DEPARTMENT OF MATHEMATICS & STATISTICS
UNIVERSITY COLLEGE OF SCIENCE
MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M.A. /M.Sc. STATISTICS (CBSE) 2016-17

Semester- IV

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					Univer-sity Exam.	Internal Assessment	
	1	2		3	4	5	6
I	**M4 STA 01 – CT 11**	Core Course- 11 **Design of Experiments-II**	4-1-0	5	80	20	100
II	**M4 STA 02 – CT 12**	Core Course- 12 **Non-Parametric Inference**	3-1-0	4	80	20	100
III	**M4 STA 03 – CP 06**	Core Course P- 06 **Practicals Based on CT 11**	0-0-6	3	80	20	100
IV	M4 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
V	M4 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
VI	M4 STA 0X- DSE 0X	DSE- 0 X	-	4	80	20	100
VII	M4 STA 07-SC 0X	Skill Course- 0X	2-0-0	2	80	20	100

Discipline Specific Elective Course (DSE) for Semester IV

Note: Students can opt one SC course with the permission of the Head of the Department.

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					Univer-sity Exam.	Internal Assessment	
	1	2		3	4	5	6
I	**M4 STA 01 - DSE 01**	DSE- 01 **Theory of Sample Surveys**	3-1-0	4	80	20	100
II	M4 STA 02- DSE 02	*DSE - 02 Sequential Analysis	3-1-0	4	80	20	100
III	**M4 STA 03- DSE 03**	DSE - 03 **Practicals Based on DSE 01**	2-0-4	4	80	20	100
IV	M4 STA 04- DSE 04	DSE - 04 Advanced Statistical Inference	3-1-0	4	80	20	100
V	M4 STA 05- DSE 05	DSE - 05 Theory of Reliability	3-1-0	4	80	20	100

VI	M4 STA 06- DSE 06	DSE - 06 Econometrics	3-1-0	4	80	20	100
VII	M4 STA 07- DSE 07	DSE - 07 Economic Statistics	3-1-0	4	80	20	100
VIII	**M4 STA 08- DSE 08**	DSE - 08 **Demography**	3-1-0	4	80	20	100
XI	M4 STA 09- DSE 09	DSE - 09 Advanced Sampling Theory	3-1-0	4	80	20	100
X	M4 STA 10- DSE 10	DSE - 10 Advanced Design of Experiments	3-1-0	4	80	20	100
XI	M4 STA 11- DSE 11	DSE - 11 Computer-Intensive Statistical Methods –I	3-1-0	4	80	20	100
XII	M4 STA 12- DSE 12	DSE - 12 Knowledge Discovery and Data Mining	3-1-0	4	80	20	100
XIII	M4 STA 13- DSE 13	DSE - 13 Computer-Intensive Statistical Methods-II	3-1-0	4	80	20	100
XIV	M4 STA 14- DSE 14	DSE - 14 Statistical Pattern Recognition	3-1-0	4	80	20	100
XV	M4 STA 15- DSE 15	DSE - 15 Survival Analysis	3-1-0	4	80	20	100
XVI	M4 STA 16- DSE 16	DSE - 16 Statistical Ecology	3-1-0	4	80	20	100
XVII	M4 STA 17- DSE 17	DSE - 17Comprehensive Examination (Based on All Compulsory Papers)	3-1-0	4	80	20	100

***** Prerequisite of DSE-03 is DSE-01

Skill Course (SC) for Semester IV

Note: Students can opt one SC course with the permission of the Head of the Department.

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					Univer-sity Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 STA 07-SC 01	Skill Course Elective - 01 Numerical Analysis	2-0-0	2	80	20	100
II	M4 STA 07-SC 02	Skill Course- 02 Official Statistics-II	2-0-0	2	80	20	100
III	M4 STA 07-SC 03	Skill Course Elective -3 Statistical Methods For Total Quality Management-II	2-0-0	2	80	20	100
IV	M4 STA 07-SC 04	Skill Course Elective - 04 Investments Under Uncertainty-II	2-0-0	2	80	20	100
V	M4 STA 07-SC 05	Skill Course Elective - 05 Actuarial Statistics-II	2-0-0	2	80	20	100
VI	M4 STA 07– SC 06	Skill Course Elective – 03 Documentations and Computing Algebra Systems (Total 30 hours)	1-0-1	2	80	20	100

SEMESTER IV M. Sc. STATISTICS 2016-17

Their will be Two core courses, Two special elective courses, two core course practicals.

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SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STA 01 – CT 11

DESIGN OF EXPERIMENTS-II

L-T-P	4-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

DESIGN OF EXPERIEMNTS: Linear estimation Gauss Markoff theorem, Testing of hypothesis (involving several linear functions, test of sub-hypothesis and test involving equality of some of the parameters).

UNIT II

General theory of analysis of experimental designs, Designs for two-way elimination of heterogeneity, Desirable properties of a good Design: Orthoganality, Connectedness and Balanced ness Relation between blocks of incomplete block designs Resolvability and affine resolvability Theorem on bounds.

