SYLLABUS
FOR
B.SC. PROGRAM IN STATISTICS

Under

Learning Outcomes based Curriculum Framework (LOCF)

Effective from the academic session 2020-2021

K A Z I N A Z R U L U N I V E R S I T Y

ASANSOL-713 340, PASCHIM BARDHAMAN

WEST BENGAL

Semester I

Course Code: BSCPSTSC101
Course Name: Descriptive Statistics

Course Type: **Core Theory & Practical**	Course Details: **CC-1(1)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes: Student will acquire

(a) knowledge of Statistics and its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences etc.

(b) information about various Statistical organisations in India and their functions for societal developments,

(c) knowledge of various types of data, their organisation and evaluation of summary measures such as measures of central tendency and dispersion etc.

(d) knowledge of other types of data reflecting quality characteristics including concepts of independence and association between two attributes,

(e) insights into preliminary exploration of different types of data.

(f) Knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.

Contents

Unit I

Introduction to Statistics, Meaning of Statistics as a Science, Importance of Statistics. Scope of Statistics in Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education and Psychology. Statistical organizations in India and their functions: CSO, ISI, NSS, IIPS (Devnar, Mumbai), Bureau of Economics and statistics.

Unit II

Population and Sample. Variables: Interval scale, ratio scale, discrete and continuous variables, difference between linear scale and circular scale. Primary and secondary data, Cross-sectional data, time series data, directional data.

Notion of a statistical population: Finite population, infinite population, homogeneouspopulation and heterogeneous population. Notion of a sample and a random sample. Summary Statistics, Review / Revision of Presentation ofData

Unit III

Classification: Raw data and its classification, ungrouped frequency distribution, Sturges' rule, grouped frequency distribution, cumulative frequency distribution, inclusive and exclusive methods of classification, Open end classes, and relative frequency distribution.

Measures of Central Tendency. Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot, Measures of Dispersion, Moments, Skewness and Kurtosis.

Unit IV

Bivariate data: Scatter diagram, product moment correlation coefficient and its properties, coefficient of determination, correlation ratio, rank correlation, interclass correlation, concept of error in regression, residuals, principle of least squares, fitting of linear regression and related results, regression diagnostics.

Partial and multiple correlation in three variables, their measures and related results.

Theory of attributes: Independence and Association of attributes, various measures of association for two way classified data.

Contents (Practical):

The following is the list of experiments to be done during this course.

1. R programming, importing and exporting data, R functions, loops,conditional statements, Rgraphics.

2. Diagrammatic representation of statistical data problems based on simple andsubdivided bar diagrams, piediagram.
3. Graphical representation of statistical data.
4. Computation of measures of central tendency and dispersion. Use of anappropriate measure and interpretation ofresults.
5. Moments, Measures of skewness and kurtosis, Boxplot
6. Consistency of data up to 2 attributes. Concepts of independence and association oftwo attributes.
7. Yule's coefficient of association(Q)
8. Bivariate data: Scatter diagram, plotting andinterpretation
9. Calculation of product moment correlation coefficient, correlation ratio, rankcorrelation
10. Calculation of regressioncoefficients
11. Fitting of regression lines by leastsquares
12. Calculation of partial and multiple correlation coefficients for threevariables.

References:

1. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2013). Fundamental of Statistics,Vol I, World Press,Kolkata.
2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2011). Fundamental of Statistics,Vol II, World Press,Kolkata.
3. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-CalculusBased Approach. Narosa Publishing Comp. NewDelhi.
4. Miller, I. and Miller, M. (2006). John E. Freund's Mathematical Statisticswith Applications, (7th Edn.), Pearson Education,Asia.
5. Mood, A.M. Graybill, F.A. and Boes, D.C. (2011). Introduction to theTheory of Statistics, 3rd Edn., Tata McGraw-Hill Pub. Co.Ltd.

Semester II

Course Code: BSCPSTSC201
Course Name- Probability Theory and Distributions

Course Type: **Core** **(Theoretical & Practical)**	Course Details: **CC-1(2)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes: Students will acquire

(a) ability to distinguish between random and non-random experiments,

(b) knowledge to conceptualise the probabilities of events including frequentist and axiomatic approach. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem,

(c) knowledge related to concept of discrete and continuous random variables and their probability distributions including expectation and moments,

(d) knowledge of important discrete and continuous distributions such as Binomial, Poisson, Geometric, Negative Binomial and Hyper-geometric, normal, uniform, exponential, beta and gamma distributions,

(e) acumen to apply standard discrete and continuous probability distributions to different situations.

