Revised Syllabus W.E.F. from Academic year 2014-15

M.Sc. STATISTICS

M.Sc. (Statistics)-I year (CGPA)

SEMESTER-I		SEMESTER-II	
Paper No.	**Name of the paper**	**Paper No.**	**Name of the paper**
STT 01	Real Analysis	STT 06	Probability Theory
STT 02	Linear Algebra	STT 07	Regression Analysis
STT 03	Distribution Theory	STT 08	Parametric Inference
STT 04	Sampling Methods	STT 09	Multivariate Analysis
STT 05	Statistical Computing (R Programming)	STT 10	Stochastic Processes
STP 01	Practical-I (based on STT 02 and STT 05)	STP 03	Practical-II (based on STT 08 and STT 09)
STP 02	Practical-II (based on STT 03 and STT 04)	STP 04	Practical-IV(based on STT 07 and STT 10)

M.Sc. (Statistics)-II year(CGPA)

SEMESTER-III		SEMESTER-IV	
Paper No.	**Name of the paper**	**Paper No.**	**Name of the paper**
STT 11	Industrial Statistics	STT 16	Asymptotic Inference
STT 12	Operations Research-I	STT 17	Operations Research-II
STT 13	Design of Experiments	STT 18	Actuarial Statistics
STT 14	Testing of hypotheses	STT 19	Reliability and Survival Analysis
STT 15 (A)/(B)	Time Series Analysis / Decision Theory	STT 20 (A)/(B)	Data Mining Techniques/ Directional Data Analysis
STP 05	Practical-V (based on STT 11, STT 12 and STT 14)	STP 07	Practical-VII (based on STT 16, STT 17 and STT 20)
STP 06	Practical-VI (based on STT 13 and STT 15)	STP 08	Practical-VIII (based on STT 18 , STT 19)
		STM 02	Project (carrying 100 marks)

NOTE:

1) Each semester will have five theory papers and assessment for each theory paper will be of 100 Marks (50External Exam+ 50 Internal Exam (02 tests each of 15 Marks+10 Marks for Assignment + 10 Marks for Class Performance)).
2) Practical-I, II, III, IV, V, VI, VII, VIII will carry 50 marks each.
3) (i)Project carrying 100 marks which is to be given at the beginning of Semester-III and evaluated at the end of Semester-IV.

   (ii) Project batch is of minimum 02 and maximum 04 students.
4) Semester-I, Semester-II and Semester-III are of 600 marks each, Semester-IV is of 700 marks each.
5) Total marks for Semester I+ Semester II+ Semester III + Semester IV = 2500.
6) Total degree is of 2500 Marks, converted in the form of 100 credits CGPA system. one credit is of 25 marks.
7) In paper STT-05 i.e. in Statistical Computing EDA using R software will be taken.
8) In STT-12 and STT-17 papers i.e. Operations Research I & II TORA software and Solver tool pack will be used for practical purpose.

M.Sc. (STATISTICS)

(CGPA)

W.E.F. from Academic year 2014-15

SEMESTER-I	
Paper No.	**Name of the paper**
STT 01	Real Analysis
STT 02	Linear Algebra
STT 03	Distribution Theory
STT 04	Sampling Methods
STT 05	Statistical Computing (R Programming)
STP 01	Practical-I (based on STT 02 and STT 05)
STP 02	Practical-II (based on STT 03 and STT 04)

STT 01 **REAL ANALYSIS**

(Maximum no. of periods = 60)

UNIT I: The Real Number System: Rational numbers, Irrational numbers, Upper bounds, Lower bounds, Least upper bound(supremum), Greatest lower bound(infimum) of the sets of real numbers. The completeness axiom, some properties of the supremum and infimum, Archimedean property of the real number system. Absolute value and the triangle inequality, The Cauchy-Schwarz inequality, plus and minus infinity and the extended real number system R*.