UNIT III

Concept of association scheme with two associate classes, Definitions of partially balanced incomplete block design with two associate classes and relation among the parameters of PBIBD. Group divisible design and its classification.

UNIT IV

Lattice and linked block designs-intra block analysis Construction of complete set of mutually orthogonal Latin square for prime and prime powers. Construction and analysis of Youden square design.

UNIT V

Simple methods of construction of BIB designs, Methods of obtaining residual and derived designs from SBIBD. Complementary design of a given design.

Books recommended:

1. Chakraborti, M.C. : Mathematics of Design and analysis.
2. Raghavarao, D. : Construction and Combinatorial Problems in Design of Experiments.
3. Cochran, W.G. and Cox, G.M. : Experimental Designs.

Reference Books:

1. Das M.N. and Giri N.C. : Design and Analysis of Experiments.
2. Kempthorne, O. : The Design and Analysis of Experiments.

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SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STAT 02 – CT 12

NON-PARAMETRIC INFERENCE

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**

Internal Assessment 20

UNIT I

Non-Parametric Inference: Order Statistics and their sampling distribution confidence interval estimates and hypothesis testing for population quantiles.

UNIT II

Tolerance limits for distribution and coverage's, Kolymogrov-smirnov and Chi-square goodness of fit tests.Ordinary sign test and Wilcoxon-signed rank test.

UNIT III

Test for two-sample problems, comparison of two distributions by Wald-wolfowitz Runs test and Kolmogrov- smirnov test Median test for equality of locations and Mann-whitney U-test.

UNIT IV

Linear ranks Statistics, its definition, probability distribution and usefulness in inference problems linear rank test for the location and scale problems.

UNIT V

Ranks: Correlation between rank order Statistics and variates values, Treatment of ties ranks. Tests for one-sample problems: Run test for randomness. Tests based on the total number of runs and the length of the longest run.

Books Recommended:

1. Gibbons, J.D. : Non-Parametric Statistical Inference.
2. Lehmann, E.L : Testing Statistical Hypotheses.
3. Rohatgi, V.K : An Introduction to Probability Theory and Mathematical Statistics (Chapter 4).
4. Rao, C.R. : Linear statistical Inference and its Applications (Sec. 7c).

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M4 STA 05 – CP 06

PRACTICALS BASED ON CT-11

L-T-P	0-0-6

Duration: 4 Hours **External Assessment 80**
Internal Assessment 20

External Assessment 80: Practicals : 60 Marks
(Practicals based on Multivariate Analysis)
Viva-voce : 20 Marks

Internal Assessment 20: Practical Record (Internal Assessment) : 20 Marks

List of Practicals

Design of Experiments

1. Testing of hypothesis regarding equality of some treatment effects in one and two-way classifications.
2. Analysis of Incomplete Block Designs without specific form of C-matrix.
3. Group divisible designs.
4. Linked block designs.
5. Simple lattice designs with 2 or more replications.
6. Youden square designs.
7. Software development of above practical problems in C-language and running the same on computers.

OPTIONAL PAPERS

Specific Elective Theory papers to be offered to the student of M.Sc. III & IV Semester.

Specific elective theory 01 **Operations Research**

Specific elective theory 02 **Statistical Quality Control**

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SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STA – DSE 01

THEORY OF SAMPLE SURVEYS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Theory of sample surveys: Partition of sample space and definition of T-classes of linear estimators. The wideness of set of seven classes of linear estimators. A unified approach to T_2 class of linear estimators Non-sampling Errors, their sources and elimination.

UNIT II

Quenouille's Techniques of bias reduction and its application to Ratio type estimators, Hartley and Ross Unbiased Ratio type estimator Ratio method of estimation in PPSWR sampling. Ratio method of estimation under Midzuno's scheme of sampling when X is known.

UNIT III

Bivariate extension of the Ratio and Regression Methods of estimation when population means of auxiliary variables are known.Varying Probabilities without replacement: Horvitz-Thompson-estimator and its variance, Yates and Grundy form of variance unbiased estimators of variance of Horvitz-Thompson's estimators.

UNIT IV

Sen-Midzuno scheme of sampling and simplification of inclusion probabilities for Yates-Grundy estimate of variance with advantages. Rao-Hartley-Cochran sampling schemes and their estimation procedures.

UNIT V

The theory of multi-stage sampling with varying probabilities with and without replacement, Des Raj ordered estimators, Murthy's unordered estimators.

Books recommended:

1. Sukhatme, P.V. and Sukhatme, B.V. : Sampling Theory of surveys with Applications.
2. Tikkiwal, B.D. : Lecture notes on Advanced Theory of sample surveys.

Reference Books:

1. Cochran, W.G. : Sampling Techniques.
2. Murthy, M.N. : Sampling theory and methods.
3. Des Raj Sampling Theory.
4. Mukhopadhyay, P. Theory and methods of survey sampling.

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M4 STA –DSE 02

SEQUENTIAL ANALYSIS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**

Internal Assessment 20

UNIT I

Sequential estimation: Wald's equation, sequential estimation of mean of a normal population Wolfowitz Lower bounds to the variance of the sequential estimates.

