West Bengal State University

Detailed Syllabus for Four-year Under Graduate
Programme

in

STATISTICS

Under Curriculum and Credit Framework for
Undergraduate Programmes

Based on

National Education Policy, 2020

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Syllabus for 4-year Undergraduate Programme
(Honours / Honours with Research)
Semester I

STSADS01T / STSAMC01T – Descriptive Statistics I & Probability I	
[Credit 3]	[45 Lecture Hours]
Unit 1: Statistical Data	[12 Lecture Hours]
Statistics: Definition and scope. Concepts of statistical population and sample. Data: quantitative and qualitative, cross-sectional and time-series, discrete and continuous. Scales of measurement: nominal, ordinal, interval and ratio. Collection of data, concept of questionnaire. Presentation of data: tabular and graphical. Frequency distributions, cumulative frequency distributions and their graphical representations. Stem and leaf displays.	
Unit 2: Univariate Data Analysis	[15 Lecture Hours]
Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Range, Mean deviation, Standard deviation, Coefficient of variation, Gini's Coefficient, Lorenz Curve. Moments, skewness and kurtosis. Quantiles and measures based on them. Box Plot. Outliers and its detection using quantiles. Trimmed mean.	
Unit 3: Introduction to Probability	[18 Lecture Hours]
Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability: classical, statistical, and axiomatic. Probability space and different properties of probability function. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.	
STSADS01P / STSAMC01P: List of Practical [Credit 2]	[60 Lecture Hours]
- Graphical representation of data. - Problems based on construction of frequency distributions, cumulative frequency distributions and their graphical representations. - Problems based on measures of central tendency. - Problems based on measures of dispersion. - Problems based on combined mean and variance and coefficient of variation. - Problems based on moments, skewness and kurtosis. - Problems related to quantiles and measures based on them. - Problem of detection of outliers using quantiles, construction of box plot. - Numerical sums using classical definition of Probability. - Numerical sums on conditional probability.	
Reference Books	

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edition, World Press, Kolkata.
- Miller, Irwin and Miller, Marylees (2006): John E. Freunds Mathematical Statistics with Applications, 7th Edition, Pearson Education, Asia.
- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edition, Tata McGraw-Hill Pub. Co. Ltd.
- Tukey, J.W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.
- Freedman, D., Pisani, R. and Purves, R. (2014): Statistics, 4th Edition, W. W. Norton & Company.
- Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
- Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
- Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), World Press.
- Parzen, E. (1972): Modern Probability Theory and its Applications, John Wiley.
- Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.
- Cacoullos, T. (1973): Exercises in Probability, Narosa.
- Ross, S. (2002): A First Course in Probability, Prentice Hall.
- Stirzaker, D. (2003) Elementary Probability, 2nd Edition, Cambridge University Press
- Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffin.

STSASE01T – Numerical Computations with C	
[Credit 2]	[30 Lecture Hours]
Unit 1: Numerical Analysis	[18 Lecture Hours]
Approximation of numbers and functions. Absolute and Relative errors. Interpolation: Polynomial approximation, Weierstrass Theorem (Statement). Difference Table, Newton's Forward and Backward interpolation formulae and Lagrange's general interpolation formula, Error terms. Numerical Differentiation and its applications. Numerical Integration: Trapezoidal and Simpson's 1/3rd rules. Numerical solution of equations: method of bisection, method of iteration and Newton-Raphson method in one unknown, conditions of convergence (statement only).	
Unit 2: Introduction to C	[12 Lecture Hours]
Components, basic structure programming. Notion of header file. Concept of character and variable; allocation of memory. Declaration and assignment of variables and array variables. Input and output operations in C. Use of conditional operations and loops; if...else, for, while, do...while etc. dim arrays. User defined functions.	

STSASE01P: List of Practical
[Credit 1] [30 Lecture Hours]

- Simple mathematical operations.
- Matrix addition, subtraction and multiplication.
- Finding values of a function $y=f(x)$ for given values of x
- Roots of a real quadratic equation.
- Finding output for a user-defined function.
- Sorting of an array and finding quantiles.
- Preparing a frequency table.
- Mean, median and mode of a grouped frequency Data.
- Variance and coefficient of variation of a grouped frequency data.
- Numerical methods: Interpolation by Lagrange's formula.
- Solving one variable equations using method of bisection.
- Solving one variable equations using Newton-Raphson method.
- Solving one variable equations using iteration method.
- Trapezoidal rule for numerical integration.
- Simpson's 1/3rd rule for numerical integration.
- Storing the C output in a file.

