# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

मोहनलाल सुखाडिया विश्वविद्यालय, उदयपुर

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## DEPARTMENT OF MATHEMATICS AND STATISTICS

## SYLLABUS

## Master of Science/ Arts (M.Sc./M.A.) 2023-24

### FACULTY: SCIENCE

### SUBJECT: STATISTICS

**Revised & Reviewed**

# DEPARTMENT OF MATHEMATICS AND STATISTICS

## Master of Science/ Arts (M.Sc./M.A.) 2023-24

## FACULTY: SCIENCE

### Programme Specific Objective

The objective of M.Sc. program in Statistics is to bring out students thinking more scientifically, they will learn different techniques of analysis using software's in industries and research for big data, get knowledge and training of technical subjects provides more chances of employability in upcoming industries. Project work will develop, thinking skills by analyzing, interpreting data, identifying pattern and drawing evidence based conclusion.

### Programme Specific Outcomes (PSOs) of M.Sc. Statistics

PSO1. Preliminaries of integration, matrices, linear algebra, probability theory and theoretical distributions along with practices of problems based on above on MS-excel and SPSS.

PSO2. Study of different sampling methods, statistical inferences and classification of design of experiments. R programming language has been introduced with practical practices.

PSO3. Study of multivariate analysis, theory of sampling techniques, statistical quality control, stochastic process, non parametric inferences and optimization techniques with practical practices on software's.

PSO4. Demography, theory of reliability, economics statistics, econometrics, linear models and regression analysis and survival analysis has been introduced and the practical practices will be made on R software. A Project work is to examine the skill and knowledge of students.

**Revised & Reviewed**

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## DEPARTMENT OF MATHEMATICS AND STATISTICS

## Master of Science/ Arts (M.Sc./M.A.) 2023-24

**Faculty : SCIENCE**

**Subject : STATISTICS**

**Semester : First**

| Course Type | Course Code | Title | Delivery Type | | | Total Hours | Credit | Total Credit | Internal Assessment | EoS Exam | M.M. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | | | | | | |
| DCC | STA8000T | Measure and Integration | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8001T | Matrices and Linear Algebra | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8002T | Probability Theory | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8003T | Theoretical Distributions | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8004P | Statistics Lab-I: Statistical Methods | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8005P | Statistics Lab-II: Practical based on STA8002T and STA8003T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |

# M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8000T**

**Title of the Course** : **Measure and Integration**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to introduce the preliminaries of set theory, measure and its property, integral function and properties of integrals.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Set theory with its limits, classes and functions.
- Measure and its properties.
- Probability measure- measurable space.
- Measurable functions and its properties.
- Properties of Integral.

## Syllabus:

### UNIT I

Set operations, Limit of sequence of sets, Classes of sets (rings, σ-rings, fields, σ-fields), Monotone classes, Borel sets, Additive set functions. (12 Hours)

### UNIT II

Measure, Properties of measure (monotonicity, countable, sub additivity and continuity), Extension of measure, Outer measures. Measurable sets. (12 Hours)

### UNIT III

Probability measure, Lebesgue, Stieltjes measure, Measurable and measure spaces. (12 Hours)

### UNIT IV

Measurable Functions and its properties. Simple functions, sequence of measurable functions. Integrability of simple and measurable functions. (12 Hours)

### UNIT V

Properties of integrals, Lebesgue monotone and dominant convergence theorems, Fatou's lemma, Lebesgue-Stieltjes integrals. (12 Hours)

**Suggested Books & References:**


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.

# M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8001T**

**Title of the Course** : **Matrices and Linear Algebra**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** : B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to introduce the preliminaries of matrices & various application of characteristic equation, Bilinear quadratic forms, singular values and Jorden decomposition which are basics to learn advanced Statistics.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Matrices properties, partitioning and universe matrices with linear dependence and independence.
- Basic and dimension, orthonormal basis.
- Characteristic equations with Eigen values and vectors.
- Bilinear and quadratic forms.
- Singular value and Jordon decomposition.

## Syllabus:

### UNIT I

Inverse and partitioning of matrices, Diagonal reduction, Normal form, Vector space, Linear dependence and independence. (12 Hours)

### UNIT II

Basis, Dimension, Inner product spaces, Orthonormal basis, Gram-Schmidt orthogonalization process and orthogonal projection of a vector. (12 Hours)

### UNIT III

Characteristic equation, Eigen values and Eigen vectors, Cayley - Hamilton theorem. Minimal polynomial, similar matrices, Algebraic and geometric multiplicity of a characteristic root. (12 Hours)

### UNIT IV

Bilinear and quadratic forms, Definiteness of quadratic forms, Reduction to canonical forms. Concept of Generalized Inverse, Moore-penrose Generalized Inverse. (12 Hours)

### UNIT V

Singular values and singular value decomposition, Jordon decomposition, extrema of quadratic forms, vector and matrix differentiation. (12 Hours)

**Suggested Books & References:**


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. Rao, A.R. and Bhimasankaram, P. (1992) : Linear Algebra, Tata McGraw Hill.
8. Rao, C.R. and Mitra, S.K. (1971) : Generalized inverse of Matrices and its applications, John Wiley & sons.

# M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8002T**

**Title of the Course** : **Probability Theory**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to acquaint the students with the fundamental concepts of probability theory and an understanding with real life statistical problems.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Axiomatic approach to probability and its application.
- Independence of experiments and events, Baye's theorem and its application.
- Random variables, distribution function and multivariate and frequency function.
- Mathematical expectation and its properties.
- WLLN and central limit theorem.