UNIT II

Robbins and stein's procedures, inverse binomial sampling.

UNIT III

Sequential Testing: Fundamental ideas about sequential procedures SPRT and its properties.

UNIT IV

Fundamental identity of sequential analysis and its applications. Applications of SPRT ror testing simple hypothesis against simple alternative in case of exponential families.

UNIT V

Application of fundamental identity is finding O.C and A.S.N. functions.

Books Recommended:

1. Gibbons, J.D. : Non-Parametric Statistical Inference.
2. Lehmann, E.L. : Testing Statistical Hypotheses.
3. Rohatgi, V.K. : An Introduction to Probability Theory and Mathematical Statistics (Chapter 4).
4. Rao, C.R. : Linear statistical Inference and its Applications (Sec. 7c).
5. Wald, A. Sequential Analysis (Chapters 4, 6, 7, 8, 9, 11).

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SEMESTER IV M. Sc. STATISTICS 2016-17

M4 SAT- DSE 03

PRACTICALS BASED ON CT-12

L-T-P	0-0-6

Duration: 4 Hours **External Assessment 80**
Internal Assessment 20

External Assessment 80: Practicals : 60 Marks
(Practicals based on Multivariate Analysis)
Viva-voce : 20 Marks

Internal Assessment 20: Practical Record (Internal Assessment) : 20 Marks

List of Practicals

Theory of sample surveys:

1 Horvitz and Thompson's procedure of estimating mean (total) of the population, variance of estimator and estimate of variance.
2 Yate's and Grundy method.
3 Midzuno's sampling scheme.
4 Rao-Hartley-Cocharan schemes.
5 Two stage sampling method (a) f.s.u being select with pps with replacement (b) s.s.u with equal prob without replacement (c) Estimation of optimum number of f.s.u and s.s.u.
6. Hartley-Ross unbiased Ratio method of estimation.
7. Bivariate Extension of Ratio & regression method of estimation (Olkin's technique).
8. Software development of above practical problems in C-language and running the same on computers.

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M4 STA –DSE 04
ADVANCED STATISTICAL INFERENCE

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Advanced statistical Inference: Unified theory of linear estimation, Estimation of variance components, variance components model MINQUE theory.

UNIT II

Admissibility of estimators: Basic theory of Admissibility and complete class, Admissibility of some commonly used estimators.

UNIT III

Nature of Bayesian Inference, Baye's estimators for Quadratic and Convex Loss Functions.

UNIT IV

Generalized Baye's Estimators, Asymptotic behavior of Baye's Estimators. Asymptotic relative Efficiency.

UNIT V

Theoretical basis for calculating ARE, Examples of the calculation of efficiency and ARE.

Books Recommended:

1. Rao, C.R. : Linear statistical Inference And its Applications (2^{nd} Edition, Chapter 4 pp.204 to 305).
2. Zacks, S. : The Theory of Statistical Inference (Wiley), Articles 6.1 to 6.4 and 8.1 to 8.5.

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M4 STA –DSE 05
THEORY OF RELIABILITY

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Reliability: Reliability growth models probability plotting techniques for Basic ideas of accelerated life testing.

UNIT II

Reliability concepts and measures components and systems coherent systems reliability of coherent systems Life distributions reliability function hazard rate.

UNIT III

common life distributions-exponential, Weibull, gamma etc Estimation of parameters and tests in these models.

UNIT IV

Notions of ageing IFR, IFRA, NBU DMRL and NBUE Classes and their duals.

UNIT V

Univariate shock models and life distributions arising out of them.

Reference Books:

1.	Barlow R.E. and Proschan	:	Statistical Theory of Reliability and Life Testing; Rinehart and Winston F. (1985).
2.	Lowless, J.F. (1982)	:	Statistical Models and Methods of Life. Time Data; John Wiley.
3.	Bain L.J and Engelhard (1991)	:	Statistical Analysis of Reliability and Life Testing. Models; Marcel Dekker.
4.	Nelson, W. (1982)	:	Applied Life Data analysis John Wilev.
5.	Zacks, S.		Reliability Theory; Springer.

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M4 STA –DSE 06

ECONOMETRICS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Econometrics: Meaning and scope of Economics, The classical least squares model, its assumptions and the properties of its estimators, Generalized least squares method. Errors in variables. The treatment of Autocorrelation, disturbances in ordinary and distributed lag models.

UNIT II

The problem of multicoilinearity, Identification problem in simultaneous equation models.

UNIT III

Simultaneous equation methods: Two-stage least square estimators, limited information estimators, K-Class estimators.

UNIT IV

Three-stage least squares and full information maximum likelihood method.

UNIT V

Monte-Carlo Studies: Empirical applications, of production function, consumption function, Engles curve.

Books Recommended:

1. Klein, L.R. : An Introduction to Econometrics.
2. Johnson, J. : Econometric Methods-3rd Edition.
3. Goldberger, A.S. : Econometric Theory.
4. Crist, C.R. : Econometric Models and Methods.
5. Klein, L.R. : Text Book of Econometrics.
6. Rao, P. and Miller, R.L. : Applied Econometrics.

