## M.Sc. Statistics

## Syllabus and Examination Regulations

## WITH EFFECT FROM 2016 – 2017 ADMITTED BATCH OF STUDENTS

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Paper** | **Marks** | **Credits** |
| I | 1.1 Probability and Distributions | **80+20** | **4** |
|  | 1.2 Estimation Theory | **80+20** | **4** |
|  | 1.3 Sampling | **80+20** | **4** |
|  | 1.4 C -Programming | **80+20** | **4** |
|  |  Practical Examination (Practical 150+Record 50) |  **200** | **8** |
|  |  Viva-Voce | **25** | **1** |
|  |  **Total** | **625** | **25** |
|  |  |  |  |
| II | 2.1 Multivariate Analysis | **80+20** | **4** |
|  | 2.2 Testing of Hypothesis | **80+20** | **4** |
|  | 2.3 Stochastic Processes | **80+20** | **4** |
|  | 2.4 Design of Experiments | **80+20** | **4** |
|  |  Practical Examination (Practical 150+Record 50) | **200** | **8** |
|  |  Viva-Voce | **25** | **1** |
|  | **Total** | **625** | **25** |
| III | 3.1 Operations Research - I | **80+20** | **4** |
|  | 3.2 Computer Intensive Statistical Methods Two optional papers (3.3 and 3.4) are to be  chosen from the following four optional papers  a) Demography b) Industrial Statistics and Quality Control  c) Time Series Analysis d) Linear Models and Regression Analysis | **80+20** | **4** |
|  | 3.3 Optional Paper-1 | **80+20** | **4** |
|  | 3.4 Optional Paper-2 | **80+20** | **4** |
|  |  Practical Examination (Practical 150+Record 50) | **200** | **8** |
|  |  Viva-Voce | **25** | **1** |
|  | **Total** | **625** | **25** |
|  |  |  |  |
| IV  | 4.1 Operations Research - II | **80+20** | **4** |
|  | 4.2 Computer Programming –$C^{++}$ Two optional papers (4.3 and 4.4) are to be  chosen from the following four optional papers  a) Econometrics b) Actuarial Statistics c) Knowledge Discovery and Data Mining d) Reliability and Survival Analysis | **80+20** | **4** |
|  | 4.3 Optional Paper-1 | **80+20** | **4** |
|  | 4.4 Optional Paper-2 | **80+20** | **4** |
|  |  Practical Examination (Practical 150+Record 50)  | **200** | **8** |
|  |  Vive-Voce | **25** | **1** |
|  | **Total** | **625** | **25** |

# SYLLABUS

# M. Sc. STATISTICS

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**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.

**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

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

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.

**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

# SYLLABUS

# M. Sc. STATISTICS

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

## 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.

**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

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**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.

**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

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# M. Sc. STATISTICS

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 2.1:** **MULTIVARIATE ANALYSIS**

**UNIT-I:** Definition of Wishart matrix and its properties, Mahalanobis Distance, Null distribution of Hotelling’s T2 statistic. Application in tests on mean vector for one and more multivariate normal populations and also on equality of the components of a mean vector in a multivariate normal population.

**UNIT-II:** Classification and discrimination procedures for discrimination between two multivariate normal populations, sample discriminant function, tests associated with discriminant functions, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations. K-nearest neighbor classification.

**UNIT-III:** Principal components, Dimension reduction, Canonical variables and canonical correlation -definition, use, estimation and computation.

**UNIT-IV:**  Factor Analysis: The orthogonal factor model, Methods of estimating factor loadings - the principal component method, principal factor method, iterated principal factor method, maximum likelihood estimation. Factor rotation: orthogonal factor rotation, varimax rotation, quartimax rotation, oblique rotation, criteria for determining number of common factors. Factor scores.

**UNIT-V:** Cluster Analysis: Hierarchical Clustering, methods single, complete and average linkage methods, Centroied method and Ward’s method. Non-Hierarchical Methods- K-means algorithm. Multidimensional scaling.

**Note: Practical exercises must be based on statistical package only.**

**Text Books:**

Anderson, T. W. (1983): An Introduction to Multivariate Statistical Analysis. 3rd Ed. Wiley.

Seber, G. A. F. (1984): Multivariate observations. Wiley.

Johnson, R and Wichern(1992): Applied Multivariate Statistical Analysis, Prentice Hall, India, 6th edition.

**Reference Books:**

Gin. N. C. (1977) : Multivariate Statistical Inference. Academic Press

Kshirsagar, A. M. (1972) : Multivariate Analysis. Marcel Dekker.

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

Muirhead, R. J. (1982): Aspects of Multivariate Statistical Theory, J. Wiley.

Rao, C. R. (1973): Linear Statistical Inference and its Applications. 2nd ed. Wiley.

Sharma. S. (1996): Applied Multivariate Techniques. Wiley.

Srivastava, M. S. and K.Chatri, C. G. (1979): An Introduction to Multivariate Statistics. North Holland

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# M. Sc. STATISTICS

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 2.2: TESTING OF HYPOTHESIS**

**UNIT-I**: Neyman – Pearson theory: Lemma using critical functions. Uniformly most powerful tests, their relation with sufficient statistics.

 **UNIT-II:** Monotone Likelihood ratio and UMP tests for one-sided hypothesis, Composite hypothesis. Unbiased tests, uniformly most powerful unbiased tests. Type A and Type A1 regions.

**UNIT-III:** Likelihood ratio criterion, its asymptotic distribution, one sample, two samples and K – sample problems. Linear hypothesis. Walds’s SPRT: Proof that it terminates in a finite number of steps with probability 1. O.C. and A.S.N. functions. Examples of (i) Binomial (ii) Normal cases for testing hypothesis μ and σ2.

**UNIT-IV**: Notion of Non-Parametric test, Different N-P tests; Run test, Sign test, Wilcoxon and Mann-Whitney test, Median test; Derivation of the mean and variance of the above test statistics when null hypothesis is true.

**UNIT-V:** χ2 – test for goodness of fit, its asymptotic distribution, description of Kolmogorov-Smirnov test, Tests involving Rank correlation (Kendall’s Tau and Spearmans rank Correlation).

**Text Books:**

Rohatgi, V.K (1984) : Statistical Inference, John Wiley & Sons.

Gibbons, J.D and Chakraborti S (2003) : Non-Parametric Inference, McGraw Hill, 4th Ed. Marcel-Dekkar Inc

Wald (1973) : Sequential Analysis, Dover, Newyork.

Goon, Gupta and Das Gupta: An Outline Statistical Theory, Vol.2, The World Press Pvt.Ltd., Calcutta.

**Reference Books:**

Lehmann, E.L (1983) : Testing of Statistical Hypothesis, John Wiley & Sons.

Rao, C.R.(1972) : Linear Statistical Inference and its Applications, 2nd Ed, John Wiley & Sons.

Sidney Siegel (1956) : Non Parametric Statistics for the Behavioral Sciences,McGraw Hill,Tokyo.

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# M. Sc. STATISTICS

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper – 2.3: STOCHASTIC PROCESSES

**UNIT-I**: Introduction to Stochastic processes; classification of Stochastic processes according to state space and time domain. Countable state Markov chains (MC’s), Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit. Classification of states, period of a state. Stationary distribution of MC.

