Choice Based Credit System (CBCS) Syllabus for M.A./M.Sc. Statistics

1st- Semester for Batch 2022 wef 2022 and onwards

BOSPG held on 23/05/2022

General Instructions for the Candidates

1. The **two** years (**4 semesters**) PG Programmes is of **96** credit weightage i.e. **24** credits/semester (**24×4 = 96**).
2. Out of **24** credits in a semester a candidate has to obtain **14** creditscompulsorily from the **Core Courses**, while the remaining **10** credits can beobtained from the **Electives(DCE, GE &OE)** in the following manner:

- A candidate can obtain a maximum of **8** credits within his /her own Department out of specialization offered by the Department as **DisciplineCentric Electives (DCE).**
- **2**credits shall be obtained by the candidate from the **Electives(GE, OE)** offered by the Department other than his/her own. The candidate shall befree to obtain these **2** credits from the **General** or **Open Elective or a Combination of both.**

SEMESTER -I			
Course Type	**Course Code**	**Title of the Course**	**No. of Credits**
Core (CR)	ST22101CR	Probability and Distribution Theory - I	**04**
	ST22102CR	Sampling Techniques	**04**
	ST22103CR	Statistical Computing	**04**
	ST22104CR	Applied Statistics	**02**
DisciplineCentric Elective (DCE)	ST22105DCE	Stochastic Processes	**04**
	ST22106DCE	Linear Algebra	**02**
	ST22107DCE	Real Analysis	**02**
	ST22108DCE	Practical based on ST2201CR & ST22102CR	**02**
	ST22109DCE	Practical based on ST22103CR & ST22104CR	**02**
Generic Elective (GE)	ST22110GE	Statistical Methods	**02**
	ST22111GE	Parametric Tests	**02**
Open Elective (OE)	ST22112OE	Time Series Analysis	**02**

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PROBABILITY AND DISTRIBUTION THEORY-I

COURSE NO: ST22101CR **No. of Credits-4**

Course Objectives: To introduce concepts of probability distribution.

Course Outcomes: Students who successfully complete this course will be able to:

- Understand the basic concepts of Probability theory.
- Understand the concepts of discrete and continuous Probability distributions.
- Identiy the distributions by uniqueness theorem.

UNIT-I

Class of sets, fields, sigma fields, minimal sigma field, and Borel sigma field. Definition of probability: classical and relative frequency approach, discrete probability space, propertiesof probability based on axiomatic approach, Independence of events, conditional probability, total and compound probability rules. Bayes theorem and its applications. Random variable.Cumulative distribution function of random variables and its properties, probability functionof a random variable. Related Examples.

UNIT-II

Joint distribution function and probability function of a random variable. Expectation of a random variable and its properties, conditional expectation, covariance and correlation. Moments, measure of location and dispersion of a random variable. Moment generating function, probability-generating function, Characteristic function of a real and vector valuedrandom variables. Inversion formula, and Uniqueness theorem. Related Examples.

UNIT-III

Standard Univariate discrete distributions: Discrete Uniform, Bernoulli, Binomial, Poisson,Negative Binomial, Geometric, Hyper geometric, logarithmic distributions and their structural properties, relations and applications, Marginal and conditional distributions. Examples related to discrete distributions.

UNIT-IV

Univariate Continuous distributions: Uniform, Beta, Gamma, Exponential, Pareto, Weibull,Laplace, Normal, Cauchy and their structural properties, relations and applications, Marginaland conditional distributions. Examples based on continuous distributions.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'lStudents edition
- Rohatgi, V.K. (1994): An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern.
- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand& Sons.
- Rao, R.C. (1973): Linear Statistical Inference and its Applications, 2/e, Wiley Eastern.
- Pitman. (1993): Probability, Narosa Publishing House.
- Johnson, S.andKotz, (1972): Distribution in Statistics, vol. I, II and III, Houghton and Miffin.
- Johnson, Kotz and Kemp (1992): Univariate discrete distribution, John Wiley
- Cramer, H. (1946): Mathematical Methods of Statistics, Princeton.

SAMPLING TECHNIQUES

COURSE NO: ST22102CR **No. of Credits-4**

Course Objectives: To introduce concepts of sampling theory.

Course Learning outcomes: Students who successfully complete this course will be able to:

- Understand the basic concepts of sampling theory.
- Formulate and calculate estimators of population mean, population ratio, population total for SRs, Systematic and cluster sampling.
- Estimate the convenient sample size under different sampling strategies.
- Compare various sampling procedures interms of variance of estimators.
- Handle the practical uses of arising insamplingstudies.