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M4 STA –DSE 07
ECONOMIC STATISTICS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Economic Statistics: Components of time series Methods of their determination, variates difference e method Yule slutsky effect.

UNIT II

Correlogram, Autoregressive models of first and second order Periodograrn analysis.

UNIT III

Income distribution - Pareto and Engel curves, Concentration curve Methods of estimating national income Intersectoral flows, Inter Industry table.

UNIT IV

Index numbers of prices and quantities and their relative Merits.

UNIT V

Construction of index numbers of wholesale and consumer prices.

Books Recommended:

1. Croxton Cowden and Klein : Applied General Statistics.
2. Goon Gupta and Dasgupta : Fundamentals of Statistics Vol. II.
3. Kendall & Stuart : Advanced Theory of Statistics Vol. II.
4. Chennery, H.B. : Inter Industrial Economics.
5. Asthana & Srivastava : Applied Statistics of India.
6. Kamitakar & Bhende : Principles of Populations studies.

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M4 STA –DSE 08

DEMOGRAPHY

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Demography: Census and Vital Statistics data, Vital Rates and ratios, standardization of rates, trends and differentials in mortality and fertility.

UNIT II

Stationary Population, construction of life table, gross and net reproduction rates.

UNIT III

Stable population theory, population estimation and projection.

UNIT IV

Demographic trends in India. Labors force analysis, birth and death, stochastic processes. Stochastic population models, logistic models.

UNIT V

Bivariate growth models, migration models, fertility analysis models, mortality analysis models.

Books Recommended:

1. Croxton Cowden and Klein : Applied General Statistics.
2. Goon Gupta and Dasgupta : Fundamentals of Statistics Vol. II.
3. Kendall & Stuart : Advanced Theory of Statistics Vol. II.

4.	Chennery H.B.	:	Inter Industrial Economics.
5.	Asthana & Srivastava	:	Applied Statistics of India.
6.	Cox	:	Demography.
7.	Barclay	:	Techniques of population Analysis.
8.	Kamitakar & Bhende	:	Principles of Populations studies.

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M4 STA –DSE 09

ADVANCED SAMPLING THEORY

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Theory of Sample Surveys: Theory of uni-variate successive sampling on occasions and its applications. Stratification problems.

UNIT II

Sufficiency in sampling theory and its application to improve classical SRSWR estimator, sukhatme, Tukey and Robson's main results on symmetric Functions and Polykays.

UNIT III

Variance estimation method of random groups, balanced half samples (IPNSS), Jack-knife method.

UNIT IV

Introduction to super population models.

UNIT V

Small area estimation: Issues in small area estimation, synthetic and generalized regression estimators.

Books recommended:

1.	Sukhatma, P.V. and Sukhatme, B.V. et al	:	Sampling Theory of surveys with Applications.
2.	Pathak	:	Lecture Notes.
3.	Choudheirl, Arijit & Stenger Horst	:	Survey sampling Theory & Methods.

4. Mukhopadhyay, P. : Small area estimation in survey sampling.
5. Cochran, W.G. : Sampling Techniwues; John Wiley
6. Mukhopadhyay, P. : Theory and methods of survey sampling, Prentice-Hill of India.

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M4 STA –DSE 10
ADVANCED DESIGN OF EXPERIMENTS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Design of Experiments: Galoi's field of order p-, Method of construction of minimum function for, generating the elements of GF (Pm). Orthogonal Array-Properties construction of orthogonal arrays of index unity.

UNIT II

Pair wise balanced designs Applications of pair wise balanced designs in the construction of Mutually Orthogonal Latin square (MOLs), Falsity of Euler's conjecture.

UNIT III

Balanced incomplete block (BIB) designs Construction of BIB designs through the method of symmetrically repeated differences, Kronecker product designs, Duals of incomplete block designs. Duals of asymmetrical BIB designs with $\lambda=1$ or $\lambda=2$.

UNIT IV

Partially balanced incomplete block (PBIB) designs with two associate classes-Group divisible, Triangular and Latin square type designs, Simple methods of their construction, Analysis with recovery of inter-block of PBIB designs.

UNIT V

Construction of confounded factorial experiments balancing in factorial experiments fractional replications.

Books recommended:

1. Chakroborti, M.C. : Mathematics of Design and Analysis of Experiments.
2. Raghavarao, D. : Constructions and Combinatorial Problems in Design of Experiments.
3. Kempthome, O. : Design and Analysis of Experiments.

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M4 STA –DSE 11
COMPUTER-INTENSIVE STATISTICAL METHODS –I

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Computer-Intensive statistical Methods I: Exploratory data analysis -: transforming data, graphical methods of steering, outliers.

UNIT II

Linear regression: influential observations and diagnostics robust methods collinearity variable selection.

UNIT III

Genera Jzed linear models: exponential families and ML estimation- analysis of deviance and variable selection logistic regression.

UNIT IV

Nonlinear regression: estimation hypothesis testing goodness of fit EM algorithm: applications to missing and incomplete data problems mixture models.