**UNIT-II**: Random walk and gambler’s ruin problem; Random walk in one and two dimensions. Gambler’s ruin problem, probability of ultimate ruin, expected duration of the game.

**UNIT-III**: Discrete state space continuous time MC: Poisson process and its properties, birth process, death process and birth and death process.

**UNIT-IV**: Wiener process as a limit of random walk and some elementary properties of Wiener process. Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size.

**UNIT-V**: Renewal theory: Elementary renewal theorem and applications. Study of residual and excess life times and their distributions. Stationary process: weakly stationary and strongly stationary processes.

**Text Books:**

Medhi J. (1994): Stochastic Processes.2nd Ed, New Age, New Delhi

Bhat, B.R. (2000): Stochastic Models: Analysis and Applications, New Age International India

Basu. A.K.(2003) :Introduction to Stochastic Process,Narosa,Chennai.

Srinivasan S.K and Mehta K.M (1981) : Stochastic Process

**Reference Books:**

Adke, S.R. and Manjunath, S.M. (1984): An Introduction to Finite Markov Processes, Wiley Eastern.

Cinlar, E. (1975): Introduction to Stochastic Processes, Prentice Hall.

Feller, W. (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern

Hoel, P.G… Port, S.G. and Stone, C.J (1972): Introduction to Stochastic Process, Houghton Miffin & Go.

Karlin, S. and Taylor, H.M. (1975): A First Course in Stochastic Processes, Vol. 1.

Parzen, E. (1962): Stochastic Processes, Holden-Day.

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# M. Sc. STATISTICS

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper-2.4: DESIGN OF EXPERIMENTS

**UNIT-I**: Principles of designs, analysis of variance and analysis of Co-variance, fixed and random effect models. Contrasts. Model Adequacy checking: Test for Normality, Test for equality of Variances (Bartlett test, Modified Levene method)

**UNIT-II**: C.R.D., R.B.D., Estimation of parametric functions and tests of hypothesis. Comparison of their efficiencies. Missing plot techniques, testing the equality of subsets of block effects or treatment effects. Multiple comparisons tests: Tukey’s test, The Fisher Least significant Difference (LSD) method, Duncans Multiple range test.

**UNIT-III**: L.S.D., Orthogonality in L.S.D., Missing plot technique, Analysis of spilt plot design.

**UNIT-IV:** Factorial Designs: Analysis of 2n and 32 designs. Estimation of factorial effects. Testing their significance, Total and Partial confounding.

**UNIT-V:** Youden Square design, intra block analysis. B.I.B.D., P.B.I.B.D., their analysis - estimation of parameters, tests of hypothesis.

**Text Books:**

Das. M.N. and Giri, N.C.: Design and Analysis of Experiments, New Age International (P) Ltd.

Montgomery, D.C.: Design and Analysis of Experiments, John Wiley & Sons, New York.

**Reference Books:**

Cochran & Cox: Experimental Designs, Asia Publishing House, Bombay.

Oscar Kempthorne (1975): The Design and Analysis of Experiments, Wiley – Eastern Pvt. Ltd, New Delhi.

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 3.1: OPERATIONS RESEARCH – I**

**UNIT-I:** Definition and scope of Operational research. Phases in Operations Research. Models and their solutions. Linear Programming: Graphical, Simplex, Revised simplex methods. Duality, sensitivity analysis.

**UNIT-II:** Transportation and assignment problems. Sequencing and scheduling problems: 2 machine n-job and 3- machine n-job problems with identical machine sequence for all jobs; 2- job n-machine problem with different routings.

**UNIT-III:** Analytical structure of inventory problem: EOQ formula of Harris, its sensitivity analysis and extensions allowing quantity discounts and shortages. Multi-item inventory subject to constraints. Models with random demand, the static risk model, P and Q- systems with constant and random lead times.

**UNIT-IV:** S-s policy for inventory and its derivation in the case of exponential demand; multi-echelon inventory models. Queuing models: specifications and effectiveness measures. Steady-state solutions of M/M/1 and M/M/C models with associated distributions of queue length and waiting time.

**UNIT-V:** M/G/1 queue and Pollazcek- Khinchine result. Steady-state solutions of M/Ek/1 and Ek/M/1 queues. Machine interference problem. Bulk queues (bulk arrival and bulk service); finite queues; queues in tandem; GI/G/1 queue and its solution; simulation of queues.

**Text Books:**

Kanti Swarup, Gupta, P.K and Man Mohan (1985): Operation Research; Sultan Chand & Sons

J.K. Sharma (2003): Operation Research Theory and Applications; MCC Millan India

S.D. Sharma: Operation Research. Kedarnath Ramnath Publishers. Meerut.

**Reference Books:**

Taha H.A (1982) Operational Research: An Introduction; Macmillan.

Hillier F.S. and Leiberaman G.J. (1962) Introduction to Operations Research; Holden Dav.

Churchman C.W., Ackoff R.L. and Amoff E.L. (1957): Introduction to Operations Research, John Wiley.

Gross, D. and Harris, C.M. (1974): Fundamentals of Queuing Theory, John Wiley.

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper - 3.2 COMPUTER INTENSIVE STATISTICAL METHODS**

**UNIT-I:** Stochastic simulation: generating random variables, simulating multivariate distributions, simulating stochastic processes such as simple queues.

**UNIT-II:** Variance reduction: importance sampling for integration, control variates and antithetic variables.

**UNIT-III:** Markov Chain Mote Carlo methods: Gibbs sampling for multivariate simulation, simulated annealing for optimization.

Simulation based testing: simulating test statistics and power functions, permutation tests.

**UNIT-IV:** Bootstrap methods: re-sampling paradigms, bias and standard errors, confidence intervals, bootstrapping in regression.

**UNIT-V:** Jackknife and cross-validation: Jackknife in sample surveys, cross-validation for tuning parameters.

**Text Books:**

Rubinstein (1981): Simulation and the Monte Carlo Method. Wiley.

M.A. Tanner (1996): Tools for Statistical Inference, Third Edition. Springer.

B. Efron and R.J. Tibshirani (1993): An Introduction to the Bootstrap. Chapman and Hal.

J. Shao and D.Tu (1995): The Jackknife and the Booststrap. Springer Verlag.

R. Gnanadesikan (1997): Methods for Statistical Data Analysis of Multivariate Observations, Second edition. Wiley

**Reference Books:**

G.S. Fishman (1996): Monte Carlo: Concepts, Algorithms, and Applications. Springer. R.Y.

D.A. Belsley, E. Kuh, and R.E. Welsch (1980): Regression Diagnostics. Wiley.

P.MeCullagh and J.A. Nelder(1999): Generalized Liner Models, 3rd ed.Chapman & Hall.

G.A.F. Seber and C.J. Wild (1989); Nonlinear Regrerssion.Wiley.

G.J McLachlan and T. Krishnan (1997): The EM Algorithms and Extensions. Wiley.

J.S.Simonoff (1996): Smoothing Methods

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (a): DEMOGRAPHY**

**UNIT-I:** Scope and content of population census of India. Population, Composition, Dependency ratio. Brief Coverage and content errors in demographic data. Adjustment of age data – use of Whipple, Myer and UN indices. Chandrasekhar – Deming formula to check completeness of registration data.

**UNIT-II:** Measures of fertility: Stochastic models for reproduction, (Dandekar`s Modified Binomial and Poisson distributions, William Brass Model), distributions of time to first birth, inter-live birth intervals and number of births.