Reference Books

- Kernighan, B.W. and Ritchie, D. (1988): C Programming Language, 2nd Edition, Prentice
- Balagurusamy, E. (2011): Programming in ANSI C, 6th Edition Tata McGraw
- Gottfried, B.S. (1998): Schaums Outlines: Programming with C, 2nd Edition, Tata McGraw Hill.
- Jain, M. K., Iyengar, S. R. K. and Jain, R. K. (2003): Numerical methods for scientific and engineering computation, New age International Publisher, India.
- Mukherjee, Kr. Kalyan (1990): Numerical Analysis. New Central Book Agency.
- Sastry, S.S. (2000): Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt Ltd., New Del.
- Scarborough, J.B. (1966): Numerical Mathematical Analysis. Oxford and IBH Publishing.
- F. B. Hildebrand: Introduction to Numerical Analysis, Tata McGraw Hill

Semester II

STSADS02T / STSAMC02T – Descriptive Statistics II & Probability II

[Credit 3] **[45 Lecture Hours]**

Unit 1: Bivariate Data Analysis [12 Lecture Hours]

Bivariate data: Definition, scatter diagram, simple correlation, linear regression, principle of least squares, fitting of polynomial and exponential curves, correlation ratio, correlation index, intra-class correlation. Rank correlation: Spearman's and Kendall's measures.

Unit 2: Categorical Data Analysis [15 Lecture Hours]

Analysis of Categorical Data: Contingency table, independence & association of attributes. Ideas of complete and absolute association. Yules measures of association and colligation, Cramer's measure of association, extension to $k \times l$ contingency table: Pearson's chi square, Kendall's τ and τ_b, Goodman Kruskal's γ. Difference of proportions, relative risk, odds ratio, log odds ratio; types of observational studies.

Unit 3: Random Variables [18 Lecture Hours]

Random Variables: Definition of discrete and continuous random variables, cumulative distribution function (c.d.f.) and its properties (without proof), probability mass function (p.m.f.) and probability density function (p.d.f.). Expectation and Variance. Standard discrete probability distributions: Discrete Uniform, Binomial, Poisson, Geometric, Negative Binomial and Hypergeometric.

STSADS02P / STSAMC02P: List of Practical
[Credit 2] **[60 Lecture Hours]**

- Correlation coefficient for a bivariate frequency distribution.
- Lines of regression, angle between lines and estimated values of variables.
- Fitting of polynomials, exponential curves.
- Spearman rank correlation with and without ties.
- Computation of correlation ratio.
- Computation of intra class correlation coefficient.
- Fitting of binomial distribution for given n and p.
- Fitting of binomial distribution after computing mean and variance.
- Fitting of Poisson distribution for given value of lambda.
- Fitting of Poisson distribution after computing mean.
- Fitting of negative binomial.
- Fitting of suitable distributions.
- Application problem based on binomial distribution.
- Application problem based on Poisson distribution.
- Application problem based on negative binomial distribution.

Reference Books

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edition, World Press, Kolkata.

- Miller, Irwin and Miller, Marylees (2006): John E. Freunds Mathematical Statistics with Applications, 7th Edition, Pearson Education, Asia.
- Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edition, Tata McGraw-Hill Pub. Co. Ltd.
- Tukey, J.W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.
- Freedman, D., Pisani, R. and Purves, R. (2014): Statistics, 4th Edition, W. W. Norton & Company.
- Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2nd Edition, Wiley.
- Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
- Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
- Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), World Press.
- Parzen, E. (1972): Modern Probability Theory and its Applications, John Wiley.
- Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.
- Cacoullos, T. (1973): Exercises in Probability, Narosa.
- Ross, S. (2002): A First Course in Probability, Prentice Hall.
- Stirzaker, D. (2003) Elementary Probability, 2nd Edition, Cambridge University Press
- Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffin.
- Rohatgi, V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edition, John Wiley and Sons.

STSASE02P – Computation using Software	
[Credit 3]	[90 Lecture Hours]
Unit 1: Introduction to Excel	[20 Lecture Hours]

Basic idea about a software. Input and modification of data. Basic cell operations; operation of mathematical and inbuilt functions on cell. Display summary statistics for univariate and bivariate data. Regression and correlation computation. Use of 'Data Analysis' tool (only the applicable functions). Construction of data table and operations on it.

Graphical representation of data: Column diagram, pie diagram, line diagram, bar diagram, scatter plot, box plot, stock diagram, surface plot and radar plot, histogram.

STSGMD01T / STSGMD02T / STSGMD03T – Statistics for Practitioners

[Credit 3]   [45 Lecture Hours]

Unit 1: Statistical Data   [10 Lecture Hours]

Population and Sample. Random and non-random sampling. Primary, secondary data. Scales of measurement: Variables and attributes; nominal and ordinal.

Unit 2: Collection of Data   [15 Lecture Hours]

Framing simple research questions and preparing well designed questionnaires. Collection of primary data using questionnaire. Compilation of data and data tidying. Data Scrutiny.

Unit 3: Summarization of data   [20 Lecture Hours]

Graphical representation, Summary measures: Mean, Median, Mode, Range, Standard deviation, Index of qualitative variation (IQV), Quartile deviation (Concept and formula only).
Social science, Health Science, Biological Science, Astronomy, Economics, Genetics, Epidemiology, Meteorology, Marketing and Business.

Reference Books

- Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edition, World Press, Kolkata.
- Statistics: The Art And Science Of Learning From Data: Alan Agresti, Christine A. Franklin, Bernhard Klingenberg.
- Statistics without Tears: A Primer for Non-Mathematicians: Derek Rowntree; Allyn and Bacon, A Simon & Schuster Company.