UNIT II: Basic Notions of Set Theory: Similar (equinumerous) sets, Finite and infinite sets, Countable and uncountable sets, Uncountability of real number system. Set algebra, countable collections of countable sets and related results. Elements of Point Set Topology: Introduction to n-dimensional Euclidean space, Open and closed intervals (rectangles), Open and closed sets on the real line, limit points of a set, Compact set. The Bolzano-Weierstrass theorem, Heine-Borel theorem for real line R (without proof).

UNIT III: Sequences and Series of Real Numbers: Introduction and examples of sequences of real number. Convergence of sequences, limit of a sequence, limit superior and limit inferior of a real valued sequences, Monotone sequences of real numbers .Cauchy sequences and related results. Infinite series, Alternating series. Convergence of series, Absolute and conditional convergence. Test for convergence of series with positive terms(Comparison test and limit comparison test). The geometric series. The integral test. The big O(h)and little o(h) notation. The Ratio test and Root test.

UNIT IV: Limit and Continuity: Limits of functions, Continuous functions, Uniform continuity, Discontinuities, Continuity and Compactness, Monotone function and discontinuities. Sequences of Functions: Introduction and examples of sequences of real-valued functions, Pointwise convergence of sequences of functions, Definition of uniform convergence, Uniform convergence and continuity, Power series and radius of convergence.

UNIT V: Differentiation and functions of several variables: The Derivative of a Real Function, Maxima minima of function, Mean value theorems. The Continuity and Derivatives, Derivatives of higher order, Taylor's theorem (without proof), Functions of several variables, constrained maxima-minima functions. **Integrals:** Improper integrals of first and second kind for one variable, uniform convergence of improper integrals. Differentiation under the sign of integral Leibnitz rule.

REFERENCES:

1) Apostol T.M.(1985) Mathematical Analysis, Narosa,Indian Ed.
2) Courant R. And John F.(1965) Introduction to Calculas and Analysis, Wiley.
3) Miller K.S.(1957)Advanced Real Calculas,Harper, New York.
4) Rudin ,Walter(1976) Principles of Mathematical Analysis,McGraw Hill.
5) Malik S.C.(2005)Principles of Real Analysis, New Age International (p)Ltd.
6) Bartle R.G.(1976)Elements of Real Analysis, Wiley.

STT 02 **LINEAR ALGEBRA**

(Maximum no. of periods = 60)

UNIT I: Vector spaces: Vector spaces, subspaces, span of a set, linear dependence, independence, Dimension and Basis.

UNIT II: Linear Transformation: Range and kernel of a linear map, Rank and Nullity, Inverse of linear transformation, Rank Nullity theorem, the space L (U, V).

UNIT III: Matrices and Determinants **:**Linear map associated to matrix , matrix associated with linear map, Matrix multiplication, Rank and Nullity of matrix, Transpose of matrix, Elementary row operations, System of linear equations, Matrix inversion, Properties of determinants, Eigen values and Eigen vectors, algebraic multiplicity and geometric multiplicity, Cayley Hamilton theorem, Minimal polynomial.

UNIT IV: Inner product spaces and Quadratic forms: Inner product spaces, orthogonality, orthonormal basis, Gram Schmidt orthogonalization process, Classification of quadratic forms, rank and signature.

UNIT V: Canonical forms and generalized inverse: Echelon form, normal form, Hermite canonical form, Diagonalisation, Singular value decomposition, Jordan canonical form, Kroneker product, generalized inverse.

Text Books:

For units I to III (3.1 to 3.6, 4.1 to 4.6, 5.1 to 5.9, 6.1 to 6.9)

1) Krishnamurthy, Mainra and Arora, An introduction to Linear Algebra, East- west press pvt. Ltd. New Delhi.

For units IV and V (4.4 to 4.6, 8.6 to 8.8, 7.1 to 7.6, 9.1 to 9.3)

2) Ramchandra Rao and Bhimasankaram, Linear Algebra, 2nd edition, Hindustan book agency (India).