**UNIT-III:** Measures of Mortality: Construction of abridged life tables (lx–linear, exponential, Reed and Merrell`s, Grevill′s) Relations between functions of Life Tables. Distributions of life table functions.

**UNIT-IV:** Stable and quasi-stable populations, intrinsic growth rate. Methods for population projection. Use of Leslie matrix.

**UNIT-V:** Models for population growth and their fitting to population data. Linear, Exponential, logarithmic, modified logarithmic, Gompertz and Logistic Curves. Stochastic models for population growth (Pure Birth Model, Simple Birth & Death Model, Birth, death and migration model).

**Text Books:**

Sudhendra Biswas (1995): Applied Stochastic Processes, New Age International Publishers Ltd.

Pathak, K.B. & Ram, F. (1998): Techniques of Demographic Analysis, Himalays

Publishers

K.Srinivisan (1998): Basic Demographic Techniques and Applications: Sage publications.

Asha A bhande, Tara Kanitkar (2004): Principales of Population Studies; Himalayas publishing House.

**Reference Books:**

Saxena H.C and Surrendran P.U: Statistical Inference.

Bartholomew, D.J.(1982): Stochastic Models for Social Processes, John Wiley.

Benjamin, B. (1969): Demographic Analysis, Geprge. Allen and Unwin.

Chain, C.L (1968): Introduction to Stochastic Processes in Biostatisties; John Wiley.

Cox, P.R. (1970): Applied Mathematical Demography, Sprinmger Verlag.

Spiegelman, M. (1969): Introduction to Demographic Analysis; Harvard University Press.

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (b): INDUSTRIAL STATISTICS AND QUALITY CONTROL**

**UNIT-I:** General Theory of Control Charts: Control charts for attribute and variables: O.C. and A.R.L. of control charts; control by gauging; Moving average and exponentially weighted moving average charts;

**UNIT-II:** Cu-sum charts using V-masks and decision intervals. Capability indices: Cp, Cpk and Cpm.

**UNIT-III:** Acceptance sampling plans for attribute inspection: Single, double and sequential sampling plans; Plans for inspection by variables for one-sided and two-sided specifications;

**UNIT-IV:** Mil Std and ISI plans; Continuous sampling plans of Dodge type and Wald-Wolfwitz type and their properties.

**UNIT-V:** Industrial Experimentation: Transfer Functions, Fractional factorial experiments, Response surface methodology.

**Text Books:**

Cowden D J (1957): Statistical Methods in Quality Control. 1st Edition. Prentice-Hall Inc.

Duncan Acheson (1986): Quality Control and Industrial Statistics. 5th Edition. Irvin

Mittag and Rinne (1993): Statistical Methods for Quality Assurance. 2nd Edition. Chapman & Hall Ltd.

Montgomerv. D.C (2012): Introduction to Statistical Quality Control. 7th Edition. John Wiley and Sons

R.C. Guptha(2001): Statistical Quality Control. 9th Edition. Khanna Publishers.

**Reference Books:**

Ott. E.R. (1975): Process Quality Control. 4th Edition. Mc Graw Hill

Phadke, M.S. (1989): Quality Engineering through Robust Design. 1st Edition. Prentice Hall

Wetherill, G.B. (1977): Sampling Inspection and Quality Control. 2nd Edition. Chapman & Hall Ltd.

Wetherill, G.B. and Brown, D.W.(1991): Statistical Process Control. Theory and Practice. 3rd Edition. Chapman & Hall Ltd.

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (c): TIME SERIES ANALYSIS**

**UNIT-I:** Time-series as discrete parameter stochastic process. Auto covariance and autocorrelation functions and their properties. Exploratory Time Series Analysis, Tests for trend.

**UNIT-II:** Exponential and Moving Average Smoothing. Holt and winters smoothing.

Forecasting based on smoothing, Adaptive smoothing.

**UNIT-III:** Detailed study of the stationary process: (1) moving average (MA), (2) Auto

Regressive (AR), (3) ARMA and (4) AR Integrated MA (ARIMA) models.

**UNIT-IV:** Box – Jenkins models. Discussion (without proof) of estimation of mean, auto covariance and autocorrelation functions under large sample theory. Choice of AR and MA periods. Estimation of ARIMA model parameters. Forecasting. Residual analysis and diagnostic checking.

**UNIT-V:** Spectral analysis of weakly stationary process. Periodgram and correlogram analyses. Computations based on Fourier transform.

**Text Books:**

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.V.

Makridakis, Wheelwright and Mc Gee: Forecasting-Methods and Applications, John Willey & sons.

Montgomery, D.C. and Johnson, L.A.(1977): Forecasting and Time Series Analysis,

McGraw Hill

**Reference Books:**

Fuller. W.A. (1976): Introduction to Statistical Time Series, John Wiley,

N.V. Granger, C.W.J. and Newblod (1984): Forecasting Econometric Time Series, 3rd Edition, Academic Press.

Priestley, M.B. (1981): Spectral Analysis and Time Series, Griffin, London.

Kendall, Sir Maurice and Ord, J.K. (1990): Time Series Analysis. 3rd edition Edward

Kendall, M.G. and Stuart A. (1966): The Advanced Theory of Statistics, Volume 3,

Charles Griffin. London

Blooinficld, P. (1976): Fourier Analysis of Time Series – An Introduction, wiley.

Granger, C.W.J. and Hatanka, M. (1964): Spectral Analysis of Economic Time Series,

Princeton Univ. Press. N.J.

Koopmans, L.H.(1974): The Spectral Analysis of Time Series, Academic Press.

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# M. Sc. STATISTICS

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (d): LINEAR MODELS AND REGRESSION ANALYSIS**

**Unit I:** Gauss-Markov set-up, Normal equations and Least squares estimates, variances and covariances of least squares estimates, estimation of error variance.

**Unit II:** Estimation with correlated observations, least squares estimates with restriction on parameters, simultaneous estimates of linear parametric functions.

**Unit III:** Tests of hypotheses for one and more than one linear parametric functions, confidence intervals and regions Analysis of Variance.

**Unit IV:** Simple linear regression, multiple regression, fit of polynomials and use of orthogonal polynomials.

**Unit V:** Multicollinearity, Ridge regression and principal component regression, subset selection of explanatory variables.

**Text Books:**

Graybill, F.A.(1983): Matrices with Applications in Statistics. Wadsworth.

Draper, N.R. and Smith, H (1998): Applied Regression Analysis. 3rd Edition. Wiley-Blackwell.

Douglas C. Montgomery, Elizabeth A. Peck and G. Geoffrey Vining(2012): Introduction to Linear Regression Analysis – 5th Edition. Wiley

Goon Gupta and Das Gupta(2003): An outline of Statistical Theory. Volume II. The World Press Pvt. Ltd.

**Reference Books:**

Bapat.R.B.(2012): Linear Algebra and Linear Models. 3rd Edition. Springer.

Cook, R.D. and Weisberg, S. (1983): Residual and Influence in Regression. 1st Edition. Chapman & Hall.

Johnson, J. (1996): Econometric Methods, 4th Edition. McGraw Hill.

Rao, C.R. (2002): Linear Statistical Inference and Its Applications. 2nd Edition. Wiley-Blackwell.

Weisberg, S. (2013): Applied Linear Regression. 4th Edition. Wiley.