## Syllabus:

### 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. (12 Hours)

### UNIT II

Independence of experiments, conditional probability and Statistical independence of events Baye's theorem (Heat and future) and its applications. (12 Hours)

### UNIT III

Random variables, Distribution functions Univariate and Multivariate and frequency functions. (12 Hours)

### UNIT IV

Mathematical expectation, Moments and conditional expectation, Tchebyshev inequality , Markov and Jenson inequalities. (12 Hours)

### UNIT V

Modes of convergence, Weak and strong law of Large numbers, various definitions of probability and inter-connections, central limit theorem. (12 Hours)

**Suggested Books & References:**


| | | | |
|---|---|---|---|
| 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. |
| 8. | Cramer H | : | Mathematical Methods of Statistics. |
| 9. | Rao, C.R. | : | Linear Statistical Inference and its Applications. |
| 10. | Mukhopadhyay, P. | : | Mathematical Statistics. |
| 11. | Cacoullos, T | : | Exercises in Probability. |

# M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8003T**

**Title of the Course** : **Theoretical Distributions**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to introduce students about theoretical concepts of various generating function, distribution functions and discrete and continuous functions.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Generating functions and their applications.
- Inversion theorem, derivation of distribution function and application of central lime theorem.
- Discrete distributions with their properties and application.
- Continuous distributions with their properties and application.
- Compound distributions, Pearson system of frequency curve.

## Syllabus:

### UNIT I

Generating functions and their applications, Moments and cumulants, Moment generating function and characteristic functions, cumulative function, their properties with proof. (12 Hours)

### UNIT II

Inversion theorem, derivation of distribution functions from characteristic functions. Central limit theorems for equal and unequal components and applications. (12 Hours)

### UNIT III

Binomial, Negative-binomial, Poisson, Hyper-geometric and Multinomial distribution with their properties and applications. (12 Hours)

### UNIT IV

Normal, Rectangular, Cauchy, Laplace, Gamma and Beta distributions. Relation between different distributions. (12 Hours)

### UNIT V

Compound distributions, Pearsonian System of frequency curves. (12 Hours)

**Suggested Books & References:**


| | | | |
|---|---|---|---|
| 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. |
| 7. | Cramer H | : | Mathematical Methods of Statistics. |
| 8. | Rao, C.R. | : | Linear Statistical Inference and its Applications. |
| 9. | Mukhopadhyay, P. | : | Mathematical Statistics. |
| 10. | Cacoullos, T | : | Exercises in Probability. |

## M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8004P**

**Title of the Course** : **Practicals Based on Statistical Methods (Using MS-Excel & SPSS)**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to develop practical knowledge of statistical problems using MS-excel as well as SPSS in students.

**Course Learning Outcomes:**

- At the end of class students will gain practical knowledge of Problems of Statistical methods and practices of data analysis on MS-excel as well as on SPSS.

## Syllabus:

**List of Practical:** (120 Hours**)**

1. Presentation of raw data.
2. Graphical representation by (i) Histogram (ii) Frequency polygon (iii) Frequency curve and (iv) Ogives.
3. Diagrammatic representation by (i) Bars (ii) Pie diagram.
4. Graphical plots: Box-Whisker plots, Histograms and Population Pyramids.
5. Measures of Central Tendency: Mean Median, Mode, G.M., H.M., Quartiles, and Deciles & Percentiles.
6. Measures of Dispersion (i) Range (ii) Semi interquartile range (iii) Mean Deviation (iv) Standard Deviation and Variance (v) Coefficient of Variation (vi) Lorenz Curve.
7. Moments and various measures of Skewness and Kurtosis.
8. Fitting of curves: (i) Straight line (ii) Parabola (iii) Exponential and Power curves.
9. Computation of simple, multiple, partial and rank correlation coefficients.
10. Computation of regression coefficient and test for intercept and slope.
11. Calculation of correlation coefficient by

(i) Karl Pearson's method and (ii) Spearman's rank method.

12. Construction of regression lines ( Up to three variables).
13. Preparation of bivariate frequency distribution, calculation of correlation coefficient for them.

**Suggested Books and Reference:**


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

## M. Sc. STATISTICS SEMESTER - I 2023-24

**Code of the Course** : **STA8005P**

**Title of the Course** : **Practicals Based on STA8002T & STA8003T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to solve the problem based on selected DCC.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Fitting of Binomial, Poisson and Normal distribution.
- Calculation of area under normal curve.
- Test for normality.
- Generating and characteristic function

## Syllabus:

**List of Practicals:** (120 Hours)

1. Random number generation (i) Binomial, (ii) Poisson, (iii) Normal
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. Plot probability curves for different sets of parameters.
7. Test for normality: P-P Plot, Q-Q Plot etc.
8. Practical using generating functions such as MGF, PGF, CGF, CF's..
9. Software development of above practical problems in Excel & SPSS and running the same on computers.

**Suggested Books and Reference:**


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

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# DEPARTMENT OF MATHEMATICS AND STATISTICS

## Master of Science/ Arts (M.Sc./M.A.) 2023-24

**Faculty : SCIENCE**

**Subject : STATISTICS**

**Semester : Second**

| Course Type | Course Code | Title | Delivery Type | | | Total Hours | Credit | Total Credit | Internal Assessment | EoS Exam | M.M. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | | | | | | |
| DCC | STA8006T | Sampling Distributions | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8007T | Statistical Inference | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8008T | Design of Experiments | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8009P | Statistics Lab-III: Statistical Computing with R | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA8010P | Statistics Lab-IV: Practical based on STA8006T, STA8007T and STA8008T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| **Select any one of the following Generic Elective Course (GEC) Course in II semester, May be obtained by the students of other departments.** | | | | | | | | | | | | |
| GEC | STA8100T | Official Statistics | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 8101T | Statistical Methods for Total Quality Management | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | |
| | STA 8102T | Investments Under Uncertainty | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | |
| | STA 8103T | Actuarial Statistics | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | |

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8006T**

**Title of the Course** : **Sampling Distributions**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to introduce sampling distribution and their application for testing significance of hypothesis.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Univariate sampling distributions, Chi-square distribution ( central and non-central) and their applications.
- t and F distribution (central and non central) and their applications.
- Orthogonal polynomials, order statistics and their distribution.
- Sampling distribution of median and range, regression and correlation, null and non-null distribution of sample correlation coefficient.
- Bivariate distribution (discrete and Continuous)

## Syllabus:

### UNIT-I

Univariate sampling distributions: Random sampling and sampling distribution, Chi-square distribution (Central and non-central) and their applications, large sample theory. (12 Hours)