Contents (Theory):

Unit I

Random experiment: Trial, sample point, sample space, definitions of equally likely, mutually exclusive and exhaustive events, definition of probability, classical and relative frequency approach to probability, axiomatic approach to probability and its properties, merits and demerits of these approaches, total and compound probability theorems, conditional probability, independence of events, Bayes theorem and its applications in real life problems.

Unit II

Random Variable: Concept of discrete random variable, probability mass function and distribution function, joint probability mass function of several discrete random variables, marginal and conditional probability mass functions. Expectation of random variables and its properties, conditional expectation, moments in terms of expectation, moment generating function (m.g.f.) and cumulant generating function (c.g.f.), Properties of m.g.f. and c.g.f., Coefficients of skewness and kurtosis based on moments.

Unit III

Continuous Random Variable: Concept of continous random variable, probability density function and distribution function, joint probability density function of several continuous random variables, marginal and conditional probability density functions. Expectation of continuous random variables and its properties, conditional expectation, moments in terms of expectation, moment generating function (m.g.f.) and cumulant generating function (c.g.f.), Properties of m.g.f. and c.g.f., Coefficients of skewness and kurtosis based on moments. Some standard transformed random variables and their distributions.

Unit IV

Some Standard Discrete and Continuous Probability Distributions,
Evaluation of p.m.f., c.d.f., mean, variance, m.g.f. and c.g.f. of the following distributions: Uniform distribution, Bernoulli distribution, Binomial distribution, Poisson distribution, Geometric distribution, Negative binomial distribution, Hypergeometric distribution. Normal distribution and its properties, uniform distribution, exponential distribution, gamma, Weibull and beta distributions.

Contents (Practical):

The following is the list of experiments to be done during this course.

1. Computation of conditional probabilities and probabilities based on Bayestheorem
2. Plotting of discrete distributions and visualization of their shapes for variationin parameters
3. Plotting of continuous distributions and visualization of their shapes for

variationin parameters

4. Plots of distribution functions for some important discrete and continuousdistributions
5. Fitting of binomial, Poisson, geometric, hypergeometric and negativebinomial distributions and computation of expected frequencies, mean variance,m.g.f.
6. Fitting of normal, exponential, gamma, Weibull and beta distributions andcomputation of expected frequencies, mean variance,m.g.f.
7. Computation of normal probability and interpretation ofresults.

References:

1. Dudewicz, E.J. and Mishra, S.N. (2008). Modern Mathematics Statistics,Wiley.
2. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-CalculusBased Approach. Narosa Publishing Comp. NewDelhi.
3. Johnson, S. and Kotz, S. (1972). Distribution in Statistics Vol. I-II & III, Houghtonand Mifflin.
4. Lipschutz, S., Lipson, M. L. and Jain, K. (2010). Schaum's Outline ofProbability. 2nd Edition. McGraw Hill Education Pvt. Ltd, New Delhi.
5. Pitman, J. (1993). Probability. NarosaPublishingHouse.
6. Rao,C.R.(2009).LinearStatisticalInferenceanditsApplications,2Edition, WileyEastern.
7. Rohatgi, V.K. and Saleh, A.E. (2008). An introduction to ProbabilityTheory and Mathematical Statistics, WileyEastern.

Semester III

Course Code: BSCPSTSC301
Course Name: Statistical Inference

Course Type: **Core Theory & Practical**	Course Details: **CC-1(3)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes: The students will acquire

(a) Concept of law large numbers and their uses

(b) Concept of central limit theorem and its uses in statistics

(c) concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions,

(d) knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts,

(e) knowledge about inferences from Binomial, Poisson and Normal distributions as illustrations,

(f) knowledge about order statistics and associated distributions,

(g) concept about non-parametric method and some important non-parametric tests.