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# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 4.1: OPERATIONS RESEARCH** **–II**

**UNIT-I:** Decision Theory: Decision theory approach, Decision theory under unertainty, under risk, posterior probabilities and Bayesian analysis, Decision tree analysis, Decision making with utilities.

**UNIT-II:** Game Theory: Two-person games, pure and mixed strategies, existence of solution and uniqueness of value in zero-sum games, finding solutions in 2x2, 2xm and mxn games. Dynamic Programming.

**UNIT-III:** Integer programming-branch and bound algorithm and cutting plane algorithm. Multi-criterion and goal programming. Replacement problems; block and age

**UNIT-IV:** Project management; PERT and CPM; probability of project completion, crashing.

**UNIT-V:** Information Theory: Communication Process, Entropy, Channel capacity, Efficiency, Redundancy, Shannon-Fano encoding procedures. Non- linear programming: Kuhn Tucker conditions, Wolfe and Beadle’s algorithms for solving quadratic programming problems.

**Text Books:**

Kanti Swaruup, Gupta, P.K and Man Mohan (2000): Operations Research; Sultan Chand & Sons

J.K. Sharma (2003): Operations Research- Theory and Applications; Mac Millan, India

S.D. Sharma: Operations Research, Kedarnath Ramnath Publishers. Meerut.

**Reference Books:**

Taha H.A. (1982): Operational Research-An Introduction; Macmillan.

Hillier F.S. and Leiberman G.J. (1962): Introduction to Operations Research

Holden Dav. Churchman C.W., Ackoff, R.L. and Arnoff, E.L. (1957): Introduction to Operations Research, John Wiley.

Gross, D. and Harris,C.M. (1974): Fundamentals of Queuing Theory, John Wiley.

# SYLLABUS

# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**PAPER – 4.2: COMPUTER PROGRAMMING – C++**

**UNIT-I:** Object oriented programming principles, Declaration of classes, array of classes, Pointer to classes, constructors such as void constructor, copy constructor, Destructor,

**UNIT-II:** Friend functions, inline functions, static class members, this pointer, Single, Multiple inheritances: Types of derivation such as public, private, protected inheritance and member access controls, ambiguity in inheritance,

**UNIT-III:** Virtual base class, container classes. Function overloading, Operator Overloading, Overloading of assignment, binary, unary operators.

**UNIT-IV:** Polymorphism, Early binding, virtual functions, Late binding, pure virtual functions, abstract base classes, constructor under inheritance, destructor under inheritance, virtual destructors.

**UNIT-V:** Templates and Exception Handling. Data File operations, structures and file operations, classes and file operations.

**Text Books:**

Deital & Deital: C++; Prentice-Hall Inc

Sinan Si Alhir, Oreilly :UML

Sarang: Object Oriented programming with C++; Prentice-Hall Inc

Balaguruswamy, E : Programming with C++; Tata Mc Graw hill.

**Reference Books:**

R.Decker and So Hirshfield (1998): The Object Concept: An Introduction to Computer Programming using C++; PWS Publishing.

S.B.Lippmann and J.Lajoie (1998): C++ Primer. Third edition. Addison- Wesley. P.Nauahton (1996). The Java Handbook. Tata McGraw-Hill

W.J. Savitch (2001): Problem Solving with C++ The Object of Programming. Third Edition. Addison-Wesley Longman.

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# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (a): ECONOMETRICS**

**UNIT-I:** Nature and scope of Econometrics. General linear model: Assumptions, O.L.S method of estimation, Tests of hypothesis, Confidence intervals, Prediction, Estimation subject to linear restrictions, Maximum Likelihood estimator.

**UNIT-II:** Tests of structural change; Dummy variables and seasonal adjustments, Equality of two regressions equations, Specification errors; Estimation methods.

**UNIT-III:** Generalized Least squares: Aitken estimators, Heteroskedasticity: Goldfield – Quandt test, Park test, Weighted least square method of estimation. Autocorrelation: Detection by Durbin- Watson statistic, Estimation methods (Cochran Orcutt and Durbin′s methods of estimation) SUR system of equations.

**UNIT-IV:** Lagged Variables: Distributed lag models: Koyck approach, Adaptive Expectations Model, Stock Adjustments Models, Almon`s approach. Errors in Variables.

**UNIT-V:** Simultaneous Equation Models: Structural form, Reduced form and recursive form, Identification Problems, Order and Rank conditions, Methods of Estimation: ILS, 2SLS, IV, LIML and 3SLS.

**Text Books:**

Gujarthi, D(1979): Basic Econometrics, McGraw Hill.

Johnston. J. (1984): Econometric methods, Third edition, McGraw Hill

Koutsoyiannis, A (1979): Theory of Econometrics, Macmillan Press

Theil. H (1982): Introduction to the Theory and Practice of Econometrics, John Wiley.

**Reference Books:**

Apte P.G. (1990): Textbook of Econometrics. Tate McGraw Hill

Cramer. J.S. (1971): Empirical Econometrics. North Holland.

Intrilligator, M.D. (1980): Econometric models – Techniques and Applications, Prentice Hall of India.

Klein, L.R.(1962): An introduction to Econometrics, Prentice Hall of India

Mai Invaud, E (1966): Statistical Methods of Econometrics, North Holland

Srivastava, V.K. and. Giles D.A.E (1987): Seemingly Unrelated Regression Equation Models, Marcel Dekker.

Walters, A (1970): An Introduction to Econometrics. McMillan & Go,

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# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (b): ACTUARIAL STATISTICS**

**UNIT-I:** Theory of Interest rates: Rate of interest; Nominal rate of interest. Accumulation factors. Force of interest, present values, stoodley formula for the force of interest, present value of cash flows, valuing cash flows. Basic compound interest function, equations of values and yield on transaction-annuities certain, present values and accumulation, concepts of different annuities, continuously payable annuities, varying annuities.

**UNIT-II:** Utility theory, insurance and utility theory, models for individual claims and their sums, Approximations for the distribution of the sum. Application to insurance. Survival function Time until-death for a person age x, curate future lifetime, force of mortality.

**UNIT-III:** Life table and its relation with survival function, examples, the deterministic survivorship group, recursion formulas, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

**UNIT-IV:** Life insurance: Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance, Life annuities: Single payment, continuous life annuities, discrete life annuities, Life annuities with mth monthly payments, recursions, complete annuities-immediate and apportionable annuities-due.

**UNIT-V:** Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions, evaluation for special mortality laws. Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrements, central force assumptions for multiple decrements. Uniform distribution assumption for multiple decrements.

**Text Books:**

N.L. Bowers, H.U. Gerber, J.C. Hickman, D.A.Jones and C.J.Nesbitt, (1986): Actuarial Mathematics, Society of Actuaries, Ithaca, llliois, U.S.A.Second Edition (1997)

Chapters: 1,2,3,4,5,9 &10

J.J.Mccutcheon and W.F.Scott: An Introduction to Mathematics of Finance, Butter Worth & Heinemann

**Reference Books:**

Spurgeon E.T.(1972): Life Contingencies, Cambridge University Press.

