3 Yr. Degree Course
(Minor)
based on NEP-2020
STATISTICS

(Effective from Session 2024-25)

(Batch: 2024-2027)

SAMBALPUR UNIVERSITY

JYOTI-VIHAR, BURLA, SAMBALPUR, ODISHA-768019

COURSE AT A GLANCE (NEP-UG)

SUBJECT: *STATISTICS* *ACADEMIC SESSION:* **2024-27**

CORE-I COURSE

Course Number	Semester	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I	DESCRIPTIVE STATISTICS	P	4	100
Paper-II		LINEAR ALGEBRA	P	4	100
Paper-III	II	PROBABILITY AND PROBABILITY DISTRUBUTATION	P	4	100
Paper-IV		CALCULUS	P	4	100
Paper-V	III	SAMPLING DISTRIBUTION	P	4	100
Paper-VI		PARAMETRIC STATISTICAL INFERENCE	P	4	100
Paper-VII		SURVEY SAMPLING &INDIAN OFFICIAL STATISTICS	P	4	100
Paper-VIII	IV	REAL & NUMERICAL ANALYSIS	P	4	100
Paper-IX		LINEAR REGRESSION ANALYSIS AND FORCASTING (NPTEL)	P	4	100
Paper-X		STATISTICAL QUALITY CONTROL	P	4	100
Paper-XI	V	DESIGN OF EXPERIMENTS	P	4	100
Paper-XII		STASTISTICAL COMPUTING USING R PROGRAMMING	P	4	100
Paper-XIII		OPRETIONS RESEARCH	P	4	100
Paper-XIV	VI	NON- PARAMETRIC STATISTICAL INFERENCE	P	4	100
Paper-XV		MULTIVARIATE ANALYSIS	P	4	100
Paper-XVI	VII	TIME SERIES ANALYSIS	P	4	100
Paper-XVII		OPTIMIZATION TECHNIQUES	P	4	100

Paper-XVIII		ECONOMETRY	P	4	100
Paper-XIX		STOCHASTIC PROCESS	P	4	100
Paper-XX	VIII	SCIENTIFIC COMPUTING USING MATLAB (NPTEL)	P	4	100
Paper-XXI		ACTUARIAL STATISTICS	P	4	100
Paper-XXII		BAYESIAN PARAMETRIC INFERENCE	P	4	100
Paper-XXIII		STRATEGY: AN INTRODUCTION TO GAME THEORY	P	4	100

CORE-II/CORE-III COURSE

Course Number	Semester Core-II/ Core-III	Course Title	Type of Paper P-Practical NP-Non-practical	Credit Hour	Maximum Weightage of Marks
Paper-I	I/II	DESCRIPTIVE STATISTICS	P	4	100
Paper-II	III/IV	PROBABILITY AND PROBABILITY DISTRIBUTATION	P	4	100
Paper-III	V/VI	SURVEY SAMPLING & INDIAN OFFICIALS STATISTICS	P	4	100
Paper-IV	VII	TIME SERIES ANALYSIS	P	4	100
Paper-V	VIII	SCIENTIFIC COMPUTING USING MATLAB (NPTEL)	P	4	100

CORE COURSE II/ III

Minor (Paper-I) Semester I/II

DESCRIPTIVE STATISTICS

COURSE OUTCOMES

- Understand the scope and necessity of Statistics.
- Tabulate and represent the data in diagrams and graphs.
- Apply the formula and calculate descriptive measures of statistics.
- Analyze the nature of data and interpret the measures
- Analyze the data and predict the future values using curve fitting.

LEARNING OUTCOMES

The learning objectives include summarizing the data and to obtain its salient features from the vast mass of original data. After completing this course, the students should have developed a clear understanding of Concepts of statistical population and sample, variables and attributes.

UNIT-I

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram, stem and leaf diagram and Ogives, consistency and independence of data with special reference to attributes.

UNIT-II

Measures of Central Tendency: mean, median and mode, Measures of Dispersion: Range, Inter Quartile Range, Quartile Deviation, Mean Deviation, Variance and Standard Deviation, Coefficient of Variation, Moments, Absolute Moments,

Skewness and Kurtosis, Sheppard's Corrections.

UNIT-III

Bivariate data: Definition, Scatter Diagram, Simple, Partial and Multiple Correlation (3variablesonly), Rank Correlation. Simple linear regression, Principle of least squares and fitting of polynomials and exponential curves.