Contents (Theory):

Unit I

Chebyshev's inequality and its applications, basic ideas of convergence in probability and convergence in distribution, law of large numbers, central limit theorem (without proof). Concept of random sample from a distribution, statistic and its sampling distribution, standard error of an estimate, standard errors of sample mean and proportion, sampling distribution of sum of Binomial, Poisson random variables. Sampling distributions of and mean and variance from normal distribution.

Unit II

Formulation of inference problems with concrete illustrations. Point estimation: Different methods and criteria for good estimates. Data analytic illustrations, maximum likelihood estimators and statement of important properties, moment estimators.

Unit III

Tests of hypotheses: Simple, composite null and alternative hypotheses, critical region, types of error, level of significance, p-values, size and power of a test.

Tests for parameters when sampling is done from one and two normal distributions. Tests for parameters of binomial and Poisson distributions. Small sample tests based on chi-square, Students's t and F distributions. Applications of chi-square, Student's t and F distributions

Unit IV

Definition of order statistics and their distributions, sign test, run test, median test, Spearmen's rank correlation test, Sign test, Wilcoxon signed rank test, Wilcoxon Mann-Whitney test, Kolmogorov Smirnov - one sample and two sample tests.

Contents (Practical):

The following is the list of experiments to be done during this course.

1. Testing for parameters when sampling is done from one and two normal distributions.
2. Testing for parameters of binomial and Poisson distributions.
3. Drawing random sample from binomial, Poisson and normal distributions.
4. Point estimates of the parameters of binomial, Poisson and normal distributions.
5. Testing for parameters of binomial, Poisson and normal distributions.
6. Simulation using Box-Muller transformation.
7. Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi- square test, Yates' correction.

8. Chi-square test for independence of attributes.
9. Student's t test for single mean and difference of means.
10. The one-sample runs test for randomness – The Sign test – Wilcoxon's Signed Rank Test.
11. Two-Sample Case – Wilcoxon-Mann-Whitney U-test, Kolmogorov – Smirnov two- sample test.

References:

1. Freedman, D., Pisani, R. and Purves, R. (2014).Statistics.4th Edition. Norton &Comp.
2. Hanagal, D. D. (2009). Introduction to Applied Statistics: A Non-CalculusBased Approach. Narosa Publishing Comp. NewDelhi.
3. Kendall, M.G. and Stuart, A. (1979). The Advanced Theory of Statistics,Vol. 2. Inference andRelationship.4th Edition. Charles Griffin &Comp.
4. Kendall, M.G., Stuart, A. and Ord, J.K. (1994). The Advanced Theory ofStatistics, Vol. 1. DistributionTheory.6th Edition. Halsted Press (WileyInc.).
5. Kenney, J.F. and Keeping, E.S. (1947). Mathematics of Statistics. Part I. 2ndEdition. Chapman &Hall.
6. Kenney, J.F. and Keeping, E.S. (1951). Mathematics of Statistics. Part II.2nd Edition. Chapman & Hall.
7. Tanner, M. (1990). An Investigation for a Course in Statistics. McMillan, NewYork.
8. Tanur, J.M. (1989) Statistics. A Guide to theUnknown.3rd Edition, Duxbury Press.
9. Yule, G.U. and Kendall, M.G. (1973). An Introduction to the Theory ofStatistics. 14 Edition. Charles Griffin &Comp.

Semester III

Course Code: BSCPSTSSE301
Course Name: Programming with C

Course Type: **SE** **Practical**	Course Details: **SEC-1**			L-T-P: **0-0-8**	
Credit: **4**	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

Learning Outcomes:

The students will acquire the knowledge of

(a) various basic concepts, features and components related to C programminglanguage, and structure of Cprogram,

(b) various operators used like logical, assignment, conditional, bitwise in Cprogram,

(c) Control statements, conditional statements, break and continue statements,arrays, etc. in Cprogram,

(d) C programming with some basic notions for developing their ownsimple programs and visualizing graphics inC.

Contents (Practical):

Unit I

History and features of C language, components of C language, structure of a C program. Data type: Basic data types, enumerated data types, derived data types. Variable declaration, local, global, parametric variables, assignment of variables, numeric, character, real and string constants, arithmetic relation and logical operators, assignment operators, increment and decrement operators, conditional operators, Bitwise operators, type modifiers and expressions, writing and interpreting expressions, using expressions in statements. basic input / output.

Unit II

Control Constructs I: Control statements, conditional statements, if . . . . . else, nesting of if . . .