Neill A (1977) Life Contingencies, Heinemann

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# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (c): KNOWLEDGE DISCOVERY AND DATA MINING**

**UNIT-I:** Review of classification methods from multivariate analysis; classification and decision trees.

**UNIT-II:** Clustering methods from both statistical and data mining viewpoints; vector quantization.

**UNIT-III:** Unsupervised learning from univariate and multivariate data; dimension reduction and feature selection.

**UNIT-IV:** Supervised learning from moderate to high dimensional input spaces; regression trees.

**UNIT-V:** Introduction to databases, including simple relational databases; data warehouses and introduction to online analytical data processing. Association rules and prediction; data attributes.

**Text Books:**

A.Berson and S.J. Smith (1997): Data Warehousing, Data Mining and OLAP. McGraw-Hill.

L.Breiman, J.H. Friedman, R.A. Olshen, and C.J.Stone (1984): Classification Regression Trees. Taylor Francis.

J.Han and M. Kamber (2006): Data Mining; Concepts and Techniques. 2nd Edition. Morgan Kaufmann.

T.M. Mitchell (2011): Machine Learning. Springer.

**Reference Book:**

B.D.Ripley (2008): Pattern Recognition and Neural Networks. Cambridge University Press.

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# M. Sc. STATISTICS

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (d): RELIABILITY AND SURVIVAL ANALYSIS**

**UNIT-I:** Reliability concepts and measures; components and systems; coherent systems; reliability of coherent systems; cuts and paths; modular decomposition; bounds on system reliability; structural and reliability importance of components.

**UNIT-II:** Life distributions; reliability function; hazard rate; common life distributions-exponential Weibull, gamma etc. Estimation of parameters and tests in these models.

**UNIT-III:** Notions of ageing; IFR, IFRA, NBU, DMRL, and NBUE Classes and their duals; loss of memory property of the exponential distribution; closures or these classes under formation of coherent systems, convolutions and mixtures.

**UNIT-IV:** Univariate shock models and life distributions arising out of them; bivariate shock models; common bivariate exponential distributions and their properties.

**UNIT-V:** Reliability estimation based on failure times in variously censored life tests and in tests with replacement of failed items; stress-strength reliability and its estimation. Maintenance and replacement policies; availability of repairable systems.

**Text Books:**

Barlow R.E. and Proschan F.(1985): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.

Lawless J.F. (2002): Statistical Models and Methods of Life Time Data. 2nd Edition. John Wiley.

Bain L.J. and Max Engelhardt (1991): Statistical Analysis of Reliability and Life Testing Models. 2nd Edition. CRC Press.

Nelson, W (2003): Applied Life Data Analysis; Wiley Interscience.

## M.Sc Statistics With Computer Science

## Syllabus and Examination Regulations

## WITH EFFECT FROM 2016 – 2017 ADMITTED BATCH OF STUDENTS

|  |  |  |  |
| --- | --- | --- | --- |
| **Semester** | **Paper** | **Marks** | **Credits** |
| I | 1.1 Probability & Distributions | **80+20** | **4** |
|  | 1.2 Estimation Theory | **80+20** | **4** |
|  | 1.3 Sampling | **80+20** | **4** |
|  | 1.4 C -Programming | **80+20** | **4** |
|  | 1.5 Practical Examination (Pract.150+Rec.50) | **200** | **8** |
|  | 1.6 Viva-Voce | **25** | **1** |
|  |  **Total** | **625** | **25** |
|  |  |  |  |
| II | 2.1 Multivariate Analysis | **80+20** | **4** |
|  | 2.2 Testing of Hypothesis | **80+20** | **4** |
|  | 2.3 Stochastic Processes | **80+20** | **4** |
|  | 2.4 Design of Experiments | **80+20** | **4** |
|  |  Practical Examinations (Prac.150+Rec.50) | **200** | **8** |
|  |  Viva-Voce | **25** | **1** |
|  | **Total** | **625** | **25** |
| III | 3.1 Computer Organization & Architecture | **80+20** | **4** |
|  | 3.2 Data Structures Using CTwo optional papers (3.3 and 3.4) are to be chosen from the following four optional papers a) Client Server Technology and Applications b) Object Oriented Programming In C++ and  Unified Modelling Languagec) Knowledge Discovery and Data Mining d) Industrial Statistics and Quality Control | **80+20** | **4** |
|  | 3.3 Optional paper-1 | **80+20** | **4** |
|  | 3.4 Optional paper-2 | **80+20** | **4** |
|  |  Practical Examinations (Prac.100+Rec.50) | **150** | **6** |
|  |  Viva-Voce | **25** | **1** |
|  | **Total** | **575** | **23** |
|  |  |  |  |
| IV  | 4.1 Forecasting Methods | **80+20** | **4** |
|  | 4.2 Visual Application DevelopmentTwo papers (4.3 and 4.4) are to be chosen from the following four optional papers a) Distributed JAVA Objectsb) VB.NETc) Reliability and Survival Analysis d) Computer Intensive Statistical Methods | **80+20** | **4** |
|  | 4.3 Optional paper-1 | **80+20** | **4** |
|  | 4.4 Optional paper-2 | **80+20** | **4** |
|  |  Project Work | **100** | **4** |
|  |  Practical Examination (Prac.100+Rec.50) | **150** | **6** |
|  |  Viva-Voce | **25** | **1** |
|  | **Total** | **675** | **27** |

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**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.

**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

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

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.

**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

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

## 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.

**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.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER I**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**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.

**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

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 2.1:** **MULTIVARIATE ANALYSIS**

**UNIT-I:** Definition of Wishart matrix and its properties, Mahalanobis Distance, Null distribution of Hotelling’s T2 statistic. Application in tests on mean vector for one and more multivariate normal populations and also on equality of the components of a mean vector in a multivariate normal population.

**UNIT-II:** Classification and discrimination procedures for discrimination between two multivariate normal populations, sample discriminant function, tests associated with discriminant functions, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations. K-nearest neighbor classification.

**UNIT-III:** Principal components, Dimension reduction, Canonical variables and canonical correlation -definition, use, estimation and computation.

**UNIT-IV:**  Factor Analysis: The orthogonal factor model, Methods of estimating factor loadings - the principal component method, principal factor method, iterated principal factor method, maximum likelihood estimation. Factor rotation: orthogonal factor rotation, varimax rotation , quartimax rotation, oblique rotation, criteria for determining number of common factors. Factor scores.

**UNIT-V:** Cluster Analysis: Hierarchical Clustering, methods single, complete and average linkage methods, Centroied method and Ward’s method. Non-Hierarchical Methods- K-means algorithm. Multidimensional scaling.

**Note: Practical exercises must be based on statistical package only.**

**Text Books:**

Anderson, T. W. (1983): An Introduction to Multivariate Statistical Analysis. 3rd Ed. Wiley.

Seber, G. A. F. (1984): Multivariate observations. Wiley.

Johnson, R and Wichern(1992): Applied Multivariate Statistical Analysis, Prentice Hall, India, 6th edition.

**Reference Books:**

Gin. N. C. (1977) : Multivariate Statistical Inference. Academic Press

Kshirsagar, A. M. (1972) : Multivariate Analysis. Marcel Dekker.

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

Muirhead, R. J. (1982): Aspects of Multivariate Statistical Theory, J. Wiley.

Rao, C. R. (1973): Linear Statistical Inference and its Applications. 2nd ed. Wiley.

Sharma. S. (1996): Applied Multivariate Techniques. Wiley.