UNIT I

Basic ideas and distinctive features of sampling: Review of important terminology used in sampling.Concept of Bias, mean square error, Relative efficiency. Simple random sampling withand without replacement. Estimators of population proportion. Determination of sample size. SRS as applied to qualitative characteristic.

UNIT II

Stratified random Sampling: Estimation of the population mean/total and its variance,choice of sample sizes in different strata, variance under different allocations.Comparison with unstratified sampling.Estimation of the gain in precisiondue to stratification, construction of strata.

UNIT III

Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling.Some modifications of ratio and regression estimators.Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

UNIT-IV

Systematic Sampling: Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of lineartrend. Cluster sampling: Estimation of mean and its variance for equal and unequal clusters. Efficiency in terms of intra-class correlation.Optimum unit of sampling.Sampling with replacement and unequal probabilities.Estimation of mean and its variance.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Cochran, W. G: Sampling Techniques, 3rd edition, Wiley.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling,Prentice Hall of India, Private limited, New Delhi
- Des Raj &Chandak(1998): Sampling Theory, Narosa.
- Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society,Calcutta.
- Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State UniversityPress, & IARS.
- Singh, D and Chuddar, F. S. (1986): Theory and Analysis of SampleSurvey Design, New Age International Publisher.

STATISTICAL COMPUTING

COURSE NO: ST22103CR **No. of Credits-4**

Course objectives: To learn data analysis using MINITAB.

Course outcomes: After successful completion of this course, the students will be able to:

- Study large number of real data sets.
- Apply the Minitab for statistical data analysis and graphics.
- Find solutions of problems of optimization through Minitab.
- Transfer textbook knowledge to practical situations.

UNIT-I

Introduction to computers, Classification of computers, advantages, disadvantages and applications of computers, Basic set up of electronic computers, input and output devices. Basic idea about computer packages (statistical Packages).

UNIT-II

Statistical Software's: MINITAB reading and Manipulation of data, Commands/Statements in MINITAB, Descriptive Statistics. Working with Software package MINITAB for graphics, EDA: Histogram, Plot, Box plot, Pi-chart, QQ plot, density plot, and Stem and Leaf.

UNIT-III

Using MINITAB: Basic operations on matrices. Correlation and Regression analysis: simple and multiple. Test of significance of large samples, Test of single proportion, Test of significance of difference of proportions.

UNIT-IV

Using MINITAB: Chi-Square test for independence of attributes and Contingency table, t-test, Paired t-test, Test for correlation in sampling from normal population, F-test, testing of two variance of two univariate normal population.

RECOMMENDED TEXT BOOKS & REFERENCES:

- B. Ryan and B.L. Joiner (2001). MINITAB Handbook, Fourth edition, Duxbury.
- R.A. Thisted (1988): Elements of Statistical Computing, chapman and Hall.
- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.

APPLIED STATISTICS

COURSE NO: ST22104CR. **No. of Credits-2**

Course objectives: To introduce the concepts of Time Series and Index Numbers.

Course outcomes: After successful completion of this course, the students will be able to:

- Apply the the Time Series data to find the trend .
- Analyze Time Series data inorder to check the behaviour of trend.
- Understand the applications of Index Numbers.

UNIT –I

Introduction and history of time series, Trend, Linear and Non- Linear trend, periodic changes, Seasonal Variations, Analysis of time series, Mathematical Models of Time Series, Uses of the time series. Measurement of Trend,Free hand curve method, Semi-Average method, Moving average method, Method of least squares, fitting of straight line by Least Squares, Merits and Limitations of given methods.

UNIT –II

Index number: Definition and applications of index number. Construction of Index numbers and problems related to computation of Index numbers. Use of averages, simple aggregative and Weighted average methods, Laspeyre's, Paasche's, Drobish-Bowley price index number and Fishers' index number. Criteria for good index number: Mathematical Tests: Unit test, Time Reversal test, Factor Reversal tests and Circular test of index numbers.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Gupta S. C. and Kapoor V.K. (2001): Fundamental of Applied Statistics.
- Box, G.E.P. and Jenkins, G.M. (1976): Time Series Analysis-Forecasting and Control, Holden-day, San Francisco.
- Anderson, T.W. (1971): The Statistical Analysis of Time Series, Wiley, N.Y.

