

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

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

**Semester- I**

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					Univ. Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M1 STA 01 – CT 01	Core Course- 01 Measure and Integration	4-1-0	5	80	20	100
II	M1 STA 02 – CT 02	Core Course- 02 Matrices and Linear Algebra	4-1-0	5	80	20	100
III	M1 STA 03 – CT 03	Core Course- 03 Probability Theory	3-1-0	4	80	20	100
IV	M1 STA 04 – CT 04	Core Course- 04 Theoretical Distributions	3-1-0	4	80	20	100
V	M1 STA 05 – CP 01	Core Course P- 01 Practicals Based on C-Programming in Computational Statistics	0-0-6	3	80	20	100
VI	M1 STA 06 – CP 02	Core Course P- 02 Practicals Based on CT 03 & CT 04	0-0-6	3	80	20	100

**Semester- II**

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M2 STA 01 – CT 05	Core Course- 05 Sampling Distributions	4-1-0	5	80	20	100
II	M2 STA 02 – CT 06	Core Course- 06 Statistical Inference-I	3-1-0	4	80	20	100
III	M2 STA 03 – CT 07	Core Course- 07 Design of Experiments-I	4-1-0	5	80	20	100
IV	M2 STA 04 – CT 08	Core Course- 08 Theory of Sample Surveys-I	3-1-0	4	80	20	100
V	M2 STA 05 – CP 03	Core Course P- 03 Practicals Based on CT 05 & CT 06	0-0-6	3	80	20	100
VI	M2 STA 06 – CP 04	Core Course P- 04 Practicals Based on CT 07 & CT 08	0-0-6	3	80	20	100
VII	M2 STA 07-SC 0X	Skill Course- 0X	2-0-0	2	80	20	100

## Skill Course (SC) for Semester II

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

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M2 STA 07-SC 01	Skill Course Elective 01 Measurable functions and Lebesgue Integral	2-0-0	2	80	20	100
II	M2 STA 07-SC 02	Skill Course Elective - 02 Official Statistics-I	2-0-0	2	80	20	100
III	M2 STA 07-SC 03	Skill Course Elective 03 Statistical Methods For Total Quality Management-I	2-0-0	2	80	20	100
IV	M2 STA 07-SC 04	Skill Course Elective - 04 Investments Under Uncertainty-I	2-0-0	2	80	20	100
V	M2 STA 07-SC 05	Skill Course Elective - 05 Actuarial Statistics-I	2-0-0	2	80	20	100

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

### **Semester- III**

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M3 STA 01 – CT 09	Core Course- 09 Multivariate Analysis	4-1-0	5	80	20	100
II	M3 STA 02 – CT 10	Core Course- 10 Statistical Inference-II	4-0-0	4	80	20	100
III	M3 STA 03 – CP 05	Core Course P- 05 Practicals Based on CT 09	0-0-6	3	80	20	100
IV	M3 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
V	M3 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
VI	M3 STA 0X- DSE 0X	DSE- 0 X	-	4	80	20	100

## Discipline Specific Elective Course (DSE) for Semester III

**Note:** Students are to opt any three DSE courses among the following 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
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M3 STA 01- DSE 01	DSE- 01 Operations Research	3-1-0	4	80	20	100
II	M3 STA 02- DSE 02	DSE- 02 Statistical Quality Control	3-1-0	4	80	20	100
III	M3 STA 03- DSE 03*	DSE- 03* Practicals Based on DSE 01 & DSE 02	2-0-4	4	80	20	100
IV	M3 STA 04- DSE 04	DSE- 04 Mathematical Economics	3-1-0	4	80	20	100
V	M3 STA 05- DSE 05	DSE- 05 Stochastic Processes	3-1-0	4	80	20	100
VI	M3 STA 06- DSE 06	DSE- 06 Information Theory	3-1-0	4	80	20	100

\* Prerequisite for course DSE-03 is course DSE-01 and DSE-02.

## Semester- IV

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University 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 Asses sment	
	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 - 17 Comprehensive 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
					University 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 SAT 07-SC 07	Skill Course Elective – 03 Documentations and Computing Algebra Systems (Total 30 hours)	1-0-1	2	80	20	100

# SEMESTER I M. Sc. STATISTICS 2016-17

There will be four core courses and two core course Practicals.

## MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR SEMESTER I M. Sc. STATISTICS 2016-17

### M1 STA 01 – CT 01 MEASURE AND INTEGRATION

L-T-P	4-1-0
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**TIME: 3 hours**

**External Assessment 80  
Internal Assessment 20**

#### UNIT I

Set operations, Limit of sequence of sets, Classes of sets (rings,  $\sigma$ -rings, fields,  $\sigma$ -fields), Monotone classes, Borel sets, Additive set functions.