Srivastava, M. S. and K.Chatri, C. G. (1979): An Introduction to Multivariate Statistics. North Holland

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 2.2: TESTING OF HYPOTHESIS**

**UNIT-I**: Neyman – Pearson theory: Lemma using critical functions. Uniformly most powerful tests, their relation with sufficient statistics.

 **UNIT-II:** Monotone Likelihood ratio and UMP tests for one-sided hypothesis, Composite hypothesis. Unbiased tests, uniformly most powerful unbiased tests. Type A and Type A1 regions.

**UNIT-III:** Likelihood ratio criterion, its asymptotic distribution, one sample, two samples and K – sample problems. Linear hypothesis. Walds’s SPRT: Proof that it terminates in a finite number of steps with probability 1. O.C. and A.S.N. functions. Examples of (i) Binomial (ii) Normal cases for testing hypothesis μ and σ2.

**UNIT-IV**: Notion of Non-Parametric test, Different N-P tests; Run test, Sign test, Wilcoxon and Mann-Whitney test, Median test; Derivation of the mean and variance of the above test statistics when null hypothesis is true.

**UNIT-V:** χ2 – test for goodness of fit, its asymptotic distribution, description of Kolmogorov-Smirnov test, Tests involving Rank correlation (Kendall’s Tau and Spearmans rank Correlation).

**Text Books:**

Rohatgi, V.K (1984) : Statistical Inference, John Wiley & Sons.

Gibbons, J.D and Chakraborti S (2003) : Non-Parametric Inference, McGraw Hill, 4th Ed. Marcel-Dekkar Inc

Wald (1973) : Sequential Analysis, Dover, Newyork.

Goon, Gupta and Das Gupta: An Outline Statistical Theory, Vol.2, The World Press Pvt.Ltd., Calcutta.

**Reference Books:**

Lehmann, E.L (1983) : Testing of Statistical Hypothesis, John Wiley & Sons.

Rao, C.R.(1972) : Linear Statistical Inference and its Applications, 2nd Ed, John Wiley & Sons.

Sidney Siegel (1956) : Non Parametric Statistics for the Behavioral Sciences,McGraw Hill,Tokyo.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper – 2.3: STOCHASTIC PROCESSES

**UNIT-I**: Introduction to Stochastic processes; classification of Stochastic processes according to state space and time domain. Countable state Markov chains (MC’s), Chapman-Kolmogorov equations; calculation of n-step transition probability and its limit. Classification of states, period of a state. Stationary distribution of MC.

**UNIT-II**: Random walk and gambler’s ruin problem; Random walk in one and two dimensions. Gambler’s ruin problem, probability of ultimate ruin, expected duration of the game.

**UNIT-III**: Discrete state space continuous time MC: Poisson process and its properties, birth process, death process and birth and death process.

**UNIT-IV**: Wiener process as a limit of random walk and some elementary properties of Wiener process. Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size.

**UNIT-V**: Renewal theory: Elementary renewal theorem and applications. Study of residual and excess life times and their distributions. Stationary process: weakly stationary and strongly stationary processes.

**Text Books:**

Medhi J. (1994): Stochastic Processes.2nd Ed, New Age, New Delhi

Bhat, B.R. (2000): Stochastic Models: Analysis and Applications, New Age International India

Basu. A.K.(2003) :Introduction to Stochastic Process,Narosa,Chennai.

Srinivasan S.K and Mehta K.M (1981) : Stochastic Process

**Reference Books:**

Adke, S.R. and Manjunath, S.M. (1984): An Introduction to Finite Markov Processes, Wiley Eastern.

Cinlar, E. (1975): Introduction to Stochastic Processes, Prentice Hall.

Feller, W. (1968): Introduction to Probability and its Applications, Vol. 1, Wiley Eastern

Hoel, P.G… Port, S.G. and Stone, C.J (1972): Introduction to Stochastic Process, Houghton Miffin & Go.

Karlin, S. and Taylor, H.M. (1975): A First Course in Stochastic Processes, Vol. 1.

Parzen, E. (1962): Stochastic Processes, Holden-Day.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER II**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper-2.4: DESIGN OF EXPERIMENTS

**UNIT-I**: Principles of designs, analysis of variance and analysis of Co-variance, fixed and random effect models. Contrasts. Model Adequacy checking: Test for Normality, Test for equality of Variances (Bartlett test, Modified Levene method)

**UNIT-II**: C.R.D., R.B.D., Estimation of parametric functions and tests of hypothesis. Comparison of their efficiencies. Missing plot techniques, testing the equality of subsets of block effects or treatment effects. Multiple comparisons tests: Tukey’s test, The Fisher Least significant Difference (LSD) method, Duncans Multiple range test.

**UNIT-III**: L.S.D., Orthogonality in L.S.D., Missing plot technique, Analysis of spilt plot design.

**UNIT-IV:** Factorial Designs: Analysis of 2n and 32 designs. Estimation of factorial effects. Testing their significance, Total and Partial confounding.

**UNIT-V:** Youden Square design, intra block analysis. B.I.B.D., P.B.I.B.D., their analysis - estimation of parameters, tests of hypothesis.

**Text Books:**

Das. M.N. and Giri, N.C.: Design and Analysis of Experiments, New Age International (P) Ltd.

Montgomery, D.C.: Design and Analysis of Experiments, John Wiley & Sons, New York.

**Reference Books:**

Cochran & Cox: Experimental Designs, Asia Publishing House, Bombay.

Oscar Kempthorne (1975): The Design and Analysis of Experiments, Wiley – Eastern Pvt. Ltd, New Delhi.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 3.1: COMPUTER ORGANISATION AND ARCHITECTURE**

**UNIT-I:** Number Systems, Binary, Octal, Hexadecimal systems, binary arithmetic, Character codes,

**UNIT-II:** Error detection, correction, logic gates, simplification of Boolean expressions, half and full adders,

**UNIT-II:** Multiplexer, decoder, encoder, flip flops, counters Basic computer organization, Instruction formats addressing modes, Fetch, Decode Instruction cycles.

**UNIT-IV:** IO architecture, program controller, interrupts DMA transfers. Priority interrupts.

**UNIT-V:** Memory organization, Hierarchy, cache, associative, Virtual Memory, Demand paging concepts.

**Reference Books:**

Moris Mano: Computer Organization and Architecture, Pearson Education, New Delhi.

Moris Mano: Digital Logic Design, Pearson Education, New Delhi.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper – 3.2: DATA STRUCTURES USING “C”

**UNIT-I:** Introduction to Algorithms, Deterministic, Non deterministic, Random algorithms. Principles of programming methodology, stepwise refinement, concepts of structured programming, Efficiency of algorithms. Salient features of recursion and iteration.

**UNIT-II:** Introduction to data structures, classification, linear arrays, One way, Two way linked lists, circular linked lists. Operations such as traversal, insertion, deletion, searching. Algorithms for binary search, merging of sorted arrays.

**UNIT-III:** Linear and linked representations of stacks and queues, circular queues, Queues and priority queues. Applications such as Conversion of infix to postfix expression, evaluation of expressions. Conversion of recursion to non recursion, etc. Garbage collection. Hashing and collision resolution methods.

**UNIT-IV:** Trees, Traversal algorithms, binary search tree, Heap, conversion of a general tree to binary tree, Thread tree, Btree applications, tiries.