UNIT V

Smoothing with kernels: density estimation simple nonparametric regression.

Reference Books:

1. Gnanadesikan, R. : Methods for statistical Data Analysis of Multivariate Observations second edition (1997) Wiley l.
2. Belsley, D.A., E.Kuh and WeIsch, R. E. (1980) : Regression Diagnostics Wiley.
3. McCullagh, P. and Nelder, J.A. (1999) : Generalized Linear Models Third edition. Champman and Hall.
4. F.seber, G.E. and Wild, C.J. (1989) : Nonlinear Regression Wiley.
5. McLachlan, G.J. and Krishnan (1997) : The EM Algorithms and Extensions Wiley.
6. Slmonoff,J.S.(1996 Springer) : Smoothing Methods in Statistics.

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M4 STA –DSE 12
KNOWLEDGE DISCOVERY AND DATA MINING

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Knowledge discovery and Data Mining: Review of classification methods from multivariate analysis classification and decision trees. Clustering methods from both statistical and data mining view point vector quantization.

UNIT II

Unsupervised learning from univariate and multivariate data dimension reduction and feature selection.

UNIT III

Supervised learning from moderate to high dimensional input spaces artificial neural networks and extensions of regression models regression trees.

UNIT IV

Introduction to databases: Including simple relational databases data warehouses and introduction to nonline analytical data processing.

UNIT V

Association rules and prediction data attributes applications to electronic commerce.

Reference Books:

1. A. Berson and S.J. Smith (1997) : Data Warehousing Data Mining and OLAP, McGraw-Hill.
2. Breiman, L., Friedman, J.H., Olshen R.A. and Stone, C.J. (1984) : Classification and Regression Trees, Wadsworth . and Brooks/ Cole.
3. Han, J. and Kamber Morgan, M. Data (2000) : Concepts and Techniques Mining: Gaufmann.
4. Mitchell, T.M. (1997) : Machine Learning, McGraw-Hill.
5. Ripley, B.D. (1996) : Pattern Recognition and Neural Networks Cambridge University Press.

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M4 STA –DSE 13
COMPUTER-INTENSIVE STATISTICAL METHODS-II

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Computer-Intensive statistical Methods II: stochastic simulation: generating random variables simulating multivariate distributions, simulating stochastic processes such as simple queues.

UNIT II

Variance reduction: importance sampling for integration control varieties and antithetic variables. Markov Chain.

UNIT III

Monte Cario methods: Gibbs sampling for multivariate simulation-simulated annealing for optimization.

UNIT IV

Simulation based testing: simulating test Statistics and power functions permutation tests. Bootstrap methods: resampling 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.

Reference Books:

1. Fishman, G.S. (1996) : Monte Carlo: Concepts, Algorithms and Applications Springer.
2. Rubinstein, R.Y. (1981) : Simulation and the Monte Carlo Method Wiley.
3. Tanner, M.A. (1996) : Tools for statistical Inference, Third edition, Springer.
4. Efron, B., Hall, R.J. and Tibshirani (1993). : An Introduction to k1the Bootstrap. Champman
5. Shao, J. and Tu, D. (1995) : The Jackknife and the Bootstrap Springer Verlag.

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M4 STA –DSE 14

STATISTICAL PATTERN RECOGNITION

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Statistical Pattern Recognition: Linear classifiers: Linear discriminant function (LDF for minimum squared error LDF for binary outputs perception learning algorithms.

UNIT II

Nearest neighbor decision rules: description convergence, finite sample considerations use of branch and bound methods.

UNIT III

Probability of errors: Two classes normal distributions equal covariance matrix assumptions chernoff bounds and Bhattacharya distance estimation of probability of error.

UNIT IV

Feature selection and extraction: interclass distance measures discriminant analysis.

UNIT V

Probabilistic distance measures, principal components.

Reference Books:

1. Duda, R.O. and Hart, P.E. (1973) : Pattern Recognition and scene Analysis Wiley.
2. Fukunaga, K. (1990) : Introduction to statistical Pattern Recognition, Second Edition Academic Press.
3. Mclachlan, G.J. (1992) : Discriminant, Analysis and Statistical Pattern Recognition Wiley.
4. Ripley, B.D. (1996) : Pattern Recognition and Neural Networks Cambridge University Press.

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M4 STA –DSE 15
SURVIVAL ANALYSIS

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Survival Analysis: Concepts of time Order and random Censoring likehood in these cases Life distributions Exponential Gamma Weibull Lognormal Pareto Linear Failure rate parametric inference (Point estimation Confidence intervals Scores LR MLE tests Rao-Willks Waid for these distributions.

UNIT II

Life tables, failure rate mean residual life and their elementary properties Ageing classes - and their properties Bathtub Failure rate.

UNIT III

Estimation of survival function-Actuarial Estimator Kaplan-Meier Estimator Estimation under the assumption of IFR/DFR.

UNIT IV

Tests of exponentiality against non - parametric classes - Total time on test Deshpande test. Two sample problem - Gehan test Log rank test Mantel - Haenszel test Tarone - Ware tests. Semi-parametric regression for failure rate Cox7S proportional hazards model with one and several convarliates Rank test for the regression coefficients.