#### UNIT II

Measure, Properties of measure (monotonicity, countable, sub additivity and continuity), Extension of measure, Outer measures. Measurable sets.

#### UNIT III

Probability measure, Lebesgue, stieltjes measure, Measurable and measure spaces.

#### UNIT IV

Measurable Functions and its properties. Simple functions, sequence of measurable functions. Integrability of simple and measurable functions.

#### UNIT V

Properties of integrals, Lebesgue monotone and dominant convergence theorems, Fatou's lemma, Lebesgue-stieltjes integrals.

#### Books Recommended:

1. Kingman, J.F. and Taylor, S.J. : Introduction to Measure and Probability.
2. Halmos, P.R. : Measure Theory.
3. Ash R.B. : Real Analysis and Probability.
4. Rao, C.R. : Linear statistical Inference and Its Applications.
5. Goldberg R. : Methods of Real Analysis.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER I M. Sc. STATISTICS 2016-17**

**M1 STA 02 – CT 02**

**MATRICES AND LINEAR ALGEBRA**

L-T-P	4-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT I**

Inverse and partitioning of matrices, Diagonal reduction, Normal form, Vector space, Linear dependence and independence.

**UNIT II**

Basis, Dimension, Inner product spaces, Orthonormal basis, Gram-Schmidt orthogonalization process and orthogonal projection of a vector.

**UNIT III**

Characteristic equation, Eigen values and Eigen vectors, Cayley - Hamilton theorem. Minimal polynomial, similar matrices, Algebraic and geometric multiplicity of a characteristic root.

**UNIT IV**

Bilinear and quadratic forms, Definiteness of quadratic forms, Reduction to canonical forms. Concept of Generalized Inverse, Moore-penrose Generalized Inverse.

**UNIT V**

Singular values and singular value decomposition, Jordon decomposition, extrema of quadratic forms, vector and matrix differentiation.

**Books Recommended:**

1. Rao, C.R. : Linear statistical Inference and Its Applications.
2. Kolman, B. : Elementary Linear Algebra.
3. Dutta, K.B. : Matrix and Linear Algebra.
4. Graybill, F.A. (1983) : Matrices with applications in Statistics, IInd Ed., Wadsworth.
5. Biswas, S. (1984) : Topics in Algebra of matrices, Academic publications.
6. Hadley, G. (1987) : Linear Algebra, Narosa publishing House.
7. Roa, A.R. and Bhimasankaram, P. (1992) : Linear Algebra, Tata McGraw Hill.
8. Roa, C.R. and Mitra, S.K. (1971) : Generalized inverse of Matrices and its applications, John Wiley & sons.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER I M. Sc. STATISTICS 2016-17**

**M1 STA 03 – CT 03**  
**PROBABILITY THEORY**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**

**Internal Assessment 20**

**UNIT I**

Role of random experimentation in science Axiomatic approach to probability, sample space. Probability laws for combination of two or more events and its applications. Discrete Probability.

**UNIT II**

Independence of experiments, conditional probability and Statistical independence of events Baye's theorem (Heat and future) and its applications.

**UNIT III**

Random variables, Distribution functions Univariate and Multivariate and frequency functions.

**UNIT IV**

Mathematical expectation, Moments and conditional expectation, Tchebyshef inequality , Markov and Jensen inequalities.

**UNIT V**

Modes of convergence, Weak and strong law of Large numbers, various definitions of probability and inter-connections, central limit theorem.

**Recommended Books:**

1. Feller, W. : Introduction to probability Theory and its applications, Vol -I.
2. Rohatgi, V.K. : Introduction to Probability Theory and Mathematical Statistics.
3. Goon and others : An outline of statistical Theory, Vol.-I.
4. Kendall M.G. and Stuart, A. : Advanced Theory of Statistics, Vol.-I.
5. Kolmogorov A.N. : Foundations of Theory of Probability.
6. Parzen, E : Modern Probability Theory and its Applications
7. Gnedenko B.V. : The Theory of Probability.



**Reference Books:**

1. Cramer H : Mathematical Methods of Statistics.
2. Rao, C.R. : Linear Statistical Inference and its Applications.
3. Mukhopadhyay, P. : Mathematical Statistics.
4. Cacoullos, T : Exercises in Probability.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER I M. Sc. STATISTICS 2016-17**

**M1 STA 04 – CT 04**

**THEORETICAL DISTRIBUTIONS**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**

**Internal Assessment 20**

**UNIT I**

Generating functions and their applications, Moments and cumulants, Moment generating and characteristic functions, cumulative function, their properties with proof.

**UNIT II**

Inversion theorem, derivation of distribution functions from characteristic functions. Central limit theorems for equal and unequal components and applications.