### UNIT-II

t and F distributions (central and non-central) and their applications. (12 Hours)

### UNIT-III

Curve fitting and orthogonal polynomials. Standard errors of functions of moments, Order Statistics and their distributions from any continuous population. (12 Hours)

### UNIT-IV

Sampling distributions of median and range from any univariate population. Regression and Correlation. Null and Non-null distributions of sample correlation coefficient. (12 Hours)

### UNIT-V

Bivariate Distributions (discrete and continuous): Bivariate normal distribution– distribution function and its properties, marginal and conditional distributions. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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. |
| 7. | Cramer, H | : | Mathematical Methods of Statistics. |
| 8. | Weiss, | : | Statistical Decision Theory. |
| 9. | Wald, A | : | Sequential Analysis. |
| 10. | Mukhopadhyay, P | : | Mathematical Statistics. |

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8007T**

**Title of the Course** : **Statistical Inference**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aim to introduce the method of estimation their properties, randomized and non randomized tests and develop non parametric inference.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Elements of statistical decision functions, point estimation and their properties.
- Generalization of CR inequality and different method of estimation.
- Various method to obtain maximum likelihood estimators (MLE's) its properties.
- Testing of hypothesis for randomised and non randomized tests.
- Non-parametric test and sequential analysis its construction and its application.

## Syllabus:

**UNIT-I**

Theory of Estimation: Criterion of good estimators, Sufficient statistics, Factorization theorem, Distributions admitting sufficient statistic, Exponential and Pitman family's procedure for finding minimal sufficient statistic. Complete family of probability distributions, Rao Blackwell and Lehmann-scheffe theorem. (12 Hours)

**UNIT-II**

Cramer – Rao (CR) inequality, Generalization of Cramer-Rao Inequality for multi-parametric case, Methods of estimation – method of moments and its properties – method of maximum likelihood and its properties-Large sample properties of MLE. Confidence Interval: Determination of confidence intervals based on large sample & small samples. (12 Hours)

**UNIT-III**

Testing of hypothesis: Randomized and non-randomized tests, Neyman– Pearson fundamental lemma, Most powerful tests, Uniformly most powerful test, Unbiased tests, generalized Neyman-Pearson lemma, Similar test and complete sufficient statistics, Similar tests with Neyman structure, Likelihood ratio test, its properties and its asymptotic distribution, Applications of the LR method. (12 Hours)

**UNIT-IV**

Non-parametric tests: Goodness of fit test: Chi-square and Kolmogorov Smirnov test - Test for randomness, Sign tests, Wilcox on Signed rank test – Two sample problems: Kolmogorov-Smirnov test, Wald-Wolfowitz run test, Mann-Whitney U test, Median test, Kruskal Wallis test and Friedman's test. (12 Hours)

**UNIT V**

Sequential tests: Sequential Probability Ratio Test (SPRT) and its applications – Determination of the boundary constants – Operating Characteristic and expected sample size of SPRT – Optimum properties of SPRT. Applications of SPRT for testing simple v/s simple hypothesis in case of Bernoulli and Normal populations. (12 Hours)

**Suggested Books and Reference:**


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. |
| 7. | Cramer, H | : | Mathematical Methods of Statistics. |
| 8. | Sidney-siegal | : | Non-parametric Statistics for the Behavioral Sciences. |
| 9. | Weiss, | : | Statistical Decision Theory. |
| 10. | Wald, A | : | Sequential Analysis. |
| 11. | Mukhopadhyay, P | : | Mathematical Statistics. |
| 12. | Ferguson, T. | : | Theory of Mathematical Statistics. |

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8008T**

**Title of the Course** : **Design of Experiments**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to introduce factorial experiments, confounding and their analysis, incomplete block designs their construction, analysis and applications.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Analysis of factorial experiments, confounding, ANCOVA, and transformation.
- General Theory of block designs.
- Construction of MOLS and BIBD.
- Analysis of BIBD.
- Analysis of PBIBD.

## Syllabus:

### UNIT-I

Analysis of $2^n$ and $3^2$ factorial experiments, Total and partial confounding in $2^n$ and $3^2$ factorial experiments, Split-plot Designs, Analysis of Covariance and Transformation. (12 Hours)

### UNIT- II

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.

Construction of complete set of mutually orthogonal Latin square for prime and prime powers. General Block designs and its Information Matrix (C-matrix), Connectedness and Balancing in connected and disconnected designs, Orthogonality. (12 Hours)

### UNIT- III

Incomplete Block Designs: Balanced Incomplete Block Design (BIBD), Parameters of BIBD, Incidence matrix, Symmetric BIBD, Resolvable Design, Affine resolvable Design, Analysis of BIBD, (12 Hours)

### UNIT IV

Different methods of construction of BIB designs, Methods of obtaining residual and derived designs from SBIBD, Complementary design and Duals of incomplete block designs. Duals of asymmetrical BIB designs with $\lambda=1$ or $\lambda=2$.. (12 Hours)

### UNIT V

Partially Balanced Incomplete Block Designs, Concept of association scheme with two associate classes, Relation between the parameters of PBIBD, Intra block analysis of partially balanced incomplete block design, Group divisible design and its classification. (12 Hours)

**Suggested Books and Reference:**


| | | |
|---|---|---|
| 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. |
| 4. | Das, M.N. and Giri N.C. | Construction & Analysis of experiments 2nd edition, Wiley Eastern Ltd., |
| 5. | Chakraborti, M. | Mathematics of Design & Analysis-of Experiments. |
| 6. | Joshi, D.D. | Linear estimation & Design of Experiments., Wiley Eastern Ltd., New Delhi, 1987 |
| 7. | Dey, Alok | Theory of block designs, Wiley Eastern. |

## M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8009P**

**Title of the Course** : **Statistical Computing With R**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course objects to develop skills of R programming in students so they may be able to learn essentials of R programming and coding to analyze big data.