REFERENCES:

1) T. M. Karade and J. N. Salunke, Introductory Linear Algebra, Ist Edition 2012, Sonu Nilu Publication.
2) S. K. Mapa, Higher algebra Abstract and Linear, 10th edition, SARAT Book distributors, Calcutta.
3) Hoffman and Kunze, Linear Algebra, Prentice Hall India.
4) Friedberg , Insel, Spence, Linera Algebra, 4th edition, Prentice Hall India.

STT 03 **DISTRIBUTION THEORY**
(Maximum no. of periods = 60)

UNIT I: Brief review of basic distribution theory: Random experiment and its sample space, events, Probability axioms, Random variables, Discrete random variables, Continuous random variables, P.d.f., P.m.f. ,c.d.f. of random variables, M.g.f., p.g.f. c.g.f. ,characteristic function of random variables, Moments: raw moments, Central moments, Factorial moments.

UNIT II: Standard discrete and continuous distributions: Bernoulli, Binomial, Geometric, Negative Binomial, Poisson, Hypergeometric distributions. Exponential, Normal, Gamma ,Beta, Uniform, Chi-square, Lognormal, Weibull, Cauchy distributions. M.g.f., p.g.f., c.g.f., characteristic function , Moments of above distributions. Properties of above distributions.

UNIT III: Joint ,Marginal and Conditional distributions: Concept of random vectors, Joint, Marginal and conditional distributions Variance-covariance matrix. Joint p.m.f. of discrete random variables, Joint p.d.f. of continuous random variables.Marginal and conditional density using joint density. Conditional expectation and variance. Independence of random variables. Bivariate normal distributions. Joint p.d.f., Marginal p.d.f.s, Conditional p.d.f. , joint m.g.f., Some properties. Multinomial distribution: joint p.m.f., Marginal p.m.f., Conditional p.m.f., Joint m.g.f. Functions of random variables and their distributions: Function of random variables. Joint density of functions of random variables using Jacobian transformation.Convolution of random variables. Compound, Truncated and Mixture Distributions:Concept, applications, examples and problems.

UNIT IV: Sampling Distributions: Introduction, Sampling distribution of statistics from univariate normal random samples. Non-central Chi-square, t and F-distributions and their properties (Derivatives are not expected). Quadratic forms under Normality: Distribution of linear and quadratic forms in i.i.d. Standard normal variables (Technique based on m.g.f.) Independence of two linear forms, Independence of two quadratic forms and independence of linear form and quadratic form. Fisher Cochran's theorem.

UNIT V: Order Statistics: Distribution of r_{th} order statistics, Joint distribution of several order statistics and their functions. Distribution of function of order Statistics. Extreme values and their asymptotic distributions (statement only) with applications.

REFERENCES:

1)Rohatgi V.K. and Ehsanes Saleh A.K.MD.(2003) An Introduction to probability theory and Mathematical Statistics (Wiley Eastern ,2_{nd} Ed.)
2)Hogg R.V. and Craig A.T.(1978) Introduction to Mathematical Statistics(5_{th} Ed.Pearsons Education)
3)Hogg R.V. and Tanis E.(2002)An Probability and Statistical Inference(6_{th} Ed.Pearsons Education)
4)Rao C.R.(2002)Linear Statistical Inference and its Applications(2_{nd} Ed.,Wiley Eastern)
5)Dudewicz E.J.and Mishra S.N.(1988)Modern Mathematical Statistics,(Wiley & Sons)

Additional Refernces:-

Pitman J.(1993) Probability,(Narosa Publishing House)
Johnson S.and Kotz (1972)Distributions in Statistics(Vol.I,IIand III,Houghton and Miffin)
Cramer H.(1946)Mathematical Methods of Statistics(Princeton)

STT 04 **SAMPLING METHODS**

(Maximum no. of periods = 60)

UNIT I: Concept of population and sample, need for sampling, Census and sample surveys, basic concepts in sampling and designing of large-scale survey design, sampling scheme and sampling strategy. Sampling and Non-sampling errors, Response and non-response errors. Basic methods of sample selection: SRSWR, SRSWOR.