**UNIT III**

Binomial, Negative-binomial, Poisson, Hyper-geometric and Multinomial distribution with their properties and applications.

**UNIT IV**

Normal, Rectangular, Cauchy, Laplace, Gamma and Beta distributions. Relation between different distributions.

**UNIT V**

Compound distributions, Pearsonian System of frequency curves.

**Recommended Books:**

1. Feller, W. : Introduction to probability Theory and its applications, Vol -I.
2. Rohatgi, V.K. : Introduction to Probability Theory and Mathematical Statistics.

3. Goon and others : An outline of statistical Theory, Vol.-I.
4. Kendall M.G. and Stuart, A. : Advanced Theory of Statistics, Vol.-I.
5. Elderton and Johnson : Systems of Frequency Curves.
6. Wilks S.S. : Mathematical Statistics.

**Reference Books:**

1. Cramer H : Mathematical Methods of Statistics.
2. Rao, C.R. : Linear Statistical Inference and its Applications.
3. Mukhopadhyay, P. : Mathematical Statistics.
4. Cacoullos, T : Exercises in Probability.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER I M. Sc. STATISTICS 2016-17**

**M1 STA 05 – CP 01**

**PRACTICALS BASED ON C - PROGRAMMING IN  
 COMPUTATIONAL STATISTICS**

L-T-P	0-0-6
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**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

Introduction to Computer and its uses. Hardware and Software, I/O Devices: Knowledge of Computer Terminology: Memory, Main Memory, Secondary Storage Memory and their devices, Random Access Memory (RAM), Read Only Memory (ROM, Device Drivers, Central Processing Unit (CPU), Binary System, Bits and Bytes: Kilobytes, Megabytes, Giabytes, Floppy Disk and Hard Disk; Type of languages: Machine Level, High Level, Low Level, Middle Level, General Purpose, Special Purpose and Assembly Languages; Translators: Assembler, Compiler, Interpreter, Application Software and System Software.

Computer Programming in C-Language; Introduction to C-Language and its uses & advantages, C-Fundamentals: Character Set in C, Structure of C-Program; Data Types: constants, Variables and C-Keywords or Reserved words and defining defined Variable Names (user's defined variables indicating appropriate data types), and Characters type data, Types of Constants: Integer, Real and Character Constants and their print format specifications (Formatted and Un-Formatted Both); Declaration of Type of Variables used, operators: Arithmetic, Relational, Logical, Conditional, Assignment Operators, Making Expressions using Operators and converting mathematical expressions into C-Expressions, Commonly used C-Library functions, C-Statements: Input and Output Control Statements, Conditional Statements (simple and nested), Loop Control Statements (simple and nested), Creating Functions in C, Use of Automatic, External, Global and Static variables; Strings as Arrays.

The Characteristic Powerful Features of-C: data structures; Structures: Array of structures, Introduction to multifile programs Macro, Recursion Functions - passing arrays and structures as arguments to functions, functions returning pointer etc.; Pointers: Array of Pointers, Passing Pointers to Functions, Pointers and one-dimensional Arrays, Pointer arithmetic, application of Pointers in processing strings, passing function to other functions.

Working with Data Files: Defining File Name, Types of File (Sequential, Random File), Modes of Files, Opening and Closing a File, Creating a File, Creating and Processing/Updating formatting and unformatting a File containing data records, File input and Output Functions, Detecting end of a File, Removing a File.

Application of C-Programming in Various Areas of Computational Statistics: Techniques related to generating random number, developing Algorithm and Programs for some useful Statistical Data Analysis problems related to: (i) Statistical Methods-Univariate, Bivariate, Multivariate cases; (ii) Theoretical and Sampling Distributions, (iii) Statistical Inference, (iv) Theory of Sample Surveys and (v) Theory of Design of Experiments; Uses of Statistical Package – SPSS.

### **Books Recommended**

- 1 Programming with C-Byron Gottfried, schaum. Series.
- 2 C-Programming-Balaguruswami.
- 3 Let us C by Kanitkar.

### **Reference Books:**

- 1 Snedecor G.W and Cochran, W.G.: Statistical Methods.
- 2 Computer Organizations and C- Programming, William Gear, McGraw-Hill Co.
- 3 Data structures and Program Design-Robert L.Kruse, Prentice - Hall of India.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER I M. Sc. STATISTICS 2016-17**

**M1 STA 06 – CP 02**  
**PRACTICALS BASED ON CT-03 & CT-04**

L-T-P	0-0-6
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**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

**List of Practicals**

1. Calculation of central Moments, coefficient of variation,  $\beta_1$ , &  $\beta_2$  and  $\gamma_1$  &  $\gamma_2$  coefficients, sheppard's correction to moments.
2. Fitting of Binomial distribution when p is known and when p is unknown.
3. Fitting of Poisson distribution when parameter is known and unknown.
4. Fitting of Normal and Negative -binomial distributions.
5. Calculation of area under normal curves.
6. Software development of above practical problems in C-language and running the same on computers.

