St. Xavier's College (Autonomous), Ahmedabad
Syllabus of Semester – IV of the following departments under Faculty of Science based on Under Graduate Curriculum Framework – 2023 (NEP) to be implemented from the Academic Year 2023-24.

FACULTY OF SCIENCE

DEPARTMENT OF STATISTICS

Course	Title	Content	Hours/Week	Credit
DSC-1 (Theory)	Probability Distributions – II	U-1: Geometric Distribution and Negative Binomial Distribution U-2: Rectangular Distribution and Beta Distribution U-3: Weibull, Cauchy, Laplace Distribution U-4: Power Series and Compound Distribution	4 hrs	**4**
DSC-2 (Theory)	Applied Statistics-II	U-1: Introduction to Hypothesis Testing and Large Sample Tests U-2: Non-Parametric Tests U-3: Official Statistics and Sample Survey U-4: Simple Random Sampling	4 hrs	**4**
Major (Lab)	Statistics Practical -IV	Practical using manual calculation and Excel and experiential learning.	8 hrs	**4**

BSc. (Hons.) Statistics

DSC-1(Theory) Probability Distributions - II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course (Total - 04 Credit)			Prerequisite(s) of the Course (if any)
	Lecture	Practical	Experiential Lab	
Probability Distribution - II	4	0	0	Basic Mathematics, Observation & Analytical Skills

Course Outcomes:

CO-1 Identify the real-life situations to apply Negative Binomial and Geometric Probability Distribution and compute related probabilities & expected values.

CO-2 Identify the real-life situations to apply rectangular, Beta type-1 and Beta type-2 Probability Distribution and compute related probabilities & expected values.

CO-3 Demonstrate the need of identifying the real-life situation to apply Weibull, Cauchy and Laplace Probability Distributions and compute related probabilities & expected values, confidence intervals.

CO-4 Apply the knowledge of Power series and Compound Probability Distributions for handling the real-life situations demanding computation of related probabilities and expected values.

Learning Outcomes: After completion of this course, the students will be able to

(1) To be able to obtain a probability distribution of random variable in the given situation.
(2) To apply standard continuous probability distribution to different situations
(3) To apply Power series distribution to make all discrete distribution.
(4) To apply compound distribution in two knowns distribution and define unconditional distribution.

Unit: 1 Geometric Distribution and Negative Binomial Distribution (Blaise Pascal's distribution) (15Hrs)

- Introduction of Geometric Distribution
- First four moments of Geometric Distribution
- Generating Functions of Geometric Distribution
- Properties of Geometric Distribution
- Applications of Geometric Distribution
- Introduction of Negative Binomial Distribution
- First four moments of Negative Binomial Distribution
- Generating Functions of Negative Binomial Distribution
- Properties of Negative Binomial Distribution
- Applications of Negative Binomial Distribution

Unit: 2 Rectangular Distribution and Beta Distribution (15Hrs)

- Definition of Rectangular Distribution
- First four moments of Rectangular Distribution
- Mean deviation about mean of Rectangular Distribution
- Applications of Rectangular Distribution
- Definition of Beta Distribution
- Moments of Beta Distribution
- Properties of Beta Distribution

Unit: 3 Weibull, Cauchy, Laplace Distribution (15Hrs)

- Definition of Weibull Distribution
- Moments of Weibull Distribution
- Generating Functions of Weibull Distribution
- Properties of Weibull Distribution
- Definition and origin of Cauchy Distribution
- Characteristic function of Cauchy Distribution
- Properties of Cauchy Distribution
- Characterization and related distributions.
- Definition of Laplace Distribution with two and three parameters
- Characteristic function of Laplace Distribution
- Moments of Laplace Distribution
- Properties of Laplace Distribution
- Applications and examples of these distributions.