**Course Learning Outcomes:**

At the end of the class students will gain knowledge of

- Basic essential of R language.
- Constructing matrix and solving matrix operation in R.
- Creating data frames, solving descriptive statistics and graphics using R.
- Probability distributions, generation of random no's simulation of random variable in various distributions using R.
- Correlation and regression analysis using R.

## **Syllabus:** (120 Hours)

R language Essentials: The R package starting and quitting R. Basic features of R. Expressions and objects, Assignments, creating vectors, vectorized arithmetic, calculating with R Vectors, Logical operations in R. Relational operators, Data input and output, Vector arithmetic, Character vectors. Data Import.

Matrices and Arrays: Creating matrices, Operations on matrices: Triangular matrices, Matrix arithmetic, Matrix multiplication and Inverse, Lists.

R Programming: conditional statements – if and if else; loops – for, while, do-while; Repeated loops, break and next statements, Functions – built-in and user defined; Data entry – reading from text file, data editor; examples.

Data frames – creation, indexing, sorting and conditional selection; read, table function etc., examples.

Descriptive Statistics and Graphics: Obtaining summary statistics; generating tables; Programming statistical graphics: Bar charts, Pie charts, Histograms, Box plots, Scatter plots, QQ plots, exercises, Measurement of Central Tendencies, Dispersion, Skewness and Kurtosis.

Probability and Distributions: Random sampling and combinatory; obtaining density, cumulative density and quantile values for discrete and continuous distributions; generating samples from discrete and continuous distributions; Generation of pseudo random numbers, Simulation of other random variables- Bernoulli, Binomial, Poisson, Exponential, Normal random variables, Plotting density and cumulative density curves; Q-Q plot, Monte-Carlo Simulations.

Correlation and Regression Analysis: Correlation: Pearson, Spearman and Kendall's correlation, Regression – fitting, obtaining residuals and fitted values; Statistical Tests: one and two sample tests for mean and variance – one way and two-way ANOVA.

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| **1.** | Michael J. Crawley (2007) | : | The R Book, John Wiley and Sons Ltd. |
| **2.** | Peter Dalgaard (2008) | : | Introductory Statistics with R, 2nd edition, Springer. |
| **3.** | Braun, W. J. and Murdoch, D. J. | : | A First Course in Statistical Progg. with R Cambridge Univ. Press. |
| **4.** | Horton, N. J. & Kleinman, Ken | : | Using R and R Studio for data Management, Statistical Analysis and Graphics, CRC Press, USA. |

## M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8010P**

**Title of the Course** : **Practical's Based on STA8006T, STA8007T & STA8008T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to practicing the statistical problems by analyzing statistical data in different conditions.

**Course Learning Outcomes:**

At the end of class students will gain able to calculate

- Application of Large sample test, F-test, Chi-Square test and t-test.
- Bartlett's test for homogeneity of variance.
- Power curves for testing simple hypothesis v/s composite hypothesis.
- Test of significance for simple correlation coefficient.
- Non-parametric test.
- Bivariate normal distribution.
- $2^n$ and $3^2$ factorial experiments.
- $2^n$ and $3^2$ total and partial confounding
- Analysis of BIBD
- Construction of SBIBD

## Syllabus:

**List of Practicals:** (120 Hours)

1. Large sample tests.
2. Small sample tests viz Chi-square, t, F and Z tests.
3. Bartlett's test for homogeneity of Variances.
4. Non parametric tests: Kolmogorov Smirnov test, Mann-Whitney U test, Median test for k-sample problem, Kruskal Wallis test and Friedman's test.
5. Sign, Median and Run tests for small and large samples.
6. Bivariate normal distribution.
7. Construction of $2^n$ and $3^2$ factorial experiments.
8. Confounding of $2^n$ and $3^2$ factorial designs.
9. Analysis of BIBD.
10. Construction of SBIBD.
11. Software development of above practical problems in R-Software and running the same on computers.

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| **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. |
| **7.** | Cramer, H | : | Mathematical Methods of Statistics. |
| **8.** | Wald, A | : | Sequential Analysis. |
| **9.** | Mukhopadhyay, P | : | Mathematical Statistics |

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8100T**

**Title of the Course** : **Official Statistics**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to provide an indispensable element in the information system of a democratic society, the economy and the public with data about the economics, demographics, social and environmental situation.

**Course Learning Outcomes:**

At the end of class students will gain able to calculate

- Indian and international system of statistical organization.
- Role of NSSO & CSO.
- Population growth in developed developing countries.
- Various family welfare programs and labour force in India.
- Scope of population census in India.

## Syllabus:

### UNIT I

Introduction to Indian and International Statistical systems. Role, function and activities of Central and State statistical organizations. (12 Hours)

### UNIT II

Organization of large scale sample surveys. Role of National Sample Survey Organization. General and special data dissemination systems. (12 Hours)

### UNIT III

Population growth in developed and developing countries. (12 Hours)

### UNIT IV

Evaluation of performance of family welfare programs, projections of labour force and manpower. (12 Hours)

### UNIT V

Scope and content of population census of India. (12 Hours)

**Suggested Books and Reference:**


1. Basic statistics Relating to the Indian Economy (CSO) 1990.
2. Guide to Official Statistics (CSO), 1999.
3. Statistical System in India (CSO) 1995).
4. Principles and Accommodation of National Population Censuses, UNESCO.
5. Panse, V. G.: Estimation of Crop Yields (FAO).
6. Family Welfare Yearbook. Annual Publication of D/0 Family Welfare.
7. Monthly Statistics of Foreign Trade in India, DGCIS, Calcutta and other Govt. Publications.

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8101T**

**Title of the Course** : **Statistical Methods for Total Quality Management**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aim to provide the basic concept of quality system their accuracy, management system and their analysis.

**Course Learning Outcomes:**

At the end of class students will gain able to calculate

- Different standard levels of quality systems.
- Precision and accuracy of various measurement system.
- Quality management, analysis and optimization.
- Measure of quality of different level of proves and tolerance designs.