**Books for reference:**

1. Goon and others        : An outline of Statistical theory, Vol. I.
2. Rohatgi, V. K.        : An Introduction to Probability Theory and Mathematical Statistics.

## SEMESTER II M. Sc. STATISTICS 2016-17

There will be four core courses, two core course practicals and 1 split course elective.

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## SEMESTER II M. Sc. STATISTICS 2016-17

M2 STA 01 – CT 05

### SAMPLING DISTRIBUTIONS

L-T-P	4-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

#### UNIT-I

Univariate sampling distributions: Random sampling and sampling distribution, Chi-square distribution (Central and non-central) and their applications, large sample theory.

#### UNIT-II

t and F distributions (central and non-central) and their applications.

#### UNIT-III

Curve fitting and orthogonal polynomials. Standard errors of functions of moments, Order Statistics and their distributions from any continuous population.

#### UNIT-IV

Sampling distributions of median and range from any univariate population. Regression and Correlation. Null and Non-null distributions of sample correlation coefficient.

#### UNIT-V

Bivariate Distributions (discrete and continuous): Bivariate normal distribution— distribution function and its properties, marginal and conditional distributions.

#### Recommended Books:

1. Goon and others : An outline of statistical Theory, Vol. I.
2. Kale B.K : A first course on parametric Inference, Narosa Pub. House, New Delhi.
3. Kendall M.G. and Stuart, A : Advanced Theory of Statistics, Vol.-I & II.
4. Mood, Graybill and Boes : Introduction to the Theory of Statistics.

5. Rohatgi V.K. : An Introduction to Probability Theory and Mathematical Statistics.
6. Hogg and Craig : Introduction to Mathematical Statistics.

**Reference Books:**

1. Cramer, H : Mathematical Methods of Statistics.
2. Weiss, : Statistical Decision Theory.
3. Wald, A : Sequential Analysis.
4. Mukhopadhyay, P : Mathematical Statistics.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER II M. Sc. STATISTICS 2016-17**

**M2 STA 02 – CT 06**

**STATISTICAL INFERENCE-I**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT-I**

Elements of Statistical Decision Function: Formulation of the problem, Loss functions, Risk Function, Admissibility. Elements of Theory of Estimation: Point estimation, Criterion of good estimators for one parameter: consistency, unbiasedness, efficiency, sufficiency. Theorems based on these properties.

**UNIT-II**

Minimum mean square, MVU and UMVU estimators, Cramer-Rao bounds for one parameter only.

**UNIT-III**

Method of maximum likelihood estimation. Various other methods of estimation. Interval estimation, Confidence interval and confidence coefficient and examples based on them, General method for obtaining confidence intervals.

**UNIT-IV**

Elements of testing of hypothesis: Basic concepts of testing of Hypothesis, Two kinds of errors in testing, Power of the test, Critical Region, Neyman Pearson Lemma and determination of Best Critical Region. Randomised and Non-Randomised tests.

## UNIT-V

Elements of non-parametric inference: Sign, Median and Run tests. Elements of sequential analysis: Construction of SPRT and its applications.

### Recommended Books:

1. Goon and others : An outline of statistical Theory, Vol. I.
2. Kale B.K : A first course on parametric Inference, Narosa Pub. House, New Delhi.
3. Kendall M.G. and Stuart, : Advanced Theory of Statistics, Vol.-I & II.
4. Mood, Graybill and Boes : Introduction to the Theory of Statistics.
5. Rohatgi V.K. : An Introduction to Probability Theory and Mathematical Statistics.
6. Hogg and Craig : Mathematical Methods of Statistics.

### Reference Books:

1. Cramer, H : Mathematical Methods of Statistics.
2. Sidney-siegal : Non-parametric Statistics for the Behavioral Sciences.
3. Weiss, : Statistical Decision Theory.
4. Wald, A : Sequential Analysis.
5. Mukhopadhyay, P : Mathematical Statistics.
6. Ferguson, T. : Theory of Mathematical Statistics.

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**SEMESTER II M. Sc. STATISTICS 2016-17**

**M2 STA 03 – CT 07**

**DESIGN OF EXPERIMENTS-I**

L-T-P	4-1-0
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**TIME: 3 hours**

**External Assessment 80  
Internal Assessment 20**

### UNIT-I

Design of Experiments analysis of experimental model by method of least squares, Cochran's theorem, Orthogonal polynomials. Analysis of variance and covariance Transformations.