. . . else, else lf ladder, switch statements. Loops in C: for,while,do..... while loops.Control

Constructs II: Break, continue, exit ( ), go to and label declarations. One dimensional two dimensional and multidimensional arrays.

Unit III

Storage classes: Automatic variables, External variables, Static variables, Scope and lifetime of declarations. Functions, classification of functions, functions definition and declaration, assessing a function, return statement, parameter passing in functions, revise on inFunctions.

Unit IV

Structure: Definition and declaration; structure (initialization) comparison of structure variable array of structures: array within structures, structures within structures, passing structures to functions, unions accessing a union member, union of structure, initialization of a union variable, uses of union.

References:

1. Balagurusamy, E. (2004). Programming in ANSIC.3rdEdition. Tata McGrawHill.
2. Gottfried B. S. (1996). Theory and problems of Programming with C. 2nd edition.TataMcGrawHill.
3. Kanetkar, Y.P. (2003). Working with C. BPBPublication.
4. Schildt, H. (1985). C Made Easy. McGrawHill.
5. Schildt, H. (2010). C The CompleteReference,3rdEdition. Tata McGrawHill.

Semester IV

Course Code: BSCPSTSC401
Course Name: Sampling Techniques & Design of Experiments

Course Type:**Core Theory & Practical**	Course Details: **CC-1(4)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes: The students will acquire

(a) the knowledge ofcomplete enumeration and sample, sampling frame, sampling distribution, sampling and non-sampling errors, principal steps in sample surveys, limitations of samplingetc.,

(b) the knowledge ofvarious statistical sampling schemes such as simple, stratifiedand systematic sampling.

(c) the knowledge ofconducting the sample surveys and selecting appropriate samplingtechniques,

(d) the knowledge of comparing various samplingtechniques.

(e) the knowledge to carry out one way and two way Analysis ofVariance,

(f) the knowledge ofbasic terms used in design ofexperiments,

(g) use appropriate experimental designs to analyze the experimentaldata,

(h) the knowledge ofappling Multiple range tests, the multiple t–test, Student-Newman-Keulstest,Duncan's multiple range test, Tukey'stest,

(i) the knowledge ofstatistical interpretation of the experimental resultsobtained.

Contents (Theory):

Unit I

Simple Random Sampling (with and without replacement): Notations and terminology, various probabilities of selection. Random numbers tables and its uses. Methods of selecting simple random sample, lottery method, method based on random numbers. Estimates of population total, mean and their variances and standard errors, determination of sample size, simple random sampling ofattributes.

Unit II

Stratified random sampling: principles of stratification, notations, estimation of population mean and variances, cost function, allocation techniques, proportional and optimum allocations. Comparison of stratified sampling with simple random sampling.

Unit III

Analysis of variance: Definition, assumption for ANOVA test, one-way and two-way classifications for fixed effect model with one observation per cell. Introduction to design of experiments: terminology, experiment, treatment, experimental units, blocks, experimental error, replication, precision and accuracy, need for design of experiment, size and shape of plots and blocks. Fundamental principles of design of experiments: Randomization, Replication and Local control.

Unit IV

Completely randomized design(CRD), Randomized Complete Block Design(RCBD), Latin square design(LSD) and their layout and analyses. Multiple range tests, the multiple t – test, Student-Newman-Keuls test, Duncan's multiple range test, Tukey's test, Fisher's least significant difference test, Scheffe's test, comments on multiple rangetest.

Contents (Practical):

The following is the list of experiments to be done during this course.

1. Simple Random Sampling – Lottery, random number method and other relatedproblems, Sample sizecalculation.
2. Systematic Sampling – Problems related to Linear and Circular systematicsampling.
3. Problems related to Systematic sampling with LinearTrend.
4. Stratified Random Sampling – Problems related to Different types ofallocation.
5. Stratified Random Sampling – Problems related to Optimum allocation and otherrelated problems.
6. Sample sizecalculations.
7. One-way analysis of variance, Multiple range tests – The LSD test or the multiple t –test, Student-Newman-Keuls test, Duncan's multiple range test, Tukey'stest.
8. Fisher's least significant difference test, Scheffe'stest.
9. Completely Randomised Design (CRD), Randomised Complete Block Design (RCBD)– methods, analysis andinterpretation.
10. Latin Square Design – methods, analysis andinterpretation.