Unit: 4 Power Series and Compound Distribution (15Hrs)

- Concept and definition of Power Series distribution.
- Mean, variance, moment generating function, characteristic function of Power Series distribution.
- Recurrence relation between the raw moments of Power Series distribution.
- Recurrence relation between the central moments of Power Series distribution.
- Recurrence relation between the cumulants moments of Power Series distribution.
- Recurrence relation between the factorial cumulants moments of Power Series distribution.
- Special cases of Power Series distribution.
- Binomial distribution, Poisson distribution, Geometric distribution, Negative Binomial distribution, Logarithmic series distribution
- Unique determination of Power Series distribution from the first moments.
- Concept and definition of compound distribution (unconditional distribution)
- Negative binomial distribution as a compound distribution of Poisson and Gamma /Chi-square distributions.
- t-Distribution as a compound distribution of Normal and Gamma distributions.
- Poisson distribution as a compound distribution of Binomial and Poisson distributions

References:

1. Hogg, R.V. and Craig, A.T. (1972): "Introduction to Mathematical Statistics", Amerind Pub. Co.
2. Mood, A.M., Greybill, F.A. and Bose, D.C. (1974): "Introduction to the Theory of Statistics", McGraw Hill.
3. Mukhopadhyay, P. (1996): "Mathematical Statistics", New Central Book Agency.
4. Rohtagi, V.K. (1967): "An Introduction to Probability Theory and Mathematical Statistics", John Wiley and Sons.
5. Hoel, P.G. (1971): "Introduction to Mathematical Statistics", Asia Pub. House.
6. Meyer, P.L. (1970): "Introductory Probability and statistical Applications", Addison Wesley.

7. Gupta, S.C., and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan Chand publications.
8. Goon, A.M., Gupta, M.K. and Das Gupta, B. (1991): Fundamentals of Statistics, Vol. I, World Press, Calcutta.
9. Sheldon. M. Ross,:” A First Course in Probability”, (Mc Millian publishing Co.).
10. S.M. Ross (Elsever).: “Introduction to Probability and Statistics for Engineers and Scientists”
11. T. Chandra &D. Chatterjee (Narosa Pub. House): “A First course in Probability”.
12. John E. Freund, “Mathematical Statistics”, (VI Edition).

Pedagogy:

1. The course is taught using traditional chalk and talk method using Problem solving through examples and exercises.
2. Students are encouraged to use resources available on open sources.

DSC-2 (Lab) Applied Statistics-II

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course (Total - 04 Credit)			Prerequisite(s) of the Course (if any)
	Lecture	Practical	Experiential Lab	
Applied Statistics-II	4	0	0	Basic Mathematics, Observation & Analytical Skills

Course Outcomes:

CO-1 Identify the need of hypothesis testing associated with the problem under study and perform the test procedure to draw useful conclusions for the related statistical population.

CO-2 Identify the need of non-parametric testing associated with the problem under study and perform the test procedure to draw useful conclusions for the related statistical population.

CO-3 Demonstrate the availability of Official Statistics, ability to design a sample survey. Familiarize with the functioning of CSO, NSSO, ICMR and ISI.

CO-4 Apply the skill of drawing Simple Random Sample from the population and compute various estimates with their standard errors and confidence intervals.

Learning Outcomes: After completion of this course, the students will be able to

(1) To be able to apply parametric and non-parametric tests in different real-life data.

(2) Students will come to know about premium statistics institutes functioning in India.

(3) Students will get ideas about how to design a sample survey.

Unit: 1 Introduction of testing of Hypothesis and Large sample tests (15Hrs)

- Basic idea of estimation and testing of hypothesis.
- Basics of Statistical hypothesis.
- Z – test to test the significance of mean based on a large sample.
- Test the significance of the difference between two sample means based on large sample.
- Test of Proportions: To test the significance of single proportion based on a large sample, to test the significance of difference between two proportions based on large sample.
- Fisher's Information and its use to test the significance of coefficient of correlation.

Unit: 2 Non-Parametric Tests **(15Hrs)**

- Basic idea of non-parametric inference
- Concept of a non – parametric tests.
- Difference between parametric and non–parametric tests.
- Sign test for one sample.
- Wilcoxon signed rank test.
- Mann – Whitney U – test.
- W.W. Run test.
- Application based examples on non-parametric tests.