### UNIT-II

Principles of experimentation, Uniformity trials. Completely Randomised, Randomized Block Designs.

### UNIT-III

Latin Square Designs. Balanced Incomplete Block Designs and -their analysis.

### UNIT-IV

Factorial experiments:  $2^n$  and  $3^2$  factorial experiments, Total and partial confounding in  $2^n$  and  $3^2$  factorial experiments.

### UNIT-V

Missing plot technique with reference to randomized block and latin square designs, split-plot designs.

#### Recommended Books:

1. Anderson R.L and Bancroft, T.A. : Statistical Theory in Research.
2. Kempthorne, O : Design and Analysis 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. Chakraborti, M. : Mathematics of Design & Analysis-of Experiments.
3. Joshi, D.D. : Linear estimation & Design of Experiments.

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**SEMESTER II M. Sc. STATISTICS 2016-17**

**M2 STA 04 – CT 08**

**THEORY OF SAMPLE SURVEYS-I**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**

**Internal Assessment 20**

### UNIT-I

Theory of sample surveys: Planning, execution and analysis of large scale sample surveys with illustrative examples. Detailed treatment of simple random sampling.

### UNIT-II

Stratified sampling with allocation problems, Cluster sampling.

### UNIT-III

Two-stage sampling with equal and un-equal first stage units. Systematic sampling.



## UNIT-IV

Ratio and regression methods of estimation, Double sampling.

## UNIT-V

Elements of unistage sampling with varying probabilities with replacement, Successive sampling on two occasions and h-occasions.

### Recommended Books:

1. Sukhatme P.V and sukhatme B.V. : Sampling Theory of surveys with Applications.
2. Mukhopadhyay, P : Theory & Methods of Survey sampling.

### Reference Books:

2. Deming W.E. : Some Theory of sampling.
3. Des Raj : Sampling Theory.
4. Hansen Hurwitz and Madow : Sampling surveys Methods I and Theory, Vol. II & I.
5. Murthy M.N. : Sampling Theory and Methods.

## MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR SEMESTER II M. Sc. STATISTICS 2016-17

### M2 STA 05 – CP 03

### PRACTICALS BASED ON CT-05 & CT-06

L-T-P	0-0-6
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**TIME: 3 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

### List of Practicals:

1. Correlation and regression coefficients for Bivariate frequency distributions.
2. Large sample tests.
3. Small sample tests viz Chi-square, t, F and Z tests.
4. Bartlett's test for homogeneity of Variances.

5. Power curves for testing a simple hypothesis against a composite hypothesis (one sided and two sided).
6. Test of significance of sample correlation coefficient.
7. Sign, Median and Run tests for small and large samples.
8. Sequential probability Ratio Test and calculation of constants.
9. Fitting of Curves and Orthogonal Polynomials.
10. Software development of above practical problems in C-language and running the same on computers.

**Books for reference:**

1. Goon & Others : An outline of Statistical Theory, Vol. I.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER II M. Sc. STATISTICS 2016-17**

**M2 STA 06 – CP 04**

**PRACTICALS BASED ON CT-07 & CT-08**

L-T-P	0-0-6
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**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

**LIST OF PRACTICALS:**

1. Analysis of CR Design.
2. Analysis of RB Design.
3. Analysis of L S Design.
4. Analysis of BIB Design.
5. Analysis of RBD, LSD with missing observations.

6. Yate's method for analysis of a factorial experiment.
7. Analysis of a confounded factorial experiment.
8. Analysis of split-Plot Design.
9. Drawing of random samples from finite populations.
10. Drawing of random samples from Binomial and Normal populations.
11. Estimation of population mean and estimation of variance in SRS with and without replacement.
12. Estimation of mean and variance in stratified sampling -under proportional and optimum allocations.
13. Gain in precision due to stratification.
14. Estimation of mean and variance in systematic sampling and comparison with SRS.
15. Estimation of mean and variance in cluster sampling and comparison with SRS.
16. Estimation of mean and variance by (i) ratio and (ii) regression methods of estimation.
17. Estimation of mean & variance in two-stage sampling
18. Estimation in double sampling.
19. PPSWR selection of the sample and estimation.
20. Software development of above practical problems in C-language and running the same on computers.

**Books for reference:**

1. Goulden C.H. : Methods of statistical Analysis.
2. Snedecor G.W and Cochran,W.G. : Statistical Methods.
3. Laha and others : Hand BooK of Methods of Applied Statistics.
4. Singh, D and Choudhary F.S : Theory and Analysis of sample survey Designs, Wiley Eastern Ltd.