UNIT-IV

Index Numbers: Definition, construction of index numbers and problems there of for weighted and unweighted index numbers including Laspeyer's, Paasche's, Edgeworth-Marshall and Fisher's Ideal Index numbers. Errors in Index numbers. Chain base index numbers, conversion of fixed based to chain-

based index numbers and vice-versa. Consumer price index numbers, Cost of living index number, Uses and limitations of index numbers.

TEXT BOOKS

- ✓ P.N Arora, Sumeet Arora: Comprehensive Statistical Methods, S Chand
- ✓ Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, The World Press, Kolkata.
- ✓ Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Mathematical Statistics,4thEdition, Sultan Chand &Sons

SUGGESTED READINGS

- ✓ Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7thEdn.), Pearson Education, Asia.
- ✓ Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, Tata McGraw-Hill Pub. Co. Ltd.
- ✓ R S N Pillai & Bagavathi: Practical Statistics, S Chand
- ✓ C B Gupta: An Introduction to Statistical Methods, Vikas Publishing

LIST OF PRACTICALS

Emphasis should be given on interpretation of results.

1. Graphical representation of data – Simple Bar Diagram, Multiple Bar Diagram and Divided Bar Diagram, Histogram, Stem and leaf diagram, Pie diagram, Frequency polygon and frequency curve.
2. Problems based on Measures of Central Tendency.
3. Problems based on Measures of Dispersion.
4. Problems based on Moments, Skewness and Kurtosis.
5. Scatter Diagram, Karl Pearson correlation coefficient and rank correlation coefficient (with and without tie).
6. Lines of regression, angle between lines and estimated values of variables.
7. Calculate price, quantity and cost of living index numbers.

Minor (Paper-II) Semester III/IV

PROBABILITY AND PROBABILITY DISTRIBUTIONS

COURSE OUTCOMES

Concept of probability, different approaches to the theory of probability.

Concept of events, mutually exclusive independent and exhaustive

- events. Sample space and its properties. Use the basic probability rules including addition and multiplicative laws, conditional probability and Bayes theorem.

  Gain knowledge on random variables. Distinguish between discrete and
- continuous random variables. Probability mass function and probability density function.
- Understand Mathematical expectation of a random variable. Conditional expectation and variance and conditional expectations.
- Understand the most common discrete and continuous probability distributions and their real-life applications. Identify their characteristics.
- Identify the type of statistical situation to which different distributions can be applied. Use the different distributions in solving statistical problems.

LEARNING OUTCOMES

To present the general theory of statistical distributions as well as the standard distributions found in statistical practice. To train students with essential tools for statistical analyses at the post graduate level. Fostering understanding through real world statistical applications. A probability distribution is a statistical model that shows the possible outcomes of a particular event or course of action as well as the statistical likelihood of each event. Probability distribution functions are quite important and widely used in actuarial science (insurance), engineering, physics, evolutionary biology, computer science and even social sciences such as psychiatry, economics and even medical trials.

UNIT-I

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

UNIT-II

Random variables: discrete and continuous random variables, probability mass function (p.m.f.), probability density function (p.d.f.) and cumulative distribution function (c.d.f.), illustrations and properties of random variables, univariate transformations with illustrations. Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables.

UNIT-III

Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, Cumulants generating function and characteristic function.

Uniqueness and inversion theorems (without proof) along with applications. Conditional expectations.

UNIT-IV: Standard discrete probability distributions: Uniform, Bernoulli, Binomial, Poisson, Geometric, along with their properties and limiting/approximation cases. Standard continuous probability distributions: Uniform, Normal, Exponential, Beta and Gamma along with their properties and limiting/approximation cases.

TEXT BOOKS:

- ✓ Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
- ✓ Ravish R Singh & Mukul Bhatt: Probability and Statistics, S Chand
- ✓ Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of MathematicalStatistics,4thEdition (Reprint), Sultan Chand &Sons

SUGGESTED READINGS:

- ✓ Miller, Irwin and Miller, Marylees(2006): John E.Freund's Mathematical Statistics with Applications, (7thEdn.), Pearson Education, Asia.
- ✓ Iyengar: Probability and Statistics S Chand
- ✓ Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory ofStatistics,3rdEdn.,(Reprint),Tata McGraw-Hill Pub. Co. Ltd.
- ✓ Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I, 8thEdn. The World Press, Kolkata.
- ✓ Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

LIST OF PRACTICALS

1. Fitting of Binomial and Geometric distributions
2. Fitting of Poisson distributions
3. Fitting of Normal and One-parameter exponential distributions
4. Application problems based on Binomial, Geometric, Poisson, One-parameter exponential and Normal distributions.