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STOCHASTIC PROCESSES

COURSE NO: ST22105DCE **No. of Credits-4**

Course objectives: To introduce the concepts of stochastic process.

Course outcomes: After successful completion of this course, the students will be able to:

- Understand the concepts of Markov Chain.
- Apply the Poisson processes and related distributions.
- Understand the concepts of Galton-Watson branching process.

UNIT I

Introduction to Stochastic Processes (SP's); Classification of Stochastic Processes according to state space and time domain.Definition of Markov Chain and examples. Countable state Markov chains (MC's), Chapman-Kolmogrov equations; Calculation of n-step transition probability and its limit.

UNIT II

Stationary distribution, Classification of states: persistent state, transient state and ergodic state, examples, limiting theorems concerning states; Simple Random Walk Model and gambler's ruin problem; expected duration of the game, Probability of ruinat the nth trail. And Probability of a draw at the rth trial.

UNIT III

Markov Process with Discrete state space: Poisson processes, Poisson processes and related distributions, Birth and death process; Markov Process with Continuous state space, Brownian Motion, Wiener Process, Differential equations for a Wiener Process, Kolmogorov Equations.

UNIT IV

Introduction of Branching process: Galton-Watson branching process, properties of generating functions of branching process and distribution of population size, Calculation of moments of Branching Process and distribution of total progeny.Probability of ultimate extinction, numerical illustrations.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Medhi, J. (1982): Stochastic Processes, Holden-Day.
- Baily, N.T.J. (1965): The Elements of Stochastic Processes: John Wiley
- Jagers P. (1974): Branching Processes with Biological Applications, Wiley.
- Harris, T.E. (1963): The Theory of Branching Processes, Springer-Verlag.
- Hoel, P.G., Port, S.C. and Stone, C.J (1972): Introduction to StochasticProcesses, Houghton Miffin& Co.
- Karlin, S. and Taylor, H.M. (1975): A First Course in Stochastic Processes,Vol.1, and Academic Press.
- Basu, A.K. (2003): Introduction to Stochastic Processes, Narosa Publications

LINEAR ALGEBRA

COURSE NO: ST22106DCE **No. of Credits-2**

Course objectives: To introduce the concepts of linear algebra.

Course objectives: To expose the students to the study of matrices, Linear function and their representations through the survey of matrices and vector spaces..

To make students aware of representing statistical data in the matrix forms and then analysing interms of linear algebraic tools and techniques.

UNIT-I

Algebra of Matrices, trace of a matrix, tr(AB)= tr(BA), types of matrices: symmetric, skew symmetric, Hermetian, Skew-Hermetian, idempotent, nilpotent, orthogonal and Unitary matrices. Inverse of square matrix, Inverse of partitioned matrices. Rank of matrix, characteristic and minimal equation, Cayley-Hamilton Theorem and its Applications. Eigen values and Eigen vectors.

UNIT-II

Linear equations, solution of homogenous and non-homogenous equations. Vector spaces, basis and Dimensions . Linear Transformations and their matrix representation. Inner product spaces, orthogonal and orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Grabill, Walter(1976). Matrices with Applications in Statistics, 2nd Ed.Wadsworth.
- Roa,C.R.(1973), Linear Statistical Inference and its Applications, 2nd Ed.John Wileyand Sons,Inc.
- Searel, S.R.(1982).Matrix Algebra useful for Statistics. John Wiely and Sons,Inc.
- Aziz, A, Rather, N.A. and Zargar, B.A.: Elementary Matrix Algebra, KBD(Kashmir Book Depo)
- Shanti Narayan, A text book of matrices, Narosa Publ. linear independence and linear dependence of row (column) vectors.

REAL ANALYSIS

COURSE NO: ST22107DCE **No. of Credits-2**

Course objectives: To introduce the concepts of real analysis.

Course objectives: To study the behaviour and properties of Real numbers, Sequence and Series of real numbers and realvalued functions inorder to tackle daily life problems arising from physical phenemenon .

To study different properties of distribution and density functions in Statistics using Real ananalysis.

UNIT-I

Finite, countable and uncountable sets, bounded and unbounded sets, Archimedean property, ordered field, completeness of R, sequence and series, limit supremum andlimit infimum of a bounded sequence. Convergence and divergence of positive term series, comparison, root and ratio tests for the convergence of series. Cauchy-Schwarz Inequality, Chebyshev's Inequality, Central limit theorem.