# SEMESTER III M. Sc. STATISTICS 2016-17

There will be Two core courses, Two elective courses, I core course practicals and 1 Discipline specific elective practical.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## SEMESTER III M. Sc. STATISTICS 2016-17

M3 STA 01 – CT 09

### MULTIVARIATE ANALYSIS

L-T-P	4-1-0
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TIME: 3 hours

External Assessment 80

Internal Assessment 20

#### UNIT I

Multivariate Analysis: Multivariate normal distribution and its properties, density function, marginal and Conditional distribution. Distribution of Quadratic forms.

#### UNIT II

Maximum likelihood estimators of the mean vector and covariance matrix, and related distributions.

#### UNIT III

Hotelling's  $T^2$  its properties and uses, Mahalanobis  $D^2$ .

#### UNIT IV

Wishart Distribution and its properties Classification of observations.

#### UNIT V

Null and Non-null distributions of partial and multiple correlation coefficients, Multivariate central limit theorem and asymptotic distribution of  $Z = \tanh^{-1} r$ .

#### Books Recommended

1. Anderson T.W. : An Introduction to Multivariate statistical Analysis first seven Chapters.
2. Rao, C.R. : Linear statistical Inference and its applications.
3. Kshirsagar, A.M. : Multivariate Stat. Analysis.
4. Morrison : Multivariate Stat. Methods.
5. Kendall M.G. and Stuart, A. : Advanced Theory of Statistics, Vol. III.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA 02 – CT 10**

**STATISTICAL INFERENCE-II**

L-T-P	4-0-0
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**TIME: 3 hours**

**External Assessment 80**

**Internal Assessment 20**

**UNIT I**

STATISTICAL INFERENCE: Likelihood ratio test and its applications, asymptotic distribution of the L. R. statistic.

**UNIT II**

Properties of Maximum Likelihood Estimators: Generalization of Cramer-Rao Inequality for multi-parametric case.

**UNIT III**

Complete family of probability distributions complete Statistics and minimal sufficiency, Lehmann-scheffe theorem on minimum variance estimation.

**UNIT IV**

Uniformly most powerful tests with one and more than one parameter, Unbiased ness, consistency and efficiency of tests.

**UNIT V**

Similar regions. Relationship between notions of completeness and similarly unbiased tests.

**Books Recommended**

1. Rao, C.R. : Linear statistical Inference and its applications.
2. Kendall M.G. and Stuart, A. : Advanced Theory of Statistics, Vol. II.
3. Hogg, R.V. and Craig A.T. : Introduction to Mathematical Statistics.
4. Kale B.K. : A first course in parametric inference, Narosa Publishing House, N. Delhi.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA 05 – CP 05**

**PRACTICALS BASED ON CT-09**

L-T-P	0-0-6
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**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

Note: A candidate will have to attempt 3 Practicals.

**List of Practicals:**

Multivariate Analysis:

1. Linear combination of correlated normal variates and evaluation of probabilities.
2. Estimation of mean vector and covariance matrix.
3. Testing of mean vector(s).
4. Estimation and testing of partial and multiple correlation coefficients.
5. Discriminant function.
6. Software development of above practical problems in C-language and running the same on computers.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA - DSE 01**  
**OPERATIONS RESEARCH**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT I**

Operations Research: Definition, scope and general nature of O.R, .Transportation and Assignment problems.

**UNIT II**

Inventory Control: Deterministic Inventory models with at most one linear restriction and without restriction Probabilistic inventory models.

**UNIT III**

Queuing Theory: Examples of queuing processes, Models of queuing processes M/M/1 and M/M/S with Poisson arrivals; Exponential service time distribution, Length of queue and the queue discipline being F.I.F.O.

**UNIT IV**

Simulation: Definition, types, uses and limitations, phases of simulation model, Generation of random numbers, Monte-Carlo simulation. Application to inventory control and queuing theory. Game theory: Two-person zero sum game, saddle point, pure & mixed strategies, dominance principle and solution of game by graphical method.

**UNIT V**

Steady state, Solutions of Markovian queuing models: M/M/1, M/M1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

**Books Recommended:**

1. Sharma S.D. : Operating Research.
2. Gupta P.K. & Hira D.S. : Operations Research.
3. Kanti Swarup Gupta. P.K. and Manmohan : Operations Research
4. Goel B.S. & Mittal S.K. : Operations Research.
5. Sasieni Yaspan and Friedman : Operations Research

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA - DSE 02**  
**STATISTICAL QUALITY CONTROL**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT I**

Statistical Quality Control: Meaning of specification limits, item quality, Process and Product Control, Objectives of S.Q.C., Control chart for measurable quality characteristic, Chance variation and assignable variation of a process. Distribution of chance variates. Need for detection of assignable causes of Variation  $\bar{X}$  and R-charts, Determination of control limits and central line in various situations.

