St. Xavier's College (Autonomous), Ahmedabad
Syllabus of Semester – III 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 – I	U-1: Bernoulli Distribution , Binomial Distribution and, Multinomial Distribution U-2: Poisson, Hyper Geometric Distribution U-3: Normal Distribution and Log-Normal Distribution U-4: Gamma & Exponential Distribution	4 hrs	**4**
DSC-2 (Theory)	Applied Statistics-I	U-1: Correlation and regression U-2: Multiple and partial correlation U-3: Time-series Analysis U-4: Vital statistics	4 hrs	**4**
Major (Lab)	Statistics Practical -III	Practical using manual calculation and Excel and experiential learning.	8 hrs	**4**

BSc. (Hons.) Statistics

DSC-1(Theory) Probability Distributions - I

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 - I	4	0	0	Basic Mathematics, Observation & Analytical Skills

Course Outcomes:

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

CO-2 Identify the real-life situations to apply Poisson & Hyper Geometric Probability

Distribution and compute related probabilities & expected values.

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

CO-4 Apply the knowledge of Uniform and Exponential Probability Distributions for handling the real- life situations demanding computation of related probabilities and expected value.

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

(1) Students are expected to be able to distinguish between random and non-random experiments

(2) To be able to obtain a probability distribution of random variable (univariate case) in the given situation.

(3) To apply standard discrete probability distribution to different situations

(4) To apply standard continuous probability distribution to different situations

Unit: 1 Bernoulli Distribution, Binomial Distribution and Multinomial Distribution (15Hrs)

- Introduction of Distribution, r^{th} moments about origin, mean and variance of Bernoulli Distribution.
- Derivation, basic properties of this distribution – factorial moments, mean, median, mode, variance.
- Moment generating function and moments, recurrence relation for central Moments and moments about origin.
- Cumulant generating function and cumulants, recurrence relation for cumulants.
- Distribution of sum of independent binomial variates.
- Applications and examples of this distribution.

Unit: 2 Poisson, Hyper Geometric Distribution (15Hrs)

- Derivation and definition, basic properties of Poisson and Hyper geometric distributions – factorial moments, mean, median, mode, variance.
- Moment generating function and moments, recurrence relation for central moments and moments about origin.
- Cumulant generating function and cumulants.
- Distribution of sum of independent Poisson variates.
- Applications and examples of these distributions.

Unit: 3 Normal Distribution and Log Normal Distribution (15Hrs)

- Definition, basic properties of normal and log normal distributions – mean, median, mode, variance.
- Moment generating function and moments, Central moment generating function and central moments.
- Cumulants generating function and cumulants.
- Mean deviation from mean, recurrence relation for central moments.
- Distribution of linear combination of independent normal variates.
- Applications and examples of these distributions.

Unit: 4 Gamma & Exponential Distribution (15Hrs)

- Derivation and definition, basic properties of these distributions – mean, mode, variance.
- Moment generating function and moments.
- Cumulants generating function and cumulants, mean deviation from the mean.
- Distribution of sum of independent exponential variates.
- Applications and examples of these 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-I

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-I	4	0	0	Basic Mathematics, Observation & Analytical Skills

Course Outcomes:

CO-1 Demonstrate the skill of finding rates of vital events (birth, death) and measures of population growth and reflect the skill of constructing life table and interpret its columns.

CO-2 Identify the need of Time series analysis for Business and Economics data and demonstrate the scale of estimating components of Time series data.

CO-3 Demonstrate the skill of using correlation, regression, least square method and association of attributes in real life situations.

CO-4 Apply the idea of multiple and partial correlation in business, industry and daily life activities.

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

(1) To be able to interpret coefficient of correlation and fitting of regression line.

(2) To be able to construction of life table and finding rates of vital events.

(3) To apply different methods of time series in economic and business data.

(4) To be able to apply multiple and partial correlation in business, industry and daily life activities.

Unit: 1 Time Series **(15Hrs)**

- Idea of Time-series data
- Components of Time-series
- Analysis of Time series data
- Method of moving average for determining trend component
- Method of least squares (up to second degree)
- Calculation of seasonal variations
- Ratio to trend and ratio to moving average to find seasonal indices

Unit: 2 Vital Statistics (15Hrs)

- Sources of vital statistics in India
- Functions of vital Statistics, rates and ratios.
- Measurements of Mortality- Crude Death Rate (C.D.R), Specific Death Rate (S.D.R), Standardized Death Rate, Infant Mortality Rate (I.M.R)
- Assumptions, description and construction of life table.
- Importance of Life table
- Fertility: Crude Birth Rate (C.B.R), General Fertility Rate (G.F.R), Specific Fertility Rate (S.F.R), Total Fertility Rate (T.F.R)
- Measurement of population growth: Gross Reproduction Rate (G.R.R), Net Reproduction Rate (N.R.R)

Unit: 3 Bivariate Data Analysis (Curve fitting, correlation, Regression, least square method, Association of Attributes) (15Hrs)

- Concept of Bivariate data, Plotting of Bivariate data,
- Principle of Least Squares, fitting of Linear, Parabolic Exponential curves (reducible to linear).
- Most plausible solutions.
- Correlation Coefficient, Scatter diagram.
- Karl Pearson's correlation coefficient, Independence of variables.
- Limits for correlation coefficient.
- Spearman's Rank correlation coefficient
- Coefficient of Determination and Probable Error.
- Concept of Regression for two variables.
- Lines of regression, properties of regression coefficient, regression curve.
- Angles between two regression lines.
- Association of attributes.
- Methods of measuring association of attributes.

Unit: 4 Multiple and Partial Correlation (15Hrs)

- Regression and correlation in three variables.
- Yule's notations, plane of regression.
- Properties of Residuals.
- Multiple and Partial Correlation coefficient and their interrelationships.

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)

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 (Lab) Statistics Practical-III

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-III	0	2	2	Basic maths, Observation & Analytical Skills

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

1. To be able to fitting of probability distributions such as binomial, Poisson, Hypergeometric and Normal distribution to real-life data.
2. To be able to draw a random sample from binomial, Poisson, Normal, rectangular distributions
3. To be able to fit different curves to sample/population data, calculate the correlation coefficient, find the regression equations.
4. To be able to use of MS-Excel for achieving the Course outcomes.

Learning Objectives:

CO-1 Apply the concept of least squares to fit different curves to sample/population data, calculate the correlation coefficient, find the regression equations using MS-Excell and manually both.

CO-2 Demonstrate the skill of finding multiple and partial correlation coefficients from the sample data. Forecast the values of characteristic using the plane of regression found from available data.

CO-3 Demonstrate the skill of fitting of probability distributions such as binomial, Poisson, Hypergeometric and Normal distribution to real-life data.

CO-4 Reflect the skill of drawing random samples from binomial, Poisson, Normal, rectangular distributions

Computing all the practical manually and using Excel

1. Fitting and drawing random sample of Binomial distribution.
2. Fitting and drawing random sample of Poisson distribution.
3. Fitting and drawing random sample of Normal distribution.
4. Drawing of random sample from Gamma and Exponential distribution
5. Method of moving averages to determine trend component
6. Method of least square to determine and estimate trend
7. Ratio to trend and ratio to moving average to find seasonal indices
8. Karl-Pearson's Product moment correlation coefficient
9. Spearman's rank correlation coefficient
10. Fitting of line of regression
11. Plane of regression
12. Multiple and Partial correlation coefficient

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

1) Collected data and fitting the distribution
2) Measurement of Fertility rate and mortality rate in NFHS data
3) Poster/ oral presentation
4) Report preparation based on data
5) Case studies