[Question of Term Final Examination]

Khulna University



School: SET

Discipline: Statistics

Program: B.Sc (Hons)

Year: 2nd

Term: 1st

Examination Year: 2026 Session: 2024-25

Course Code: 0311 20 Econ 2153

Course Title: Economic Statistics

Total Marks: 60

Time: 3 Hours

Credit: 3.00

Section-A

There are **FOUR** questions in this section. Answer any **THREE** questions

- 1 a) Define economic statistics and explain its importance in modern economic analysis. [L2; CLO1] 05
- b) Differentiate between the concept of balance of payment and balance of trade. [L4; CLO2] 05
2. a) Distinguish between GDP and GNP. [L4; CLO2] 03
- b) Why is the consumer price index (CPI) important for different economic indicators? [L1; CLO2] 04
- c) How to calculate inflation rate of a specific year? [L1; CLO3] 03
3. a) Define Household Composition. [L1; CLO2] 02
- b) Briefly explain family budget method with a suitable example. [L4; CLO2] 04
- c) Illustrate the main idea of Engel's law of family expenditure. [L2; CLO3] 04
4. a) Briefly narrate the inter-industry dependence in input-output analysis. [L2; CLO3] 04
- b) Calculate input -output coefficients table and demonstrate the result in matrix form. [L5; CLO4] 06

	Sectors	Agriculture	Industry	Final Demand	Total output
Inputs	Agriculture	20	30	50	100
	Industry	40	20	40	100
	Others	40	50	10	100
	Total	100	100	100	300

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Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5. a) Define per capita income. “per capita income has several limitations as an index of economic development”- Express in your opinion. [L5; CLO3] 05
b) Briefly explain the indicators of OECD better life index. [L2; CLO3] 05
6. a) What is multi-dimensional poverty index (MPI)? [L1; CLO4] 02
b) How does Lorenz Curve help visualize economic inequality in a country? [L1; CLO4] 05
c) Identify the effective ways to reduce poverty in Bangladesh. [L4; CLO4] 03
7. a) What is Energy Efficiency? Elucidate the use of Energy Statistics. [L2; CLO4] 05
b) Explain inverted-U shaped relationship between economic growth and income inequality according to the Simon Kuznets Hypothesis. [L5; CLO4] 05
8. a) Define statistical quality. Briefly describe the modern dimensions of statistical quality. [L2; CLO5] 05
b) Explain the importance of Household Income and Expenditure Survey (HIES) in understanding living standards and poverty. [L5; CLO5] 05

**** THE END ****

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