Graphs and applications, linear, linked Representation, power matrices, Graph traversals such as BFS, DFS, Prim’s, Kruskal algorithms for Minimum Spanning tree construction. Warshal algorithm and Floyd algorithms.

**UNIT-V:** Programming the sorting problems such as Bubble, insertion, selection, Quick sort, Merge sort.

Time complexity of sorting, searching algorithms.

**Reference Books:**

Horowitz and Sahni: Data Structures, Galgotia Pub.

Tanenbaurm et.al.: Data Structures Using C, Prentice Hall India, Ltd.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (a): CLIENT SERVER TECHNOLOGY AND** **APPLICATIONS**

**UNIT-I:** Evolution of corporate computing models, Mainframe, mini, personal network, file server models.

Benefits of client server model and its scalability.

**UNIT-II:** The server in client server, Data base servers, Oracle Database, Tables, Views, Table spaces, Data integrity, Encoding the data integrity, Managing the data concurrency, ensuring the data security.

**UNIT-III:** The client in client server, User interlaces, CUI, GUI interfaces, OOPS concepts. Between client and server the networking issues, Middle ware, types of middleware such as DCE, RPC, MOM object oriented development with client server, DML, DDL, DCL statements of SQL, constraints such as primary and foreign key, SQL functions, nested queries, role of a DBA.

**UNIT-IV:** Structure of relational and object oriented databases, Code Rules, Normalization principles, De-normalization, ER modeling. Introduction to Web databases, data mining and data warehousing.

PL/SQL programming, Loops, control structures, Cursors, database triggers, procedures, functions and packages. Security considerations in database management systems.

**UNIT-V:** Oracle Forms, Features, Designing a form from a single table, Designing a Master detail form, GUI elements such as text box, Button, radio, check box and Event triggers.

Oracle reports, preparation of a report from a single table, Master detail report, adding title, page No. to reports, Summary reports, formulae tool.

**Reference Books:**

Steven M. Bobrowski, Syubex: Oracle, Client server Computing,1994.

David Vaskevitch, Comdex: Client Server Strategies, 1995.

Oracle, 8.0, Oracle Press, 1998.

Client Server Application Development Through Developer 2000, SAMS, 1998.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Optional Paper (b): OBJECT ORIENTED PROGRAMMING IN C++ AND UNIFIED MODELLING LANGUAGE

**UNIT-I:** Object oriented programming principles, Declaration of classes, array of classes, Pointer to classes, constructors such as void constructor, copy constructor, Destructor, friend functions, inline functions, static class members, this pointer.

**UNIT-II:** Single, Multiple inheritance, Types of derivation such as public, private, protected inheritance and member access controls, ambiguity in inheritance, Virtual base class, container classes. Function Overloading, Operator Overloading, Overloading of assignment, binary, unary operators.

**UNIT-III:** Polymorphism, Early binding, virtual functions, Late binding, pure virtual functions, abstract base classes, constructor under inheritance, destructor under inheritance, virtual destructors. Templates and Exception Handling. Data File operations, structures and file operations, classes and file operations.

**UNIT-IV:** Introduction to UML, Use case Diagrams, State diagrams, Sequence diagrams, collaboration diagrams, activity diagrams, component and deployment diagrams, understanding aggregations, composites and interfaces, realizations. Modeling tools for UML.

**UNIT-V:** Performing domain analysis, gathering system requirement, understanding design patterns.

**Reference Books:**

Deital & Deital: C++, Prentice-Hall Inc.

Sinan Si Alhir, Oreilly: UML

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (c): KNOWLEDGE DISCOVERY AND DATA MINING**

**UNIT-I:** Review of classification methods from multivariate analysis; classification and decision trees.

**UNIT-II:** Clustering methods from both statistical and data mining viewpoints; vector quantization.

**UNIT-III:** Unsupervised learning from univariate and multivariate data; dimension reduction and feature selection.

**UNIT-IV:** Supervised learning from moderate to high dimensional input spaces; regression trees.

**UNIT-V:** Introduction to databases, including simple relational databases; data warehouses and introduction to online analytical data processing. Association rules and prediction; data attributes.

**Text Books:**

A.Berson and S.J. Smith (1997): Data Warehousing, Data Mining and OLAP. McGraw-Hill.

L.Breiman, J.H. Friedman, R.A. Olshen, and C.J.Stone (1984): Classification Regression Trees. Taylor Francis.

J.Han and M. Kamber (2006): Data Mining; Concepts and Techniques. 2nd Edition. Morgan Kaufmann.

T.M. Mitchell (2011): Machine Learning. Springer.

**Reference Book:**

B.D.Ripley (2008): Pattern Recognition and Neural Networks. Cambridge University Press.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER III**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (d): INDUSTRIAL STATISTICS AND QUALITY CONTROL**

**UNIT-I:** General Theory of Control Charts: Control charts for attribute and variables: O.C. and A.R.L. of control charts; control by gauging; Moving average and exponentially weighted moving average charts;

**UNIT-II:** Cu-sum charts using V-masks and decision intervals. Capability indices: Cp, Cpk and Cpm.

**UNIT-III:** Acceptance sampling plans for attribute inspection: Single, double and sequential sampling plans; Plans for inspection by variables for one-sided and two-sided specifications;

**UNIT-IV:** Mil Std and ISI plans; Continuous sampling plans of Dodge type and Wald-Wolfwitz type and their properties.

**UNIT-V:** Industrial Experimentation: Transfer Functions, Fractional factorial experiments, Respoce surface methodology.

**Text Books:**

Cowden D J (1957): Statistical Methods in Quality Control. 1st Edition. Prentice-Hall Inc.

Duncan Acheson (1986): Quality Control and Industrial Statistics. 5th Edition. Irvin

Mittag and Rinne (1993): Statistical Methods for Quality Assurance. 2nd Edition. Chapman & Hall Ltd.

Montegomerv. D.C (2012): Introduction to Statistical Quality Control. 7th Edition. John Wiley and Sons

R.C. Guptha(2001): Statistical Quality Control. 9th Edition. Khanna Publishers.

**Reference Books:**

Ott. E.R. (1975): Process Quality Control. 4th Edition. Mc Graw Hill

Phadke, M.S. (1989): Quality Engineering through Robust Design. 1st Edition. Prentice Hall

Wetherill, G.B. (1977): Sampling Inspection and Quality Control. 2nd Edition. Chapman & Hall Ltd.

Wetherill, G.B. and Brown, D.W.(1991): Statistical Process Control. Theory and Practice. 3rd Edition. Chapman & Hall Ltd.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Paper – 4.1: FORECASTING METHODS**

**UNIT-I:** Smoothing Methods: Averaging methods, exponential smoothing methods, other smoothing methods, a comparison of methods, general aspects of smoothing methods.

**UNIT-II:** Decomposition Methods: Trend fitting, the ratio-to-moving averages, classical decomposition method, different types of moving averages.

**UNIT-III:** Models for time series data: Autocovariance and autocorrelation functions, stationary processes, white noise processes, Moving average (MA) processes, Auto Regressive (AR) processes, Auto Regressive and Moving Average (ARMA) processes. Auto Regressive Integrated and Moving Average (ARIMA) processes.

**UNIT-II:** Box - Jenknis Models: Identification, Estimation and diagnostic checking for the models. Simulation and Monto-Carlo methods.