UNIT V

Competing risk model, parametric and non - parametric inference for this model. Multiple decrement life table.

Reference Books:

1. Cox, D.R. and Oakes D.(1984) : Analysis of survival Data Chapman and Hall New York.
2. Gross, A.J and Clark, V.A. (1975) : Survival Distribution: Reliability applications in the Biomedical Sciences, John wiley and sons.
3. Wlandt-Johnson R.E, Johnson R.L. : Survival Models and Data Analysis, John Wiley and Sons.
4. Miler, R.G (1981) : Survival Analysis John Wiley.
5. Kalbfieisch, J.D and Prentice R.L (1980). : The statistical Analysis of Failure. Time Data, John Wiley.

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SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STA –DSE 16
STATISTICAL ECOLOGY

L-T-P	3-1-0

TIME: 3 hours **External Assessment 80**
Internal Assessment 20

UNIT I

Statistical Ecology: Introduction to Ecology and evolution Population dynamic: single species Exponential logistic and Gompertz models Leslie matrix model for age and stage structured population Survivorship curves - coexistence monotone and bath tub shaped rates.

UNIT II

Two species: Lotka - Volterra equations isoclines competition and coexistence, predator-pray oscillations.

UNIT III

Abundance estimation: Capture - recapture nearest neighbour line transect sampling, indirect methods.

UNIT IV

Ecological Diversity: species abundance curve Indices of diversity simpson's index shannon - Wiener index Diversity as average rarity.

UNIT V

Harvesting renewable biological resources - Maximum sustainable yield trangedy of the commons. Game theory in ecology - Evolutionality stable strategy its properties simple games such as Hawk-Dove game. Foraging theory: Optimal foraging diet choice mean variance trade-off.

Reference Books:

1. Anil Gore and S.A. Paranjpe (2000). : A course on Mathematical and Statistical Ecology (Kluwer).
2. Clark, C.W. (1976) : Mathematical Bioeconomics: Optimal Management of Renewable Resources (Wiley).
3. Maynard Smith J. (1982). : Evolution and the Theory of Games (Cambridge Press).
4. Pielou, E.C (1977) : An Introduction to Mathematical Ecology (Wiley).
5. Seber, G.A.F. (1982) : Estimation of Animal udance and Related Parameters (Charles Griffiri).
6. Stephens, D.W and Krebs J.R (1986) : Foraging Theory Princeton (University Press)

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STA –DSE 17

COMPREHENSIVE EXAMINATION

(BASED ON ALL COMPULSORY PAPERS)

L-T-P	3-1-0

Duration: 4 Hours **External Assessment 80**

Internal Assessment 20

External Assessment 80: Practicals : 60 Marks

Viva-voce : 20 Marks

Internal Assessment 20: Practical Record (Internal Assessment) : 20 Marks

1. The written examination will be based on objective type and short answer questions.
2. The Viva-Voce examination will be conducted by a committee consisting of examiner who set the written-examination paper, Head of the department and one senior faculty member of the department of the subject concerned.
3. If examiner would not be in a position to come to conduct Viva-Voce, then a subject expert may be called from the panel of examiners of the paper.

Skill Course (SC) for Semester II

M2 STA 07-SC 01

Skill Course Elective 01

Measurable functions and Lebesgue Integral

UNIT I

Convergence of sequence of Measurable function: Convergence pointwise, uniform Convergence, Convergence almost every where (a.e.).

UNIT II

Convergence in measure of a sequence of measurable functions, characteristic function of a set, simple function, step function, pointwise Convergence, theorem of measure functions.

UNIT III

Lebesgue Integral; Characteristic function of a set; Simple functions, Lebesgue integral of a simple function; Lebesgue integral of a bounded measurable function.

UNIT IV

Lebesgue integral and Riemann integral of a bounded function defined on a closed interval; Lebesgue integral of a non-negative function; Lebesgue integral of a measurable function.

UNIT V

Properties of Lebesgue integral. Convergence Theorems and Lebesgue integral; the bounded convergence theorem; Fatou's Lemma: Monotone convergence theorem; Lebesgue convergence theorem.

Books Recommended:

1. George F-Simmons : Introduction to Topology and Modem Analysis, McGraw Hill Book Co.
2. S.I.Hu : Elements of Real Analysis
3. H.L. Royden : Real Analysis.
4. G.N. Purohit : Lebesgue Measure and Integration.
5. Bartle, Robert G. : The elements of integration and Lebesgue measure

M2 STA 07-SC 02

Skill Course Elective 02

OFFICIAL STATISTICS-I

UNIT I

Introduction to Indian and International Statistical systems. Role, function and activities of Central and State statistical organizations.

UNIT II

Organization of large scale sample surveys. Role of National Sample Survey Organization. General and special data dissemination systems.

UNIT III

Population growth in developed and developing countries.

UNIT IV

evaluation of performance of family welfare programmes, projections of labour force and manpower.

UNIT V

Scope and content of population census of India.

