

**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**

| <b>Course</b>   | <b>Title</b>                                          | <b>Content</b>                                                                                                                                                                                                                                   | <b>Hours/Week</b> | <b>Credit</b> |
|-----------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|
| <b>STMC331C</b> | Probability<br>Distributions – I                      | U-1: Bernoulli Distribution ,<br>Binomial Distribution and,<br>Multinomial Distribution<br>U-2: Poisson, Hyper Geometric<br>Distribution<br>U-3: Normal Distribution and Log-<br>Normal Distribution<br>U-4: Gamma & Exponential<br>Distribution | 4 hrs             | <b>4</b>      |
| <b>STMC332C</b> | Applied<br>Statistics-II                              | U-1: Correlation and regression<br>U-2: Multiple and partial correlation<br>U-3: Time-series Analysis<br>U-4: Vital statistics                                                                                                                   | 4 hrs             | <b>4</b>      |
| <b>STMC333L</b> | Statistics<br>Practical -<br>III                      | Practical using manual calculation<br>and Excel and experiential learning.                                                                                                                                                                       | 8 hrs             | <b>4</b>      |
| <b>STSE331C</b> | Statistical<br>analysis<br>using<br>JAMOV<br>software | U-1: Introduction to Jamovi<br>U-2: Descriptive data analysis<br>U-3: Presentation of Data                                                                                                                                                       | 4 hrs             | <b>2</b>      |

## BSc. Statistics

### STMC331C Probability Distributions - I

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

| Course Title & Code                     | Credit Distribution of The Course<br>(Total - 04 Credit) |           |                  | Prerequisite(s) of the Course<br>(if any)          |
|-----------------------------------------|----------------------------------------------------------|-----------|------------------|----------------------------------------------------|
|                                         | Lecture                                                  | Practical | Experiential Lab |                                                    |
| Probability Distribution – I & STMC331C | 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,  $r^{\text{th}}$  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.

## **STMC332C Applied Statistics-I**

### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

| <b>Course Title &amp; Code</b>                     | <b>Credit Distribution of The Course<br/>(Total - 04 Credit)</b> |                  |                             | <b>Prerequisite(s) of<br/>the Course (if<br/>any)</b>       |
|----------------------------------------------------|------------------------------------------------------------------|------------------|-----------------------------|-------------------------------------------------------------|
|                                                    | <b>Lecture</b>                                                   | <b>Practical</b> | <b>Experiential<br/>Lab</b> |                                                             |
| <b>Applied<br/>Statistics-I<br/>&amp; STMC332C</b> | 4                                                                | 0                | 0                           | Basic<br>Mathematics,<br>Observation &<br>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 Wiley.
5. Bhatt, B.R. (1999): "Modern probability theory", New Age International.
6. 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.

### **STMC333L 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 & STMC333L | 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

## **SKILL ENHANCEMENT COURSE**

### **STSE331C Statistical analysis using JAMOVI software**

#### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

| <b>Course Title &amp; Code</b>                                                  | <b>Credit Distribution of The Course<br/>(Total - 02 Credit)</b> |                  |                             | <b>Prerequisite(s) of<br/>the Course<br/>(if any)</b>       |
|---------------------------------------------------------------------------------|------------------------------------------------------------------|------------------|-----------------------------|-------------------------------------------------------------|
|                                                                                 | <b>Lecture</b>                                                   | <b>Practical</b> | <b>Experiential<br/>lab</b> |                                                             |
| <b>Statistical<br/>analysis using<br/>JAMOVI<br/>software<br/>&amp;STSE331C</b> | 0                                                                | 4                | 0                           | Basic<br>Mathematics,<br>Observation &<br>Analytical Skills |

#### **Course Outcomes:**

- CO-1 Gain familiarity with statistical concepts and techniques commonly used in data analysis.
- CO-2 Learn how to import data from various sources into Jamovi, such as spreadsheets or statistical software formats.
- CO-3 Understand how to manipulate data within Jamovi, including sorting, filtering, and recoding variables.
- CO-4 Learn to calculate and interpret descriptive statistics, such as mean, median, standard deviation, and frequencies.
- CO-5 Gain proficiency in creating visualizations, including histograms, scatter plots, bar charts, and box plots, to explore and present data effectively.

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

- (1) Efficiently navigate the Jamovi user interface, accessing various tools and features for data analysis.
- (2) Calculate and interpret descriptive statistics to summarize and understand the characteristics of datasets.
- (3) Generate a variety of visualizations, including histograms, scatter plots, bar charts, and box plots, to explore data and communicate findings effectively.

#### **Unit-I: Introduction to Jamovi**

**(12Hrs)**

- Introduction and Features of Jamovi
- Navigating and Understanding User interface (UI)
- Types of Data, Measurements of Scale
- Entering data, Importing data, Wrangling data
- Computing means, Computing z-scores
- Transforming variables
- Computing variables
- Filtering cases

**Unit-II: Descriptive data analysis****(18Hrs)**

- Measures of central tendency
- Measures of Dispersion
- Exporting tables and plots
- Frequency distribution
- Normality test
- Categorical data analysis
- Tabulation, Frequency tables, Contingency tables
- Descriptive summary

**Unit-III: Presentation of Data****(10Hrs)**

- Simple Bar diagram
- Multiple bar diagram
- Sub-divided Bar diagram
- Line chart
- Pie Diagram
- Histogram
- Scatter diagram
- Box plot
- Violin chart

**References:**

1. "Discovering Statistics Using Jamovi" by Andy Field, Jeremy Miles, and Zoë Field.
2. "Statistics with Jamovi for Dummies" by Greg Fox and Michael Mitchell.
3. "Introduction to Statistics: A Hands-on Approach with Jamovi" by Robert V. Hogg, Elliot A. Tanis, and Dale Zimmerman.

**Pedagogy:**

1. The course is taught using computer to solving problem through examples and exercises.
2. Students are encouraged to use resources available on open sources.