UNIT-II

Limit, Continuity, uniform continuity of functions of one variable, the algebra of continuous functions, monotonic functions, types of discontinuities, infinite limits and limits at infinity. Differentiability, Rolle's Theorem, Mean Value Theorems, Riemann sum and integral (simple problems). Functions of several variables. Limit and continuity of functions of several variables.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Apostol, T.M (1985), Mathematical Analysis, Narosa, India Ed.
- Courant, R.and John, F.(1965), Introduction to Calculus and Analysis, Wiley. S.C.Malik, Mathematical Analysis, New Age International Limited.
- Miller, K.S(1975)Advanced Real Calculus, Harper, New York.
- Rudin, Walter(1976). Principles of Mathematical Ananlysis, McGraw Hill.

COURSE NO: ST22108DCE No. of Credits-2

PRACTICAL BASED ON COURSES

ST22101CR & ST22102CR

Using Statistical Software

COURSE NO: ST22109DCE No. of Credits-2

PRACTICAL BASED ON COURSES

ST22103CR & ST22104CR

Using Statistical Software

STATISTICAL METHODS

COURSE NO: ST22110GE **No. of Credits-2**

Course objectives: To introduce the concepts of descripitive statistics.

Course outcomes: Students who successfully complete the course will be able to:

- Understand the measures of central tendency and their applications.
- Understand the measures of dispersion and their usage.
- Understand the concepts of correlation and regresssion.

UNIT-I

Descriptive Statistics: Measures of central tendency, Characteristic for an ideal measure of dispersion, Measure of dispersion range, quartile deviation, variance, standard deviation, co-efficient of variation, Skewness and Kurtosis.

UNIT-II

Measures of Co-relation: Scatter diagram, Karl Pearson Coefficient of correlation, Rank correlation, Regression, Lines of regression, Regression co-efficient, Fitting of regression lines.

RECOMMENDED TEXT BOOKS & REFERENCES:

- S.C. Gupta & V.K Kapoor (2012), Fundamentals of Mathematical Statistics, Sultan Chand & Sons,
- Dudewicz, E.J. and Mishra, S.N. (1988): Modern Mathematical Statistics, Willy, Int'l Students edition.
- Gupta S. C. and Kapoor V.K. (2001): Fundamental of Applied Statistics.

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PARAMETRIC TESTS

Course No: ST22111GE **No. of Credits-2**

Course objectives: To introduce the concepts of Testing of Hypothesis.

Course outcomes: Students who successfully complete the course will be able to:

- Formulate the hypothesis test and then apply appropriate statistic.
- Determine the probalilityof making type-I and type-II error.
- Understand the logic and framework of the inference of hypothesing testing.

UNIT I

Principles of test of significance , Null and alternative hypothesis, two tailed and onetailed test of hypothesis, Type I & Type II errors, level of significance, critical region,degree of freedom, concept of p-value.

UNIT II

Test for large samples: test of mean, test for difference between mean of two samples, test fordifference between the standard deviations of two samples. Tests of proportions: single anddifference of proportion, Chi-square test: for independence of attributes and goodness-of-fit.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).
- Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I &II (2005).
- Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences. (1964,1977) by John Wiley.

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TIME SERIES ANALYSIS

COURSE NO: ST22112OE **No. of Credits-2**

Course objectives: To introduce the concepts of Time Series.

Course outcomes: After successful completion of this course, the students will be able to:

- Understand the concepts of Components of Time Series.
- Apply the the Time Series data to find the trend .
- Analyze Time Series data inorder to check the nature of trend.

UNIT –I

Introduction to time series, Components of Time Series:Secular Trend, Seasonal Variations, Cyclic Variations, Irregular variation., Mathematical Models of Time Series, Main objectivesof analysing Time Series.

UNIT –II

Measurement of Trend, Graphical Methods, Method of Semi-Averages, Method of moving averages, Method of Least squares,fitting by Principle of Least Squares, Merits and Limitations of given methods.

RECOMMENDED TEXT BOOKS & REFERENCES:

- Gupta S. C. and Kapoor V.K. (2001): Fundamental of Applied Statistics.
- Box, G.E.P. and Jenkins, G.M. (1976): Time Series Analysis-Forecasting and Control, Holden-day, San Francisco.
- Anderson, T.W. (1971): The Statistical Analysis of Time Series, Wiley, N.Y.

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