## Syllabus:

### UNIT I

Quality System: ISO 9000 standard, QS 9000 standards, Concept of six-sigma and the define-measure-analysis-improve-Control Approach. (12 Hours)

### UNIT II

Precision and accuracy in measurement systems. Estimation of Measurement Uncertainty. (12 Hours)

### UNIT III

Total Quality Management, Process Analysis and Optimization. (12 Hours)

### UNIT IV

Quality at Design Stage, Quality Function Deployment, Failure Mode and Effect Analysis. (12 Hours)

### UNIT V

Conjoint Analysis, System, Parameter and tolerance designs. (12 Hours)

**Suggested Books and Reference:**


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.

## M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8102T**

**Title of the Course** : **Investments Under Uncertainty**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aim to provide basic concepts of trading about money, management to keep funds safe and secure.

**Course Learning Outcomes:**

At the end of class students will gain able to calculate

- Risk faction in trading.
- Money market, fixed income, equity.
- Compound interest, rate of inflation.
- Analysis of risk aversion.
- Fraction that affect investments, portfolios of risk.

## Syllabus:

**UNIT I**

Main Theme: Risk – Return Trade off. (12 Hours)

**UNITI II**

Money market, Fixed income, equity, stocks and bonds, Treasury notes, market indexes, Rates of interest. (12 Hours)

**UNIT III**

Compound interest, inflation, Risk in a portfolio context, law of one price and arbitrage. (12 Hours)

**UNIT IV**

Risk and risk aversion, mean variance analysis, allocation between risky and risk free portfolios. (12 Hours)

**UNIT V**

Diversification and portfolio risk, Markovitz portfolio selection, optimal portfolios. (12 Hours)

**Suggested Books and Reference:**


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

# M. Sc. STATISTICS SEMESTER - II 2023-24

**Code of the Course** : **STA8103T**

**Title of the Course** : **Actuarial Statistics**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to provide basic knowledge of Actuarial Statistics, its application in statistics to define analyze and solve the financial impact of future events and helps insurance companies to forecast about the future fund requirement of companies.

**Course Learning Outcomes:**

After completion of classes students will be able to learn:

- Basic concepts of actuarial Science.
- Probability models for Life, Life table and its applications.
- Probability models for individual and aggregate claims.
- Computations various types of Insurance payables.
- Different types of life annuities and their computation. Net premiums and Net premium reserves.

## Syllabus:

**UNIT I**

Probability Models and Life Tables. (12 Hours)

**UNIT II**

Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curtate future lifetime, force of mortality. (12 Hours)

**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. (12 Hours)

**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. (12 Hours)

**UNIT V**

Distribution of aggregate claims, compound Poisson distribution and its applications, Distribution of aggregate claims, compound Poisson distribution and its applications. (12 Hours)

**Suggested Books and Reference:**


1. 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)
2. Spurgeon E.T. (1972), Life Contingencies, Cambridge University Press.
   Neill, A. (1977). Life Contingencies, Heineman.

**Revised & Reviewed**

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## DEPARTMENT OF MATHEMATICS AND STATISTICS

### Master of Science/ Arts (M.Sc./M.A.) 2024-25

**Faculty : SCIENCE**

**Subject : STATISTICS**

**Semester : Third**

| Course Type | Course Code | Title | Delivery Type | | | Total Hours | Credit | Total Credit | Internal Assessment | EoS Exam | M.M. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | | | | | | |
| DCC | STA 9011T | Multivariate Analysis | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9012T | Theory of Sampling Techniques | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| **Select any Three Discipline specific Elective (DSE) Courses from selected DSE groups in III semester.** | | | | | | | | | | | | |
| DSE I | STA 9104T | Statistical Quality Control | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9105T | Stochastic Process | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE II | STA 9106T | Operation Research | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9107T | Non-Parametric Inference | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE III | STA 9108P | Elective Statistics Lab-II: Practical based STA9011T & STA9012T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9109P | Elective Statistics Lab-I: Practical based STA9104T or STA9105T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9110P | Elective Statistics Lab-II: Practical based STA9106T or STA9107T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |

| Select any One of the following Generic Elective Course (GEC) Course in III semester, May be obtained by the students of other departments. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEC | STA 9111P | Hands-on with MS-Excel | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | |
| | STA 9112P | Hands-on with R | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | |
| | STA 9113P | Hands-on with SPSS | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | |
| | STA 9114P | Hands-on with C / C++ Language | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9011T**

**Title of the Course** : **Multivariate Analysis**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to provide a deeper understanding of statistical data in real life problems and their analysis using multivariate applications.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Multivariate normal distribution and its properties and distribution of quadratic forms.
- MLE's of the mean vector and covariance matrix. Null and non-null distributions of partial and multiple correlation coefficients and multivariate central limit theorem.
- Hotelling's $T^2$ its properties and uses, Mahalanobis $D^2$.
- Wishart distribution and its properties classification of observations.
- Principal components, canonical correlation, definition, uses, estimation and computation.

## Syllabus:

### UNIT I

Multivariate Analysis: Multivariate normal distribution and its properties, density function, marginal and Conditional distribution. Distribution of Quadratic forms. (12 Hours)

### UNIT II

Maximum likelihood estimators of the mean vector and covariance matrix, and related distributions. Null and Non-null distributions of partial and multiple correlation coefficients, Multivariate central limit theorem and asymptotic distribution of $Z = \tanh^{-1} r$. (12 Hours)

### UNIT III

Hotelling's $T^2$ its properties and uses, Mahalanobis $D^2$. (12 Hours)

### UNIT IV

Wishart Distribution and its properties, Classification of observations. (12 Hours)

### UNIT V

Principal components, dimension reduction, canonical variates and canonical correlation—definition, uses, estimation and computation. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 1. | Anderson T. W. | : | An Introduction to Multivariate statistical Analysis first seven Chapters. |
| 2. | Rao, C. R. | : | Linear statistical Inference and its applications. |
| 3. | Khirsagar, A. M. | : | Multivariate Statistical Inference |
| 4. | Morrison | : | Multivariate Statistical Methods. |
| 5. | Kendall M.G. and Stuart, A. | : | Advanced Theory of Statistics, Vol. III. |
| 6 | Giri, N.C | | Multivariate Statistical Inference |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9012T**

**Title of the Course** : **Theory of Sampling Techniques**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aim to check the characteristics of population by using various method of sampling

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Partition of sample space and definition of T-classes of linear estimators.
- Quenouille's techniques of bias reduction and its applications, methods of estimation in PPSWR, ratio method of estimation.
- Ratio and regression methods of estimation for PPSWR, Variance by HT-estimator and YG-estimators.
- Sen- Midzuno scheme of sampling of inclusion probabilities.
- The theory of multistage sampling with VPWR and VPWOR.

