# SYLLABUS

# M. Sc. STATISTICS

**I SEMESTER**

**(For the academic year 2020-2021)**

**Paper – 1.1:** **PROBABILITY AND DISTRIBUTIONS**

**UNIT-I:** Classes of sets, field, Sigma-field, minimal sigma-field, Borel field. Limit of a sequence of sets. Measure on field, extension of measure to sigma field, Lebesgue measure, Lebesgue- Stieltjes measures. Measurable functions, Borel function, induced sigma field.

**UNIT-II:** Random variable, convergence of sequence of random variables-convergence in probability, almost surely, in the rth mean and in distribution, and their relationships. Characteristic function, properties, inversion theorem, continuity theorem, Central limit theorem, Lindberg-Levy, Liapunoff forms.

**UNIT-III:** Mathematical Expectation, Moments of random variable, conditional expectation, problem of moments. Basic Markov’s, Chebycheff’s, Holder’s, Minkowski’s and Jensen’s inequalities. Law of large numbers: Chebyshev’s and Khinchin’s forms of WLLN. Kolmogorov’s SLLN. Convergence theorems relating to Xn+Yn, XnYn and Xn/Yn where Xn  X and Yn  C.

**UNIT-IV:** Weibull and Laplace distributions-their m.g.f and c.f and other properties. Compound distributions-Poisson-Binomial. Sampling distributions: Non-Central chisquare, non central-t and non central F distributions and their properties. Distribution of quadratic forms under normality and related distribution theory.

Semester end examinations will be conducted from the syllabus of Unit I, Unit II, Unit III and Unit IV only. However, the content of **Unit V**will be evaluated as an **assignment.**

**UNIT-V:** Multivariate normal, Bivariate normal as a particular case, moments, characteristic function, conditional and marginal distributions. Distributions of Order Statistics from rectangular, exponential and Normal distributions. Empirical distribution function, distribution of correlation coefficient.

**Text Books:**

Bhat, B.R.: Modern Probability Theory.,Wiley Eastern Ltd.

Rohatgi, V.K.: AnIntroduction to Probability Theory and Mathematical Statistics, John Wiley.

Goon, A.M., Gupta, M.K., Das Gupta, B.: An Outline of Statistical Theory Volume-I, The World Press Pvt. Ltd., Calcutta.

**Reference Books:**

Billingsley, P. (1986): Probability and Measure. Wiley.

Kingman, J F C and Taylor, S. J. (1966): Introduction to Measure and Probability. Cambridge University Press.

David,H.A (1981) : Order Statistics, 2nd Ed, John Wiley.

Feller, W (1966) : Introduction to probability theory and its applications, Vol.II, Wiley

Cramer H (1946) : Mathematical Methods of Statistics, Princeton University Press

Morrison, D.F (1976) : Multivariate Statistical Methods, 2nd Ed, McGraw Hill

Mardia, K.V.,Kent J.T and Bibby J.M.(1979) : Multivariate Analysis, Academic Press.

Anderson, T.W(2003) : An introduction to Multivariate Statistical Analysis, 3rd Ed ,John Wiley

R.A.Johnson and D.W.Wichern (2007) : Applied Multivariate Statistical Analysis, 6th Ed Prentice Hall India

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# M. Sc. STATISTICS

**I SEMESTER**

**(For the academic year 2020-2021)**

Paper – 1.2: ESTIMATION THEORY

**UNIT-I:** Point Estimation: Concepts of Unbiasedness, Consistency, minimum variance unbiased estimation, Information in a sample, Cramer-Rao inequality, efficiency of an estimator, Chapman-Robin’s inequality and Bhattacharya bounds, definition of CAN estimator.

**UNIT-II:** Concept of sufficiency – single parameter and several parameter cases. Fisher-Neyman Factorization theorem, Minimal sufficient statistic, exponential families and Pitman families. Invariance property of sufficiency under 1 – 1 transformation of sample space and parameter space.

**UNIT-III:** Distributions admitting sufficient Statistics, Rao-Blackwell Theorem, Completeness, Lehman-Scheffe Theorem, joint sufficiency (regular case).

**UNIT-IV:** Method of maximum likelihood, CAN estimators for one-parameter Cramer family. Cramer-Huzurbazar theorem, solution of likelihood equations, Method of scoring. Connection between MLE’s and efficient estimators, MLE’s and sufficient estimators.

Semester end examinations will be conducted from the syllabus of Unit I, Unit II, Unit III and Unit IV only. However, the content of **Unit V**will be evaluated as an **assignment.**

**UNIT-V:** Censored and truncated distributions: Type 1 and Type 2 Censoring for normal and exponential distributions and their MLE’s. Interval estimation: Confidence Intervals, using pivots; shortest expected length confidence intervals.

**Text Books:**

Goon, A.M., Gupta, M.K., Das Gupta, B.: An Outline of Statistical Theory Volume -II, The World Press Pvt. Ltd., Calcutta.

Rohatgi, V.(1998 ): An Introduction to Probability and Mathematical Statistics, Wiley Eastern Ltd., New Delhi.