**UNIT II**

Meaning of Statistical Control and its relation with specification limits, Modified control limits, warning limits and tolerance limits Rational sub-grouping Control charts for Attributes: p, np and c-charts. Advantages of S.Q.C., comparison of  $\bar{X}$  and R-chart with p-chart when both can be used for same situation.

**UNIT III**

Acceptance sampling by attributes, Need for sampling inspection, methods for acceptance. Lot quality and lot-by-lot acceptances A.Q.L., A.Q.Q.L., producer's risk, consumer's risk, rectification, O.C function, A.S.N and average to inspection of an acceptance procedure.

**UNIT IV**

Single and double sampling plans and their mathematical analysis: Knowledge of standard sampling inspection tables Dodge and Romig table of Military standard 150.

**UNIT V**

Sampling inspection plans for continuous production process where lots cannot be formed. Sampling inspection plans by variables - One-sided specification standard (known and unknown). Two sided specification (standards known).

**Books Recommended:**

1. Grant E.L. and Leavenworth, R.S. : Statistical Quality Control.
2. Brooker and Goode : Sampling Inspection by variables.
3. Burr. I.W. : Engineering Statistics and Quality Controls.
4. Montgomery D.C. : Statistical Quality Control.
5. M.Mahajan : Statistical Quality Control Dhanpat Rai & Co. Pvt. Ltd. Nai sarak, Delhi.



**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA - DSE 03**

**PRACTICALS BASED ON DSE-01 & DSE-02**

L-T-P	2-0-4
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**Duration: 4 Hours**

**External Assessment 80**

**Internal Assessment 20**

**External Assessment 80:** Practicals : 60 Marks  
(Part-I Operations Research : 30 Marks)  
(Part-II Statistical Quality Control: 30 Marks)  
Viva-voce : 20 Marks

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

Note: A candidate will have to attempt 3 Practicals in all taking at least one from each part.

**List of Practicals:**

Operations Research and Statistical Quality Control and their software development in C-language and running the same on computers.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA –DSE 04**  
**MATHEMATICAL ECONOMICS**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**

**Internal Assessment 20**

**UNIT I**

Mathematical Economics Use of Mathematics and Statistics in Economics Theory of consumer behavior, indifference curves, equilibrium, of exchange, family budget enquiries, Angles curve, the derivation of slutsky's equation for 2 commodity, Elasticity relations in demand theory.

**UNIT II**

Nature of cost, Equalibrium of the firm: Pricing under' conditions of perfect competition and monopoly, Walrasion genral equilibrium of exchange, Leontiefs static input-output analysis.

### UNIT III

Component of time' series Methods of their determination, variates -difference method Yule-slutsky effect Correlogram analysis.

### UNIT IV

Concept of structure and model: Theoretical models and decision models, Growth models of Harrod and D Mar, Mahalanobis model.

### UNIT V

The Pareto distribution, the lognormal distribution, Lorenz curve.

#### Books Recommended:

1. Allen R.G. D. : Mathematical Analysis for Economics.
2. Chenery, H.B. : Inter-Industrial Economics.
3. Gicks : Value and Capital.
4. Wold, H. : Demand Analysis.
5. Baumol, W.J. : Economic Dynamics.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**

**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA –DSE 05**

**STOCHASTIC PROCESSES**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80  
Internal Assessment 20**

### UNIT I

Stochastic Processes Markov chain with stationary transition probabilities properties of transition functions.

### UNIT II

Classification of states stationary distribution of a Markov chain existence and uniqueness convergence to the stationary distribution.

### UNIT III

Markov pure jump processes Poisson process Birth and death process.

### UNIT IV

Second order processes mean and covariance function Gaussian and Wiener process.

### UNIT V

Stochastic differential equations estimation theory and spectral distribution.

**Books Recommended:**

1. Hoel, P.G., Port. S.C. and Stone, C.J. : Introduction to stochastic processes.
2. Feller W. : An Introduction to Probability Theory and its Applications Vol.- 1, 3 Chapters XI-XV.
3. Bailey, N.T.J. : The Elements of stochastic Processes.
4. Takacs : Stochastic Processes Chapters I and II.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER III M. Sc. STATISTICS 2016-17**

**M3 STA –DSE 6**

**INFORMATION THEORY**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT I**

Information Theory: A quantitative measure of information discrete memory-less channel the entropy function.

**UNIT II**

Conditional joint and marginal entropy and relation between them redundancy efficiency and channel capacity.

**UNIT III**

B.S.C. and B.E.C. elements of encoding unique decipherability and noiseless coding theorem.

**UNIT IV**

Minimum distance principle and parity check coding.

**UNIT V**

Shanon-Fano encoding Shanon's binary encoding Huffman's code error correcting codes.