## Syllabus:

### UNIT-I

Methods of estimation based on auxiliary variables: Ratio and regression methods of estimation, Elements of Uni-stage sampling with varying probabilities with replacement, 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. (12 Hours)

### UNIT-II

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, Sen-Midzuno scheme of sampling and simplification of inclusion probabilities for Yates-Grundy estimate of variance with advantages.
(12 Hours)

### UNIT III

Rao-Hartley-Cochran sampling schemes and their estimation procedures, Two-stage sampling with equal and unequal first stage units, Double sampling, The theory of multi-stage sampling with varying probabilities with and without replacement. (12 Hours)

### UNIT-IV

Des Raj ordered estimators, Murthy's unordered estimators, Hartley and Ross Unbiased Ratio type estimator, Quenouille's Techniques of bias reduction and its application to Ratio type estimators. (12 Hours)

### UNIT-V

Ratio method of estimation in PPSWR sampling, Ratio method of estimation under Midzuno's scheme of sampling when X is known, Bivariate extension of the Ratio & Regression method of estimation when population means of auxiliary variables are known. (12 Hours)

**Suggested Books and Reference:**


1. Sukhatme P.V and sukhatme B.V. : Sampling Theory of surveys with Applications.
2. Mukhopadhyay, P : Theory & Methods of Survey sampling.
3. Tikkiwal, B.D. : Lecture notes on Advanced Theory of sample surveys.
4. Deming W.E. : Some Theory of sampling.

5. Des Raj : Sampling Theory.
6. Hansen Hurwitz and Madow : Sampling surveys Methods I and Theory, Vol. II & I.
7. Murthy M.N. : Sampling Theory and Methods.
8. Cochran, W.G. : Sampling Techniques

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9104T**

**Title of the Course** : **Statistical Quality Control**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to derive statistical techniques which achieve quality in production of manufacturing product and service organization.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Concept of statistical quality control.
- Control charts for attributes and variables.
- Need of sampling inspection, acceptance s sampling by attributor.
- Single and double sampling plans.
- Sampling inspection plans for continuous variables.

## Syllabus:

### 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 $\overline{X}$ and R-charts, Determination of control limits and central line in various situations. (12 Hours)

### 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 $\overline{X}$ and R-chart with p-chart when both can be used for same situation. (12 Hours)

### 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. (12 Hours)

### 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. (12 Hours)

### 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). (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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 Dhanpat Rai | : | Statistical Quality Control |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9105T**

**Title of the Course** : **Stochastic Process**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to provide basic concepts of stochastic process and types of Stochastic process with wide applicability using probability and random sampling.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Stochastic process with stationary transition probabilities and its properties.
- Classification of states stationary distribution of a Markov chain.
- Markov pure jump process, passion process, birth and death process.
- Second order processes mean and covariance function.
- Stochastic differential equations, estimation theory and special distribution.

## Syllabus:

**UNIT I**

Definition and examples of stochastic process: Stochastic processes and their classification, Markov process and Markov Chain, Transition probabilities and properties of transition functions, Classification of states, transient Markov chain, Determination of higher order transition probability and its limits. Limit theorems for Markov Chains, Discrete time Markov chain, Stationary distribution and its interpretation, Chapman-Kolmogorov equation, (12 Hours)

**UNIT II**

Continuous time Markov Chain: Poisson process and related inter-arrival time distribution, compound Poisson process, Pure birth process, pure death process, birth and death process and Problems. (12 Hours)

**UNIT III**

Random Walks: One-dimensional, two-dimensional and three-dimensional random walks. Duality in random walk. Simple random walks, Barriers, Gambler ruin problems. Applications from social, biological and physical sciences. (12 Hours)

**UNIT IV**

Markov process with continuous state space, Weiner process, Wiener process as a limit of random walk; first-passage time and other problems. Renewal processes, Elementary renewal theorem and its applications. Brownian motion process and its basic properties. (12 Hours)

**UNIT V**

Galton -Watson branching processes: Definition and examples of discrete time branching process, Probability generating function and its properties, Offspring mean and probability of extinction. Statistical inference in MC and Markov processes. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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. |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9106T**

**Title of the Course** : **Operations Research**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The learning object of the course to enrich the knowledge of students with advanced concepts and techniques of LPP, inventory control, simulation techniques and queuing theory.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- OR definition, scope and nature, LPP, duality, transpiration and assignment problems.
- Deterministic, Inventory models with at most one linear restriction and without restriction probabilistic inventory models.
- Queuing theory and its differ models of process.
- Simulation, definition, its types uses and limitations.
- Steady state, solutions of Markovian queuing models.

## Syllabus:

### UNIT I

Operations Research: Definition, scope and general nature of O.R, Linear programming problem, Duality, Transportation and Assignment problems. (12 Hours)

### UNIT II

Inventory Control: Deterministic Inventory models with at most one linear restriction and without restriction Probabilistic inventory models. (12 Hours)

### 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. (12 Hours)

### 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. (12 Hours)

### 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. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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 |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9107T**

**Title of the Course** : **Non-Parametric Inference**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aim to provide basic concepts of non parametric inferences and its application for small and large samples.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Order statistics and their sampling distribution and hypothesis testing for population quantities.
- Tolerance limits for distribution and coverage's, Chi-square goodness of fit test and signed test.
- Test for two sample problems comparison and their distributions, Run test, median test and U-test.
- Linear ranks statistics, Probability distribution and irefulness.
- Correlation between rank order statistics and variate values. Test based on the total number of runs and the length of the longest run.