References:

Basic statistics Relating to the Indian Economy (CSO) 1990.

Guide to Official Statistics (CSO), 1999.

Statistical System in India (CSO) 1995).

Principles and Accommodation of National Population Censuses, UNESCO.

Panse, V. G., Estimation of Crop Yields (FAO)

Family Welfare Yearbook. Annual Publication of D/0 Family Welfare.

Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.

M2 STA 07-SC 03

Skill Course Elective 03

STATISTICAL METHODS FOR TOTAL QUALITY MANAGEMNET-I

UNIT I

Quality System: ISO 9000 standard, QS 9000 standards, Concept of six-sigma and the define-measure-analysis-improve-Control Approach.

UNIT II

Precision and accuracy in measurement systems. Estimation of Measurement Uncertainty.

UNIT III

Total Quality Management, Process Analysis and Optimization.

UNIT IV

Quality at Design Stage, Quality Function Deployment, Failure Mode and Effect Analysis.

UNIT V

Conjoint Analysis, System, Parameter and tolerance designs.

References:

1. Logothetis, N. (1992)/ Managing Total Quality; Prentice Hall of India.
2. Okland J.S. (1989). Total Quality Management; Butterworth-Heinemann.
3. Mittag H.J. and Rinne H. (1993) Statistical Methods of Quality Assurance.
4. Montgomry D.C. (1985); Statistical Process Control; John Wiley.
5. Montgomery D.C. (1999) Design and Analysis of Experiments; John Wiley.

M2 STA 07-SC 04

Skill Course Elective 04

INVESTMENTS UNDER UNCERTAINTY-I

UNIT I

Main Theme: Risk – Return Trade off.

UNITI II

Money market, Fixed income, equity, stocks and bonds, Treasury notes, market indexes, Rates of interest.

UNIT III

Compound interest, inflation, Risk in a portfolio context, law of one price and arbitrage.

UNIT IV

Risk and risk aversion, mean variance analysis, allocation between risky and risk free portfolios.

UNIT V

Diversification and portfolio risk, Markovitz portfolio selection, optimal portfolios.

References:

Bodie, Z., Kane, A. and Marcus, A.J. (1996), Inversments 4th Edition, Irwin.

(Chapters: 1, 2, 4, 5, 6, 7, 8, 9, 10,20, 21, 22)

Additional References:

Arrow, K. J. (1971), Essays in the Theory of Risk Bearing, North Holland.

Hull John C. (1993) options, Futures and other Derivative Securities. 2nd Ed. Prentice Hall.

M2 STA 07-SC 05

Skill Course Elective 05

ACTUARIAL STATISTICS-I

UNIT I

Probability Models and Life Tables.

UNIT II

Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality.

UNIT III

Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

UNIT IV

Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations.

UNIT V

Distribution of aggregate claims, compound Poisson distribution and its applications, Distribution of aggregate claims, compound Poisson distribution and its applications.

References:

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

Additional References:

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

Neill, A. (1977). Life Contingencies, Heineman.

Skill Course (SC) for Semester IV

M4 STA 07-SC 01

Skill Course Elective 01

NUMERICAL ANALYSIS

L-T-P	2-0-0

TIME: 3 hours

External Assessment 80

Internal Assessment 20

UNIT I

Theory of Iteration: Simple iteration, Rate of Convergence, Acceleration a convergence, method for multiple and complex roots.

UNIT II

Convergence of iteration process in the case of several unknowns.

UNIT III

Real and complex roots, solution of transcendental and polynomial equations by using besection method, secant method.

UNIT IV

Regula-Falsi method, Newton Ruphson method, Chebyshev method and Muller method.

UNIT V

Concept of synthetic division, the Birge – vita, Bairstow and Graeffe's root squaring method. System of Simultaneous equations(Linear): Direct method of determinant, Gauss–Elimination.

Books Recommended:

1. Jain, Iyenger and Jain : Numerical Analysis.
2. Jain, M. K. : Numerical solutions of differential equation.
3. Chouhan D.S., Vyas P. & Soni. V. : Studies in Numerical Analysis

M4 STA 07-SC 02

Skill Course Elective 02

OFFICIAL STATISTICS-II

UNIT I

System of collection of Agricultural statistics.

UNIT II

Crop forecasting and estimation, productivity.

UNIT III

Fragmentation of holdings, support prices, buffer stocks, impact of irrigation projects.

UNIT IV

Statistics related to industries, foreign trade.

UNIT V

Balance of payment, cost of living, inflation, educational and other social statistics.

References:

Basic statistics Relating to the Indian Economy (CSO) 1990.

Guide to Official Statistics (CSO), 1999.

Statistical System in India (CSO) 1995).

Principles and Accommodation of National Population Censuses, UNESCO.

Panse, V. G., Estimation of Crop Yields (FAO)

Family Welfare Yearbook. Annual Publication of D/0 Family Welfare.

Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.

M4 STA 07-SC 03

Skill Course Elective 03

STATISTICAL METHODS FOR TOTAL QUALITY MANAGEMNET-II

UNIT I

Planning and analysis of fractional factorial experiments.