**Books Recommended:**

1. Ash, R. : Information Theory.
2. Reza, F.M. : An Introduction to Information Theory.
3. Hancocd : Principles of communication Theory.

# SEMESTER IV M. Sc. STATISTICS 2016-17

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

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## SEMESTER IV M. Sc. STATISTICS 2016-17

M4 STA 01 – CT 11

### DESIGN OF EXPERIMENTS-II

L-T-P	4-1-0
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TIME: 3 hours

External Assessment 80

Internal Assessment 20

#### UNIT I

DESIGN OF EXPERIMENTS: 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: Orthogonality, 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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STAT 02 – CT 12**

**NON-PARAMETRIC INFERENCE**

L-T-P	3-1-0
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**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).

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA 05 – CP 06**

**PRACTICALS BASED ON CT-11**

L-T-P	0-0-6
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**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

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA – DSE 01**

**THEORY OF SAMPLE SURVEYS**

L-T-P	3-1-0
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**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.

## MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR SEMESTER IV M. Sc. STATISTICS 2016-17

### M4 STA –DSE 02

### SEQUENTIAL ANALYSIS

L-T-P	3-1-0
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**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 for 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.





**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 04**  
**ADVANCED STATISTICAL INFERENCE**

L-T-P	3-1-0
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**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<sup>nd</sup> 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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 05**  
**THEORY OF RELIABILITY**

L-T-P	3-1-0
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**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 : Statistical Analysis of Reliability and Life Testing. (1991) Models; Marcel Dekker.
4. Nelson, W. (1982) : Applied Life Data analysis John Wiley.
5. Zacks, S. Reliability Theory; Springer.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**

**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 06**

**ECONOMETRICS**

L-T-P	3-1-0
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**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 multicollinearity, 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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**

**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 07  
ECONOMIC STATISTICS**

L-T-P	3-1-0
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**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 Periodogram 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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 08**

**DEMOGRAPHY**

L-T-P	3-1-0
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**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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 09**

**ADVANCED SAMPLING THEORY**

L-T-P	3-1-0
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**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. Choudheir, Arijit & Stenger Horst : Survey sampling Theory & Methods.

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

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 10**  
**ADVANCED DESIGN OF EXPERIMENTS**

L-T-P	3-1-0
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**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 ( $P_m$ ). 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. Kempthorne, O. : Design and Analysis of Experiments.

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**SEMESTER IV M. Sc. STATISTICS 2016-17**

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

L-T-P	3-1-0
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**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**

Generalized 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 I.
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. Simonoff, J.S. (1996 Springer) : Smoothing Methods in Statistics.



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**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 12**  
**KNOWLEDGE DISCOVERY AND DATA MINING**

L-T-P	3-1-0
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**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 nonlinear 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. : Concepts and Techniques Mining: Gaufmann. Data (2000)
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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**SEMESTER IV M. Sc. STATISTICS 2016-17**

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

L-T-P	3-1-0
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**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 Carlo 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 the Bootstrap. Chapman
5. Shao, J. and Tu, D. (1995) : The Jackknife and the Bootstrap Springer Verlag.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 14**

**STATISTICAL PATTERN RECOGNITION**

L-T-P	3-1-0
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**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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 15**  
**SURVIVAL ANALYSIS**

L-T-P	3-1-0
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**TIME: 3 hours**

**External Assessment 80**  
**Internal Assessment 20**

**UNIT I**

Survival Analysis: Concepts of time Order and random Censoring likelihood 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.

**MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR**  
**SEMESTER IV M. Sc. STATISTICS 2016-17**

**M4 STA –DSE 16**  
**STATISTICAL ECOLOGY**

L-T-P	3-1-0
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**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-prey 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 tragedy of the commons. Game theory in ecology - Evolutionary 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. : A course on Mathematical and Statistical Ecology (Kluwer) Paranjpe (2000).
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 abundance 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
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**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 Modern 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. Montgomery 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.

##### **UNIT 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), Investments 4<sup>th</sup> 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. 2<sup>nd</sup> 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 Actuaries, Ithaca, Illinois, 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
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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 bisection method, secant method.

## **UNIT IV**

Regula-Falsi method, Newton Raphson 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. : Studies in Numerical Analysis  
& Soni. V.

**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. Montgomery 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), Investments 4<sup>th</sup> 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. 2<sup>nd</sup> 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, deferred 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 semicontinuous basis, reserves based on true monthly premiums, reserves on an apportionable or discounted continuous 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 Actuaries, Ithaca, Illinois, U.S.A. Second Edition (1997)

Additional References:

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

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

## IV<sup>th</sup> Semester M4 SAT 07-SC 07 Skill Course 2016-17 SEC-VI

### Documentations and Computing Algebra System

L-T-P	1-0-1
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( 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.