**UNIT-V:** Application of Time-Series analysis: Determining randomness of data examining stationarity of a time series, removing non-stationarity in a time series, Recognizing seasonality in a time-series.

**Reference Books:**

Makridakis, S., Wheel Wright S.C., and McGee V.E.: Forecasting Methods and Applications.

Chatifield: Time-Series Analysis, Chapman & Hall.

Montgomery, Johnson & Gardiner: Forecasting and Time Series Analysis, McGraw Hill.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

# Paper – 4.2: VISUAL APPLICATION DEVELOPMENT

**UNIT-I:** Visual programming advantages, Event driven code, Data types, arrays, user defined data types, passing variables to procedures, understanding the scope and life of variables.

**UNIT-II:** Creating forms, form properties, visual basic tools and customizing the tool box, Displaying the text, button, list, dropdown, check box, radio, frame controls. Control arrays, handling mouse events, key board events, visual basic debugging tools.

**UNIT-III:** Understanding the COM, COM component software architecture, benefit of COM interfaces, Component object library, Component object servers.

Reading, writing the text files, creation, deletion, copying the files. Crystal reports, Report creation, changing the properties at runtime.

**UNIT-IV:** Object linking and Embedding, OLE Storage, Creating active document server, OL Drag arid Drop.

Data control, Navigating the data control, Creating Queries in visual basic, Jet DAC, using the record set ODBC, RDO creating applications, working with data bound control.

**UNIT-V:** Creating intranet applications, understanding the client side, server side scripting, creation of ASP pages.

**Reference Books:**

Steven Holzner : Visual Basic 6 Programming- Black Book, Dream Tech.

Peter Norton and Michael Groh; Peter Norton’s Guide to Visual Basic 6, Tech Media

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (a): DISTRIBUTED JAVA OBJECTS**

**UNIT-I:** Distributed object computing, TCP/IP concepts, Object oriented analysis and design, Design architectures, client server and distributed architectures, Design patterns, factory, observer, callback patterns.

**UNIT-II:** Java overview, Standlone, Applets, AWT and Swing based GUI, Multithreading, Interfaces, Delegation event modelling, IO Streams.

**UNIT-III:** Java Networking, Sockets, Datagrams, security, JDBC.

**UNIT-IV:** Connectivity, Java help, Java mail, skeletons, Remote reference layer, RMI based software agents.

**UNIT-V:** Introduction to CORBA, COM, DCOM approaches to distribute computing.

**Reference Books:**

Bill McGarty: Java Distributed Objects, Techmedia.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (b): VB.NET**

**UNIT-I:** Data bases: Access databases: Database file, tables, queries, SQL server databases: Data files, log files; Oracle databases: Data files, redo log files, control files, temp files, password files; Relational databases design: Normalization.

**UNIT-II:** Introduction ADO.NET: Overview: Architecture, components; connection class: Common constructors, opening a connection, closing a connection, command class, Data Adapter class, Data reader class.

**UNIT-III:** Visual Studio: NET Data Wizards: Odbc data adapter wizard-creating a ODBE Connection, Building a SELECT query, generating a data set, filling a data set; OLEDB Data adapter wizard: SQL and Oracle data adapter wizards.

**UNIT-IV:** SQL and queries for Access: Dynamic connections: Building a connection string, Opening, closing, checking connection state; in-line SQL, Access queries, selecting data in access, Inserting, updating.

**UNIT-V:** Deleting, migrating data in Access. Stored procedures and views for SQL server and Oracle: Stored procedures- Oracle Packages, views-creating a view.

Accessing data in ASP.NET. Selecting and displaying data, Web form data grid Control.

**Reference Books:**

VB.NET Professional Black Book, NY

Beginning VB.NET: Thearon Willis, Wiley, India.

Microsoft ADO.NET: Riordon, Microsoft Press

Introducing Microsoft ASP.NET, Prentice Hall of India.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (c): RELIABILITY AND SURVIVAL ANALYSIS**

**UNIT-I:** Reliability concepts and measures; components and systems; coherent systems; reliability of coherent systems; cuts and paths; modular decomposition; bounds on system reliability; structural and reliability importance of components.

**UNIT-II:** Life distributions; reliability function; hazard rate; common life distributions-exponential Weibull, gamma etc. Estimation of parameters and tests in these models.

**UNIT-III:** Notions of ageing; IFR, IFRA, NBU, DMRL, and NBUE Classes and their duals; loss of memory property of the exponential distribution; closures or these classes under formation of coherent systems, convolutions and mixtures.

**UNIT-IV:** Univariate shock models and life distributions arising out of them; bivariate shock models; common bivariate exponential distributions and their properties.

**UNIT-V:** Reliability estimation based on failure times in variously censored life tests and in tests with replacement of failed items; stress-strength reliability and its estimation. Maintenance and replacement policies; availability of repairable systems.

**Text Books:**

Barlow R.E. and Proschan F.(1985): Statistical Theory of Reliability and Life Testing; Holt, Rinehart and Winston.

Lawless J.F. (2002): Statistical Models and Methods of Life Time Data. 2nd Edition. John Wiley.

Bain L.J. and Max Engelhardt (1991): Statistical Analysis of Reliability and Life Testing Models. 2nd Edition. CRC Press.

Nelson, W (2003): Applied Life Data Analysis; Wiley Interscience.

# SYLLABUS

# M. Sc. STATISTICS WITH COMPUTER SCIENCE

**SEMESTER IV**

**WITH EFFCT FROM 2016- 2017 ADMITTED BATCH OF STUDENTS**

**Optional Paper (d): COMPUTER INTENSIVE STATISTICAL METHODS**

**UNIT-I:** Stochastic simulation: generating random variables, simulating multivariate distributions, simulating stochastic processes such as simple queues.

**UNIT-II:** Variance reduction: importance sampling for integration, control variates and antithetic variables.

**UNIT-III:** Markov Chain Mote Carlo methods: Gibbs sampling for multivariate simulation, simulated annealing for optimization.

Simulation based testing: simulating test statistics and power functions, permutation tests.

**UNIT-IV:** Bootstrap methods: re-sampling paradigms, bias and standard errors, confidence intervals, bootstrapping in regression.

**UNIT-V:** Jackknife and cross-validation: Jackknife in sample surveys, cross-validation for tuning parameters.

**Text Books:**

Rubinstein (1981): Simulation and the Monte Carlo Method. Wiley.

M.A. Tanner (1996): Tools for Statistical Inference, Third Edition. Springer.

B. Efron and R.J. Tibshirani (1993): An Introduction to the Bootstrap. Chapman and Hal.

J. Shao and D.Tu (1995): The Jackknife and the Booststrap. Springer Verlag.

R. Gnanadesikan (1997): Methods for Statistical Data Analysis of Multivariate Observations, Second edition. Wiley

**Reference Books:**

G.S. Fishman (1996): Monte Carlo: Concepts, Algorithms, and Applications. Springer. R.Y.

D.A. Belsley, E. Kuh, and R.E. Welsch (1980): Regression Diagnostics. Wiley.

P.MeCullagh and J.A. Nelder(1999): Generalized Liner Models, 3rd ed.Chapman & Hall.

G.A.F. Seber and C.J. Wild (1989); Nonlinear Regrerssion.Wiley.

G.J McLachlan and T. Krishnan (1997): The EM Algorithms and Extensions. Wiley.

J.S.Simonoff (1996): Smoothing Methods