Minor (Paper-III) Semester V/VI

SURVEY SAMPLING & INDIAN OFFICIAL STATISTICS

COURSE OUTCOMES

- Understand the basic principles underlying survey design and estimation.
  Apply the different sampling methods for designing and selecting a sample from a population.
  Implement Cluster sampling, Ratio and Regression estimation in real life problems.
  Apply unequal probability sampling designs viz. PPSWR, PPSWOR
- including Lahiri's method and Murthy's estimator for survey. Analyze the nature of data and interpret the measures.
  Understand the structure and functioning of Indian Official Statistical
- System.

LEARNING OUTCOMES

Survey Sampling provides the tolls/ techniques for selecting a sample of elements from a target population keeping in mind the objectives and nature of population. Most of the research work is done through Sample Survey. The students are able to know about Indian Official Statistical System. After completing the course, students should have developed clear understanding of: Basic concepts of survey sampling, Principles of survey sampling and main steps involved in selecting a sample, Simple random sampling, Stratified random sampling, Systematic sampling, Ratio and Regression method of estimation, Cluster sampling (equal cluster size), Concepts of sub sampling, Indian Official Statistical System.

UNIT-I

Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: probability and nonprobability samplings, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion, variances of these estimates, estimates of the invariances and sample size determination.

UNIT-II

Stratified random sampling: Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision. Systematic Sampling: Technique ($N= nk$), estimates of population mean and total, variances of these estimates. Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections.

UNIT-III

Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, comparison with SRSWOR. Cluster sampling (equal clusters only) estimation of population mean and its variance.

UNIT-IV

Present official statistical system in India, methods of collection of official statistics, its quality and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), National Statistical Office (NSO) and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry and finance.

TEXT BOOKS

- ✓ Sukhatme, P.V., Sukhatme, B.V.Sukhatme, S.Asok,C.(1984).Sampling Theories of Survey With Application, IOWAStateUniversityPressandIndianSocietyofAgriculturalStatistics
- ✓ Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
- ✓ http://mospi.nic.in/

SUGGESTED READINGS

- ✓ Cochran W.G.(1984):Sampling Techniques(3rd Ed.),Wiley Eastern.
- ✓ Murthy M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.
- ✓ Des Rajand ChandhokP. (1998):Sample Survey Theory, Narosa Publishing House.
- ✓ Goon A.M., Gupta M.K. and Dasgupta B.(2001):Fundamentals of Statistics(Vol.2), World Press.
- ✓ J K Sharma (2014) Business Statistics, Vikas Publication.

LIST OF PRACTICALS

1. To select a SRS with and without replacement.
2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS.
3. For SRSWOR, estimate mean, standard error, the sample size
4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods. Compare the efficiencies of above two methods relative to SRS.
5. Estimation of gain in precision in stratified sampling.
6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend.
7. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS.
8. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra- class correlation coefficient, efficiency as compared to SRS.

Minor (Paper-IV) Semester- VII

(With/Without Research)

TIME SERIES ANALYSIS

COURSE OUTCOMES

- Understand the concept of time series with its components and able to compute ACVF and ACF.
- Remove trend and seasonality using different methods to convert the time series into stationary.
- Apply auto regressive, moving average, ARMA, ARIMA models, BoxJenkins approach to forecast time-series data empirically.
- Check and validate models with its residual analysis and diagnostic checking. Analyze the nature of data and interpret the measures
- Analyze the data and predict the future values using curve fitting and exponential smoothing techniques.

LEARNING OUTCOMES

Students of this course are taught to understand and predict the changes in economy. Areas of learning include Profit of experience, Safety from future, Utility Studies, Sales Forecasting, Budgetary Analysis, Stock Market Analysis, Yield Projections, Economic Forecasting, Census Analysis, Risk Analysis & Evaluation of changes. To learn and develop scientific view to understand the time series data and its analysis. To learn stationary and non-stationary, and seasonal and no seasonal time series models. Learn to estimate model parameters and compare different models developed for the same dataset in terms of their estimation and prediction accuracy.