## Syllabus:

### UNIT I

Non-Parametric Inference: Order Statistics and their sampling distribution confidence interval estimates and hypothesis testing for population quantiles. (12 Hours)

### UNIT II

Tolerance limits for distribution and coverage's, Kolmogorov Smirnov and Chi-square goodness of fit tests. Ordinary sign test and Wilcoxon-signed rank test. (12 Hours)

### UNIT III

Test for two-sample problems, comparison of two distributions by Wald-Wolfowitz Runs test and Kolmogorov Smirnov test Median test for equality of locations and Mann-Whitney U-test. (12 Hours)

### UNIT IV

Linear ranks Statistics, its definition, probability distribution and usefulness in inference problems linear rank test for the location and scale problems. (12 Hours)

### 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. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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). |

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9108P**

**Title of the Course** : **Practical's Based on STA9011T & STA9012T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to solve practical problems based on Multivariate Analysis and Theory of Sampling Techniques (hands-on with MS-excel.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Evaluation of probabilities for multiple data.
- Estimate mean vector and variance covariance matrix
- Estimate and test the significance of multiple and partial correlation coefficient and regression.
- Estimate two-stage sampling mean and variance.
- Estimate mean and variance by different method of estimation.

**Syllabus:** (120 Hours)

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. Estimation of regression lines.
6. Practical based on Hostelling $T^2$
7. Discriminant function.
8. Estimation of mean and variance by (i) ratio and (ii) regression methods of estimation.
9. Estimation of mean & variance in two-stage sampling.
10. Estimation in double sampling.
11. Horvitz and Thompson's procedure of estimating mean (total) of the population, variance of estimator and estimate of variance.
12. Yate's and Grundy method.
13. Midzuno's sampling scheme.
14. Rao-Hartley-Cochran schemes.
15. 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.
16. Hartley-Ross unbiased Ratio method of estimation.
17. Bivariate Extension of Ratio & regression method of estimation (Olkin's technique).
18. Software development of above practical problems in C-language and running the same on computers.

## M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9109P**

**Title of the Course** : **Practical's Based on STA9104T or STA9105T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to solve problems based on statistical quality control or Stochastic process (any selected DSE) (hands-on with MS-excel).

**Course Learning Outcomes based on STA9104T:**

At the end of class students will gain knowledge of

- Control charts for attributes and variables.
- Sampling inspection, acceptance sampling.
- Single and double sampling plans.
- Sampling inspection plans for continuous variables.

## Syllabus

1. Control charts for variable.
2. Control charts for attributes.
3. 3-σ limits
4. Control chart for standard deviation or σ limits.
5. p-chart for fraction defective.
6. d-chart for number of defectives.
7. c-chart for number of defects.
8. Average outgoing Quality curve & its Limits.
9. O.C. Curve for Single & double sampling plan.
10. ASN for Single & double sampling plan.

or

**Course Learning Outcomes based on STA9105T:**

At the end of class students will gain knowledge of

- N-step transition probabilities.
- Realization of Markov chain.
- Estimation of transition probability of Markov chain using realization.
- Stochastic Process
- Markov pure jump process, passion process, birth and death process.

## Syllabus

1. Calculation of n-step transition probabilities and limiting distribution in Markov chain.
2. Realization of Markov chain.
3. Estimation of transition probability of Markov chain using realization.
4. Stochastic Process and their software development in R-software and running the same on computers.

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9110P**

**Title of the Course** : **Practical's Based on STA9106T or STA9107T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to solve problems based on Operation Research or Non-parametric Inference (any selected DSE) (hands-on with MS-excel).

**Objectives of the Course (DSE STA9106T)** :

The course aims to solve problem based Operation Research.

**Course Learning Outcomes:**

At the end of class students will gain practical knowledge of

- LPP, duality, transportation and assignment problems.
- Inventory models and Inventory control.
- Queuing theory and its models of process.
- Monte Carlo Simulation.
- Steady state, solutions of Markovian queuing models.

## Syllabus

1. LPP by Simplex method
2. Duality Problems.
3. Transportation Problems.
4. Assignment Problems.
5. Problems based on Inventory Control.
6. Problems based on Queuing theory.
7. Problem Based on Monte Carlo Simulation.
8. Problems on Markovian models.

**or**

**Objectives of the Course (DSE STA9107T)**

The course aims to solve problem based on Non-parametric tests

**Course Learning Outcomes:**

- Order statistics and sampling distribution and confidence interval
- Tolerance limits for distribution, sign test, rank test, goodness of fit tests
- Median test
- Rank test

## Syllabus

1. Non parametric tests: Kolmogorov Smirnov test, Mann-Whitney U test, Median test for k-sample problem, Kruskal Wallis test and Friedman's test.
2. Sign, Median and Run tests for small and large samples.

## M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9111P**

**Title of the Course** : **Hands-on with MS Excel**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to practice practical problems in Statistical methods using MS-excel.

**Course Learning Outcomes:**

At the end of class students will gain practical knowledge of

- Students will gain thee knowledge of various statistical tools using software MS Excel.
- Students encourage to adopt the advance data analysis tools packs to evaluate the complex statistical methods.

# M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9112P**

**Title of the Course** : **Hands-on with R**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to practice practical problem based on Statistical methods using R language.

**Course Learning Outcomes:**

- Students will learn the basic of R-programming with installation & execution of R-Studio & R-Console.
- They will handle the various important feature of input method loops, operator etc.
- Students will use the advance technique of gen random no. generation plotting types as well as simulation technique.

## M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9113P**

**Title of the Course** : **Hands-on with SPSS**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to practice analytical problems based on Statistical methods using SPSS software.

**Course Learning Outcomes:**

- Students will gain knowledge of analysis of data using SPSS software.
- They will learn one way & two way data analysis.
- Students will gain knowledge of parametric & non-parametric test.

## M. Sc. STATISTICS SEMESTER - III 2024-25

**Code of the Course** : **STA9114P**

**Title of the Course** : **Hands-on with C/C++ Language**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Generic Elective Course (GEC)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with STATISTICS as a core subject.