Kale, B.K.(1999) : A First Course on Parametric Inference, Narosa Publishing house.

**Reference Books:**

Lehmann, E.L. (1986) : Theory of Point Estimation. John Wiley

Rao, C.R. (1973) : Linear Statistical Inference and its applications. John Wiley

Dudewicz, E.J. and Mishra, S.N.(1988): Modern Mathematical Statistics. Wiley, Int.Student edition.

Lawless J.F (2003) : Statistical Models and Methods for Lifetime Data,2nd Ed, John Wiley & Sons.

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# M. Sc. STATISTICS

**I SEMESTER**

**(For the academic year 2020-2021)**

## Paper – 1.3: SAMPLING

**UNIT-I:** Selection with varying probabilities, PPS sampling, Horvitz and Thompson estimator, Yates and Grundy’s estimator, Midzuno -Sen Sampling Scheme.

**UNIT-II:** Systematic Sampling: Estimation of population mean and its variance, Methods for populations with linear trend: Yates end correction, Modified systematic sampling, balanced systematic sampling, centrally located sampling. Circular systematic sampling.

**UNIT-III:** Cluster sampling: Estimation of population mean and its variance, efficiency of cluster sampling. Determination of optimal cluster size. Estimation of proportion. Cluster sampling with varying sizes.

Two-stage sampling: Two-stage sampling with equal first stage units. Estimation of mean and its variance. Optimum allocation. Three stage sampling with equal probabilities. Two-stage-pps sampling.

**UNIT-IV:** Ratio estimator: Introduction, Bias and Mean square error, Estimation of variance, confidence interval, comparisons with mean per unit estimator, Ratio estimator in stratified random sampling.

Difference estimator and Regression estimator: Introduction, Difference estimator, Difference estimator in stratified sampling. Regression estimator, Comparison of regression estimator with mean per unit estimator and ratio estimator. Regression estimator in stratified sampling.

Semester end examinations will be conducted from the syllabus of Unit I, Unit II, Unit III and Unit IV only. However, the content of **Unit V**will be evaluated as an **assignment.**

**UNIT-V:** Multiphase Sampling: Introduction, Double sampling for Difference estimation

Double sampling for ratio estimation. Double sampling for regression estimator, Optimum allocation varying probability sampling. Non sampling errors: Sources and types of non Sampling errors, Non response errors, techniques for adjustment of non response, Hansen and Hurwitz Technique, Deming’s Model.

**Text Books:**

F.S. Chaudhary: Theory and Analysis of Sample Survey Designs, New Age International Publishers, Delhi.

Des Raj, Pramod Chandak (1998) : Sample survey Theory, Narosa Publishing House, Delhi

Cochran, W.G.: Sampling Techniques.

Murthy, M.N.: Sampling Theory and Methods

Primal Mukhopadhyay : Theory and Methods of Survey Sampling. Prentice-Hall of India Private limited – New Delhi.

Sukhatme, P.V. and Sukhatme, B.V.: Sampling Theory of Surveys with Applications.

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# M. Sc. STATISTICS

**I SEMESTER**

**(For the academic year 2020-2021)**

**Paper – 1.4: C - PROGRAMMING**

**UNIT-I:** Identifiers and Keywords, Data types, constants, variables and arrays, Declarations, expressions, statements, symbolic constants.

Operations and expressions: Arithmetic operators, Unary operators, relational and logical operators, Assignment operators, conditional operator, and library functions.

**UNIT-II**: Data Input and Output: getchar, putchar functions, scanf, printf, gets puts functions. Control statements: While, do-while, for, nested loops, if-else, switch, break, continue exit operator, goto statement. Functions: Definition, accessing a function, passing arguments to a function, specifying argument types, function prototypes, and recursion.

**UNIT-III**: Program Structure: Storage classes, automatic, external and static variables. Arrays: Definition, processing an array, passing arrays to a function. Multi dimensional arrays, Arrays and strings.

**UNIT-IV**: Pointers: Fundamentals, pointer declarations, passing pointers to a function, pointers and multi-dimensional arrays, operations on pointers, arrays of pointers, passing functions to other functions.

Semester end examinations will be conducted from the syllabus of Unit I, Unit II, Unit III and Unit IV only. However, the content of **Unit V**will be evaluated as an **assignment.**

**UNIT-V**: Structures and Unions: Definition, processing, structures and pointers, passing structures to a function. Data Files: Opening and closing a data file, creating, processing a data file, unformatted data files.

**Text Books:**

Programming in ANSI C (2002) : Balaguruswamy, E, Tata McGraw Hill,6th Edition.

Problem solving with C: M.T.Somasekhara, Prentice Hall India.

The C-Programming Language: Brain, W.Karnighan & Dennis, M.Reitech, Prentice Hall India Ltd.

Programming with C: Byrun, S.Gotterfield, Schism’s Outline Series, Tata McGraw Hill Edition.

Programming in C S.G. Kochan (2014) :,4th Ed, Pearson Education