UNIT-I

Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, growth curves.

UNIT-II

Trend Cont: Method of moving averages. Detrending. Effect of elimination of trend on Other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to (Linear) Trend.

UNIT-III

Seasonal Component: Ratio to Moving Averages and Link Relative method, Moving- average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR(1) and AR(2)–Yule-Walker equations.

UNIT-IV

Stationary Time series: Weak stationarity, autocorrelation function and correlogram of moving average; its applications. Random Component: Variate component method. Forecasting: Exponential smoothing methods.

TEXTBOOKS

- ✓ Kendall M.G. (1976): Time Series, Charles Griffin.
- ✓ Brockwell, P.J. and Davis, R.A. (2003). Introduction to Time Series Analysis, Springer

SUGGESTEDREADINGS

- ✓ Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4thEdition(Reprint), Sultan Chand &Sons
- ✓ Chatfield C. (1980): The Analysis of Time Series–An Introduction, Chapman & Hall.
- ✓ Mukhopadhyay P. (2011): Applied Statistics, 2nded.Revisedreprint, Books and Allied

LIST OF PRACTICALS

1. Fitting and plotting of modified exponential curve
2. Fitting and plotting of Gompertz curve
3. Fitting and plotting of logistic curve
4. Fitting of trend by Moving Average Method
5. Measurement of Seasonal Indices Ratio-to-Trend method
6. Measurement of Seasonal Indices Ratio-to-Moving Average method
7. Measurement of seasonal indices Link Relative method 8. Forecasting by exponential smoothing

Minor (Paper-V) Semester- VIII

SCIENTIFIC COMPUTING USING MATLAB (NPTEL)

COURSE OUTCOMES

- Use MATLAB effectively to analyze and visualize data.
- Apply numeric techniques and simulations to solve engineering-related problems.
- Apply a top-down, modular, and systematic approach to design, write, test, and debug sequential MATLAB programs to achieve computational objectives.
- Have in depth understanding and use of Matlab fundamental data structures (classes).
- Create and control simple plot and user-interface graphics objects in MATLAB.

Be able to understand and use Matlab Toolboxes for solving real life problems.

LEARNING OUTCOMES

After completion, a student can introduce the MATLAB software environment and fortify an organized, top-down way to define and solve big problems. He will be able to introduce common approaches, structures, and conventions for creating and evaluating computer programs, primarily in a procedural paradigm with an introduction to object-oriented concepts and terminology. He can apply a variety of common numeric techniques to solve and visualize engineering-related computational problems. He will be familiar with various toolboxes to solve real life applications

UNIT-I

Introduction: What is MATLAB? Use and requirements, basics of MATLAB: windows, online help, input-output, File types, platform dependence, some general commands, creating and working with arrays of numbers, creating and printing simple plots, creating, saving and executing with a script file, creating and executing a function file, working with files and directories.

UNIT-II

Interactive computation: Matrices and vectors – inputs, indexing, matrix manipulation, creating vectors, matrix and array operations – arithmetic, logical, elementary math operations, vectorization, command line functions, built-in functions.

UNIT-III

Saving and loading data in MATLAB, Plotting Graphs, Programming in MATLAB: scripts and functions – script files, function files, language specific features. Basic statistical functions and descriptive analysis.

UNIT-IV

Applications: Linear Algebra – solving linear equations, Gaussian elimination, finding eigen values and vectors

Curve fitting and interpolation – Polynomial curve fitting on the fly, least square curve fitting, interpolation.

Data analysis and statistics

TEXT BOOKS

- Rudra Pratap (2006). Getting started with MATLAB 7: A quick introduction for Scientists and Engineers, Oxford University Press.

SUGGESTED READINGS

- ✓ Stephen J. Chapman (2005). Essentials of MATLAB Programming, Cengage Learning.
- ✓ Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg (2001) A Guide to MATLAB: For Beginners and Experienced Users, Cambridge University Press

LIST OF PRACTICALS

1. Solving linear equations, Gaussian elimination, finding eigen values and vectors
2. Curve fitting and interpolation – Polynomial curve fitting on the fly, least square curve fitting, interpolation.
3. Data analysis and statistics

For details please visit

https://nptel.ac.in/courses/111102137