References:

1. Ardilly, P. and Yves T. (2006). Sampling Methods: Exercise and Solutions.Springer.
2. Cochran, W.G. (2007). Sampling Techniques. (Third Edition). John Wiley &Sons,New Delhi.
3. Cochran, W. G. and Cox, G. M. (1957). Experimental Design. John Wiley &Sons,New York.

4. Das, M. N. and Giri, N. S. (1986). Design and Analysis of Experiments (2^{nd}Edition).Wiley.
5. Dean, A. and Voss, D. (1999). Design and Analysis of Experiments.Springer-Verlag, NewYork.
6. Des Raj. (1976). Sampling Theory. Tata McGraw Hill, New York. (Reprint1979).
7. Federer, W.T. (1955). Experimental Design: Theory and Applications. Oxford &IBH Publishing Company, Calcutta, Bombay and NewDelhi.
8. Joshi, D.D. (1987). Linear Estimation and Design of Experiments. New AgeInternational

   (P) Ltd. New Delhi.
9. Montgomery, D.C. (2017). Design and analysis of Experiments, 9^{th}Edition. John Wiley &Sons.
10. Mukhopadyay, P. (2007). Survey Sampling. Narosa Publisher, NewDelhi.
11. Sampth, S. (2005). Sampling Theory and Methods, 2^{nd}Edition, Alpha Science InternationalLtd.
12. Singh, D. and Choudhary, F.S. (1977). Theory and Analysis of Sample SurveyDesigns. Wiley Eastern Ltd, New Delhi. (Reprint1986)
13. Sukhatme, P.V. and Sukhatme, B.V. (1970). Sampling Theory Surveys withApplications (Second Edition). Iowa State UniversityPress.
14. Thompson, S.K. (2012). Sampling. John Wiley &Sons.

Semester- IV

Course Code: BSCPSTSSE401

Course Name: Computational Techniques using R

Course Type: **SE** **(Practical)**	Course Details: **SEC-2**			L-T-P: **0-0-8**	
Credit: **4**	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

Course Learning Outcomes:

The students will acquire the knowledge of

(a) various basic concepts related to computer architecture and its organization,variousperipheraldevices,

(b) languages: machine language, assembly language and high levellanguages,

(c) ideas on operating systems, linker, loader and compileretc.,

(d) R programming with some basic notions for developing their own simpleprograms and visualizing graphics inR.

Contents (Practical):

Unit I

Computer basics: Introduction and brief history of evolution of computers, Classification of computers: special purpose and general purpose; analog, digital and hybrid; Super, main-frame etc.

Unit II

Organization of general purpose digital computers: CPU, main memory and peripherals. Mass storage devices and other I/O devices.

Computer languages: Machine code language (machine language), assembly language and high level languages. Software: Operating systems, linker, loader, compiler, interpreter and assembler.

Unit III

Computer programming: Algorithm and flow-chart. Storage of information: concepts of records

and files. File organization: sequential, relative and indexed.

Unit-IV

Programming with R: Introduction to R, Data types in R (numeric, logical, character, complex etc.), R objects: vector, matrix, array, list, data frame, factor, and time series. Arithmetic, logical and relational operators, explicit and implicit looping, functions and functional programming in R, Lexical scoping rules in R, benefits of Lexical scoping, other scoping rules, debugging facility in R. Few important mathematical, statistical and graphical functions in R.

References:

1. Chambers, J. (2008). Software for Data Analysis: Programming with R,Springer.
2. Crawley, M.J. (2017). The R Book, John Wiley &Sons.
3. Eckhouse, R.H. and Morris, L.R. (1975). Minicomputer SystemsOrganization, Programming and Applications,Prentice-Hall.
4. Matloff, N. (2011). The Art of R Programming, No Starch Press,Inc.
5. Peter N. (1986). Inside the IBM PC, Prentice-HallPress.