Unit: 3 Official Statistics and Sample Survey **(15Hrs)**

- Concept of complete enumeration and sample survey.
- Difference between census and survey.
- Importance of sample survey.
- Principle steps in sample survey.
- Sampling and non-sampling errors.
- Sampling in Qualitative Research
    - Qualitative sampling techniques
    - Sampling strategies in qualitative research
    - Issues and challenges in qualitative sampling
- Sampling in Survey Research
    - Survey sampling methods
    - Questionnaire design and sampling considerations
- Sampling weights and adjustments
- Origin and functions of -National Sample Survey Organization (NSSO).
- Central Statistical Organization (CSO), Indian Statistical Institute (ISI).
- Indian Council for Medical Researches (ICMR)

Unit: 4 Simple Random Sampling **(15Hrs)**

- Probability of selecting any specified unit in the sample.
- Selection of Simple Random Sample.
- Merits and drawbacks of Simple Random Sampling.
- Simple Random Sampling of Attributes.
- Estimation of population mean and variance
- Size of Simple Random Sample for specified precision.

References:

1. Mood, Graybill and Bose: “Introduction to theory of Statistics”.
2. Hogg and Craig: “Introduction to mathematical Statistics”.
3. Gupta and Kapoor: “Fundamentals of mathematical statistics”.
4. Feller, W.C. (1968): “An Introduction to probability theory and its applications”, John
5. Wiley.
6. Bhatt, B.R. (1999): “Modern probability theory”, New Age International.

7. Gupta, S.C., and Kapoor, V.K.: "Fundamentals of Applied Statistics", Sultan Chand Publication.
8. Pathak, K.B. and Ram, F.: "Techniques of demographic analysis", Himalaya Publishing house (1992).
9. Srivastava, O.S. (1982): "A text book of demography".
10. Goon, A.M., Gupta, M.K. and Das Gupta, B. (1991): "Fundamentals of Statistics", Vol. II, World Press, Calcutta.
11. Mukhopadhyay, P.: "Applied Statistics", New Central Book Agency (1999)

DSC (Lab) Statistics Practical-IV

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course Title & Code	Credit Distribution of The Course			Prerequisite(s) of the Course (if any)
	Lecture	Practical	Experiential Lab	
Statistics Practical-IV	0	2	2	Basic Mathematics, Observation & Analytical Skills

Learning Outcomes: At the end of this course students are expected to be able-

1. To be able to fit probability distributions such as Negative-binomial and geometric to real-life data.
2. To be able to draw a random sample from Negative-binomial, Geometric, Weibull. Cauchy and rectangular distributions
3. To be able to apply parametric and nonparametric test in different situations.
4. To be able to use of MS-Excel for achieving the Course outcomes.

Learning Objectives:

CO-1 Demonstrate the skill of applying parametric and nonparametric test in real life data.

CO-2 Demonstrate the skill of fitting of probability distributions such as negative-binomial, Geometric distribution to real-life data.

CO-3 Reflect the skill of drawing random samples from Negative-binomial, Geometric, Weibull. Cauchy and rectangular distribution.

CO-4 Compute the estimates of population characteristics such as mean, proportion, variance with their estimates from using simple random samples.

Computing all the practical manually and using Excel

1. Fitting and drawing random sample of Negative-Binomial distribution.
2. Fitting and drawing random sample of Geometric distribution.
3. Drawing random sample From Rectangular distribution.
4. Drawing of random sample from Weibull and Cauchy distribution.
5. Large sample tests for variables.
6. Large sample tests for attributes.

7. Estimates of population characteristics such as mean, proportion, variance with their estimates from using simple random samples.
8. Non-Parametric tests (Run test, Median test, Sign test, Sign-Ranked test).

Activities: (To be conducted in a group of two students)

1) Collected data and fitting the distribution
2) Poster/ oral presentation
3) Report preparation based on data
4) Case studies