UNIT II: Stratified sampling: Formation of strata and number of strata, Allocation problems and estimation problems, cost and variance analysis. Systematic sampling and related results on estimation of population total, mean and proportion.

UNIT III: Use of supplementary information for estimation: Ratio and Regression estimators and their properties and MSEs. Unbiased and almost Unbiased ratio type estimators.

UNIT IV: Unequal Probability Sampling Designs: Inclusion probabilities, Horwitz - Thompson estimator and its properties. PPSWR, PPSWOR methods (including Lahiri's scheme) and related estimators of a finite population mean (Heansen-Horwitz and Desraj estimators for a general sample size and Murthy's estimator for a sample of size, Midzuno sampling design).

UNIT V: Cluster sampling, Estimator of population mean and its properties. Two-stage sampling. Double sampling and its uses in ratio and regression estimation.

REFERENCES:

1) Chaudhari A. And Mukerjee R. (1988) Randomized Response: Theory and Techniques, New York, Marcel Dekker Inc.
2) Cochran W.G.(1984) Sampling Techniques, Wiley.
3) Des Raj and Chandok(1999)Sample Survey Theory, Narosa.
4) Murthy M. N.(1977) Sampling Theory and Methods, Statistical Pub. Society, Calcutta.
5) Sukhatme P.V., Sukhatme B.V. and Ashok C.(1984)Sampling Theory of Surveys with Applications, Iowa state University Press and IARS.
6) Singh D. and Chaudhary F. S. (1986) Theory and Analysis of Sample Survey Designs, New Age International Publishers.
7) Mukhopadhay P.(2002) Theory and Methods of Sample Survey, Chpman and Hall.

Statistics for National Developement:

1) CSO.National Accounts Statistics-Sources and Health.
2) Keyfitz N.(1977)Applied Mathematical Demography, Springer Verlag.
3) UNESCO,Principles for Vital Statistics Systems,Series M-12
4) Sen A. (1977)Poverty and Inequality.
5) Datt R.,Sundharam K.P.M.(Revised edition)Indian Economy, S. Chand & company Ltd.
6) Johnson S.and Kotz (1972)Distributions in Statistics, Vol.I, II& III,Houghton and Miffin.
7) Cramer H.(1946)Mathematical Methods of Statistics, Princeton.

STT 05 **STATISTICAL COMPUTING**
(Maximum no of periods: 60)

UNIT I: Introduction: History of R programming, starting and ending R, R commands, Data types, Getting help in R, R use as calculator.

UNIT II: Descriptive Statistics: Diagrammatic representation of data, measures of central tendency, measures of dispersion, measures of skewness and kurtosis.

UNIT III: Probability and probability distributions: problems on finding basic probabilities, some special discrete distributions and continuous probability distributions, probabilities and inverse for various distributions, sketching graphs for various distributions.

UNIT IV: Statistical inference: Sampling distribution of sample means, estimation of parameters, hypothesis testing, goodness of fit tests.

UNIT V: Correlation, inference procedure for correlation coefficient, bivariate correlation, multiple correlations. Linear regression and its inference procedure.

REFRENCES

1) Normal Maltoff (2009) The art of R programming.
2) Purohit S. G., Gore S. D. and Deshmukh S. K. (2010) Statistics using R, Narosa.
3) W. John Braun, John Braun, Duncan James Murdoch(2007) First Course in Statistical Programming with R, Cambridge University Press.
4) M. D. Ugarte, A. F. Militino, A. T. Arnholt (2008) Probability and Statistics with R, CRC Press.
5) Peter Dalgaard (2008) Introductory Statistics with R, Springer.
6) Michael J. Crawley (2007) The R Book, John Wiley and Sons.