Semester- V

Course Code: BSCPSTSDSE501
Course Name: Time Series Analysis

Course Type: **DSE** **(Theory & Practical)**	Course Details: **DSE-1(1)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Learning Outcomes: The student will acquire the knowledge of

(a) time series data, its applications to various fields and components of timeseries,

(b) fitting and plotting of various growth curves such as modified exponential, Gompertz and logistic curve,

(c) fitting of trend by Moving Average method,

(d) measurement of Seasonal Indices by Ratio-to-Trend, Ratio-to-Moving Average and Link Relative methods,

(e) calculation of variance of random component by variate component method,

(f) applications to real data by means of laboratory assignments.

Contents (Theory):

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,

Unit II

Fitting of various mathematical curve, and growth curves.

Trend Cont.: Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series.

Unit III

Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend. Seasonal Component count: Ratio to Moving Averages and Link Relative method, Deseasonalization.

Unit IV

Cyclic Component: Harmonic Analysis. Some Special Processes: 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.

Contents (Practical):

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. Calculation of variance of random component by variate difference method.
9. Forecasting by exponential smoothing.
10. Forecasting by short term forecasting methods.

References:

1. Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. (2015). Time

SeriesAnalysis: Forecasting and Control. 5th Edition. John Wiley &sons,Inc.

2. Brockwell, P.J. and Davis, R.A. (2003). Introduction to Time Series Analysis.Springer.
3. Chatfield, C. (2001). Time Series Forecasting., Chapman &Hall.
4. Fuller, W.A. (1996). Introduction to Time Series. 2nd Edition.Wiley.
5. Kendall, M.G. and Ord, J.K. (1990). Time Series. 3rd edition. EdwardArnold.
6. Montgomery, D.C., Jennings, C.L. and Kulahci, M. (2012). Introduction to TimeSeries Analysis and Forecasting, JohnWiley.
7. Mukhopadhyay, P. (2011). Applied Statistics, 2nd ed. Revised reprint, Books andAlliedPvt.Ltd.

Course Code: BSCPSTSSE501
Course Name: Computational Statistics

Course Type: **SE (Practical)**	Course Details: **SEC-3**			L-T-P: **0-0-8**	
Credit: **4**	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

Learning Outcomes:

The students will acquire the knowledge of

(a) various computational algorithms relevant to statisticians as supportsystem,
(b) codes preferably using Rlanguage,
(c) Linear congruential and mid-square methods for uniformgenerator,
(d) Inverse transform method for simulating various probability distributions andstochastic models,
(e) data base management system with special emphasis on significance of topic tothe statisticians,
(f) Entity relationship, Relational, Hierarchical and NetworkModels,
(g) practical assignments on above mentioned topics.

Contents (Practical):

Unit I

Graphical methods with applications: histogram, Quantile based plot (boxplot and Q-Q plot), scatter diagram, time series plot, autocorrelation plot.

Computation of the normal integral, Student's t-integral, non-central t integral, Gamma, Beta integral for positive real numbers. Computation of incomplete beta and incomplete gamma integral, computation of Bessel function and modified Bessel function.

Unit II

Generation of uniform random numbers (mid-square method and linear congruential generator).

Simulation of probability distributions and stochastic models (Inverse transformation method only). Applications of simulation techniques.

Unit III

Introduction. Purpose of database systems. Database abstraction. Data models. Instances and schemes. Data independence. Data definition and data manipulation languages. Database manager, Administrators and users.

Unit IV

Entity relationship model, Entities and entity sets. Relationships and relationship sets, Attributes, Mapping constraints, Keys, Entity relationship diagram. Reducing E-R diagrams to tables. Aggregation, Design of an E-R database scheme.

Relational models. Structure of relational database. Distributed database. Relational algebra. Relational commercial languages. SQL. Relational database design. Query languages and query processing. Crash recovery. Concurrency control. Hierarchical model. Network model.

References:

1. Date, C.J. (1981). Introduction to Database Systems,Addison-Wesley.
2. Kennedy W. J. & Gentle J. E. (1980). Statistical Computing, MarcelDekker.
3. Korth, H.F. and Silberschatz, A. (2010). Database System Concepts,McGraw-Hill.

4. Ross, S.M. (2012). Simulation. AcademicPress.
5. William H. P. and William T. V. (1992). Numerical Recipes in C: The Art ofScientific Computing, Cambridge UniversityPress.