UNIT II

Basic ideas of response surface methodology and contour plots.

UNIT III

Quality in manufacturing control charts for attribute and variable characteristics process adjustments based on control chart evidences.

UNIT IV

Process capability and performance indices. Evolutionary operations.

UNIT V

Measuring customer satisfaction, American customer Satisfaction index model.

Note: Candidate will have to undertake both courses 1 & 2 in Semester II and Semester IV respectively.

References:

1. Logothetis, N. (1992)/ Managing Total Quality; Prentice Hall of India.
2. Okland J.S. (1989). Total Quality Management; Butterworth-Heinemann.
3. Mittag H.J. and Rinne H. (1993) Statistical Methods of Quality Assurance.
4. Montgomry D.C. (1985); Statistical Process Control; John Wiley.
5. Montgomery D.C. (1999) Design and Analysis of Experiments; John Wiley.

M4 STA 07-SC 04

Skill Course Elective 04

INVESTMENTS UNDER UNCERTAINTY-II

UNIT I

Capital assets, pricing model, passive strategy, risk premium.

UNIT II

index models and diversification, CAPM and index model.

UNIT III

Options markets, American and European options, call and put options, open strategies, option like instruments, option valuation.

UNIT IV

Binomial option pricing, Black-Scholes option valuation, uses of Black-Scholes formula.

UNIT V

Futures markets, Mechanics and strategies, Futures prices, expected spot prices.

Note: Candidate will have to undertake both courses 3 & 4 in Semester II and Semester IV respectively.

References:

Bodie, Z., Kane, A. and Marcus, A.J. (1996), Inversments 4th Edition, Irwin.
(Chapters: 1, 2, 4, 5, 6, 7, 8, 9, 10,20, 21, 22)

Additional References:

Arrow, K. J. (1971), Essays in the Theory of Risk Bearing, North Holland.

Hull John C. (1993) options, Futures and other Derivative Securities. 2nd Ed.
Prentice Hall.

M4 STA 07-SC 05

Skill Course Elective 05

ACTUARIAL STATISTICS-II

UNIT I

Insurance and Annuities

Principles of compound interest: Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor, Continuous compounding.

UNIT II

Life insurance: Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, diferred insurance and varying benefit insurance, recursions, commutation functions.

UNIT III

Life annuities: Single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities-immediate and apportionable annuities-due.

UNIT IV

Net premiums: Continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation type benefits.

Payment premiums, apportionable premiums, commutation functions, accumulation type benefits.

UNIT V

Net Premium reserves: Continuous and discrete net premium reserve, reserves on a semicontinous basis, reserves based on true monthly premiums, reserves on an apportinable or discounted continuos basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.

Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses.

Claim amount distributions, approximating the individual model, stop-loss insurance.

Note: Candidate will have to undertake both courses 3 & 4 in Semester II and Semester IV respectively.

References:

N.L. Bowers, H.U. Gerber, J.C. , D.A. Jones and C.J. Nesbitt, (1986), 'Actuarial Mathematics,' Society of Actuarias, Ithaca, Illiois, U.S.A. Second Edition (1997)

Additional References:

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

Neill, A. (1977). Life Contingencies, Heineman.

IVth Semester
M4 STA 07– SC 06
Skill Course 2016-17
SEC-VI

Documentations and Computing Algebra System

L-T-P	1-0-1

(10 L+ 20 P)

Hands-on experience using the integrated programs (Math equations typing etc.) of Microsoft Office. Creating table of contents, footnotes, references, hyperlinking etc. Power point presentation.

Elements of LaTeX; Hands-on-training of LaTex; graphics in LaTeX; PS Tricks; Beamer presentation.

Modeling of the following problems using Mathematica/ Maxima.

Plotting of graphs of function of type, $ax, \in \mathbb{R}, [x], \sqrt{ax+b}, |ax+b|, x^n$ (n even and odd positive integer, $x^{\frac{1}{n}}$ (n a positive integer), $\frac{|x|}{x}$ for $x \neq 0, \sin\frac{1}{x}$ for $x \neq 0, x\sin\frac{1}{x}$ for

$x \neq 0$, $e^{\pm\frac{1}{x}}$, e^{ax+b}, $\log(ax+b)$, $\frac{1}{ax+b)}$, $\sin(ax+b)$, $\cos(ax+b)$, $|\sin(ax+b)|$, $|\cos(ax+b)|$.

Discuss the effect of a and b on the nature of the graph.

- Plotting the graphs of polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them.
- Sketching parametric curves.
- Tracing of conics in Cartesian coordinates.
- Obtaining surface of revolution of curves.
- Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian co-ordinates.
- Matrix operations (addition, multiplication, inverse, transpose, determinant, rank, eigenvectors, eigenvalues, Characteristic equation and verification of Cayley Hamilton equation, system of linear equations)
- Graph of Hyperbolic functions.
- Computation of limit, differentiation and integration of vector functions.
- Complex numbers and their representations, operations like addition, multiplication, division, modulus. Graphical representation of polar form.