Semester- VI

Course Code: BSCPSTSDSE601
Course Name: Applied Statistics

Course Type: **Core (Theory &Practical)**	Course Details: **DSE-1(2)**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Learning Outcomes: Students will acquire

(a) income distributions and their fitting in real life situations,

(b) commonly used measures of demography pertaining to its three basic aspects, viz.the fertility, mortality andmigration,

(c) various data collection methods enabling them to have a better insight in policymaking, planning and systematicimplementation,

(d) Construction and implication of lifetables,

(e) Population growth curves, population estimates andprojections,

(f) Real data implementation of various demographic concepts as outlined abovethroughpracticalassignments.

Contents (Theory):

Unit I

Analysis of income and allied size distributions: Pareto and log-normal distributions, genesis, specification and estimation, Lorenz curve, Gini coefficient.

Demand analysis: Classification of commodities, Engel curve analysis using cross-section and time series data, Engel curves incorporating household characteristics, demand projection, specific concentration curves.

Unit II

Sources of demographic data, census, registration, ad hoc surveys, hospital records, demographic profiles of the Indian census.

Measurement of Mortality and Life Table: Crude death rate, Standardized death rates, Age- specific death rates, Infant Mortality rate, Death rate by cause, Complete life table and its main features, Uses of life table.

Unit III

Measurement of Fertility: Crude birth rate, general fertility rate, age specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate. Rates and ratios. Measures of mortality. Life Table – construction and applications.

Unit IV

Stable and stationary population. Measures of fertility and reproduction. Indian data.

Standardization of vital rates. Population growth curves, population estimates and projections.

Measures of migration. Use of demographic data for policy formulation.

Contents (Practical):

1. Fitting of Engel's curve and calculation of income elasticity ofdemand.
2. Fitting of Pareto's law for income distribution for a given Income dataset, for entirerange as well as specificrange.
3. Fitting of a Lorentz curve for a data and computation of the concentration ratiousinggraphicalmethod.
4. Calculation of Crude birth rate; General fertility rate; Age specific fertility rate;Total fertility rate; Gross reproduction rate; Net reproductionrate.
5. Calculation of Infant mortality rate, Crude death rate, Age specific deathrates.
6. Computation of standardized birth and deathrates.
7. Construction of lifetables.
8. Population growth curves, population estimates andprojections.

References:

1. Benjamin, B. (1959). Health and Vital Statistics. Allen andUnuwin.

2. Cramer, J.S. (1969). Empirical Econometrics. North Holland Pub.Co.
3. Karmel, P.H. and Polasek, M. (1957). Statistics for Economists. PitmanPublishing.
4. Klein, L.R. (1962). An Introduction to Econometrics. PrenticeHall.
5. Mishra, B.D. (2004). An Introduction to the Study of Population. South AsianPublishers.
6. Mukhopadhyay, P. (1994). Applied Statistics. New Central Book Agency Pvt.Ltd. Calcutta.
7. Ramkumar, R. (1986). Technical Demography. John Wiley &Sons.
8. Srinivasan, K. (1998). Demographic Techniques and Applications. SagePublications.
9. Srivastava O.S. (1983). A Text Book of Demography. VikasPublishingHouse.
10. Shryock, H.S. (1971). The Methods and Materials in Demography. U.S. Bureau ofCensus.

Course Code: BSCPSTSSE601
Course Name: Statistical Techniques for Research Methodology

Course Type:**SE** **Practical**	Course Details: **SEC-4**			L-T-P: **0-0-8**	
Credit: **4**	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30		20	

Learning Outcomes: Students will acquire

(a) basic concepts and aspects related to research, data collection, analysesand interpretation,
(b) Prepare and finalize research report on some real lifesituations.

Contents (Practical):

Unit I

Introduction: Meaning, objectives and motivation in research, types of research, research approach, significance of research. Research problems: definition, selection and necessity of research problems.

Unit II

Survey methodology and data collection, inference and error in surveys, the target populations, sampling frames and coverage error, methods of data collection, non-response, questions and answers in surveys.

Unit III

Processing, Data Analysis and Interpretation: Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation.

Unit IV

Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), interpret the results and draw inferences.

Students should submit a research report based on empirical study on some real life situation. The student will personally collect, analyze, interpret the data and prepare a report under the supervision of a faculty.

References:

1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2ndRevised Edition reprint, New Age InternationalPublishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners,SAGE Publications.