**Objectives of the Course** :

The course aims to develop skill in making programs based on statistical problems using $C/C^{++}$ programming language.

**Course Learning Outcomes:**

After learning C++ programming students will able to :

- Concepts of compile and run the C++ programming language.
- Proficient in writing syntactically correct and efficient C++ code.
- Develop the skills to implement and manipulate variables, arrays, and pointers in C++ programs.
- Create and implement data structures and algorithms using C++.
- Capable of handling input and output operations, including file handling, in C++ programs.

## **Syllabus:** (120 Hours)

**PRACTICAL/ LAB WORK** (Using C/C++ Programming Language)

**List of Practical**

1. Practical based on Conditional Statements
2. Practical based on Loops Statements
3. Practical based on Structures and Unions.
4. Plot of a graph y = f(x)
5. Roots of a quadratic equation (with imaginary roots also)
6. Sorting of an array and hence finding median
7. Mean, Median and Mode of a Grouped Frequency Data
8. Variance and coefficient of variation of a Grouped Frequency Data
9. Preparing a frequency table
10. Value of n! using recursion
11. Random number generation from uniform, exponential, normal(using CLT) and gamma
12. distribution, calculate sample mean and variance and compare with population parameters.
13. Matrix addition, subtraction, multiplication Transpose and Trace
14. Fitting of Binomial, Poisson distribution and apply Chi-square test for goodness of fit
15. Chi-square contingency table
16. t-test for difference of means
17. Paired t-test
18. F-ratio test
19. Multiple and Partial correlation.
20. Compute ranks and then calculate rank correlation(without tied ranks)
21. Fitting of lines of regression

**Suggested Books and References:**


1. Kernighan, B.W. and Ritchie, D. (1988): The C-Programming Language,2nd Edition,Prentice Hall.
2. Balaguruswamy, E. (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill.
3. Gottfried, B.S. (1998): Schaum's Outlines: Programming with C, 2nd Edition, TataMcGraw Hill.
4. Kanitkar Y.: Computer Programming in C, B. P. B. Publication, New Delhi.

**Revised & Reviewed**

# MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

## DEPARTMENT OF MATHEMATICS AND STATISTICS

### Master of Science/ Arts (M.Sc./M.A.) 2024-25

**Faculty : SCIENCE**

**Subject : STATISTICS**

**Semester : Fourth**

| Course Type | Course Code | Title | Delivery Type | | | Total Hours | Credit | Total Credit | Internal Assessment | EoS Exam | M.M. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | | | | | | | |
| DCC | STA 9013T | Demography | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| **Select any Five Discipline specific Elective (DSE) Courses from selected DSE groups in IV semester.** | | | | | | | | | | | | |
| DSE I | STA 9115S | Project work | - | - | S | 120 | 4 | 4 | 20 | 80 | 100 | Presentation, submission and viva-voce |
| | STA 9116T | Theory of Reliability | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE II | STA 9117T | Linear Models & Regression Analysis | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9118T | Economics Statistics | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE III | STA 9119T | Econometrics | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9120T | Survival Analysis | L | - | - | 60 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE IV | STA 9121P | Elective Statistics Lab-III: Practical based on STA9013T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9122P | Elective Statistics Lab-IV: Practical based on STA9116T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| DSE V | STA 9123P | Elective Statistics Lab-V: Practical based on STA9117T & STA9119T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | --- |
| | STA 9124P | Elective Statistics Lab-VI: Practical based on STA9118T & STA9120T | - | - | P | 120 | 4 | 4 | 20 | 80 | 100 | |

# M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9013T**

**Title of the Course** : **Demography**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Centric Compulsory (DCC)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to achieve knowledge about the statistical study of human population with various factors.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Census and vital data.
- Stationary populations, construction of life table.
- Stable population theory.
- Demographic trends in India
- Bivariate growth models, migration models, fertility and mortality analysis models.

## Syllabus:

### UNIT I

Demography: Sources of demographic data, Census, registration and vital statistics data, Coverage and content errors in demographic data, Chandrasekharan—Deming formula to check completeness of registration data, adjustment of age data- use of Whipple, Myer and UN indices. Population transition theory, Basic demographic measures: Ratios, Proportions and percentages, Population Pyramids, Sex ratio Crude rates, Density of population, Probability of dying. (12 Hours)

### UNIT II

Measures of mortality: Crude death rate, Standardized death rates, Age-specific death rates, Infant Mortality rate, Death rate by cause.

Measures of fertility: Crude birth rate, General fertility rate, Age specific birth rate, Total fertility rate, Gross birth rate, Net reproduction rate, Trends and differentials in mortality and fertility. (12 Hours)

### UNIT III

Life Table: Description of life table, Construction of complete and abridged life tables, Complete life table and its main features, Uses of life tables, Makehams and Gompertz curves, National life tables, UN model life tables, Abridged life table (Greville's Formula, Reed-Merrels's Formula and King's Method). (12 Hours)

### UNIT IV

Models of population growth and their filling to population data: Growth rates, Natural increase rate, Arithmetic, Geometric, Exponential, Logarithmic, Logistic, Gompertz growth rates, Stable and Stationary populations, Stable population theory, Population estimation and projection, Methods for population projection, component method of population projection. (12 Hours)

### UNIT V

Internal migration and its measurement, migration models, concepts of international migration, Net migration, Inter and post censal estimates, Projection method including logistic curve fitting, Decennial population census in India, population projection by component method. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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. |

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9115S**

**Title of the Course** : **Project Work**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (20 Hours) and Field work .analysis and report writing (100 hours) (Presentation, submission and viva-voce)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of human interest. The project work will provide hands-on training to the students to deal with data emanating from some real-life situation and propel them to dwell on some theory or relate it to some theoretical concepts.

**Course Learning Outcomes:**

After completing the project/ dissertation the students will learn several valuable skills and gain knowledge through writing and presenting a statistical report on a real life problem by:

- CO1Data Collection: how to gather relevant data from various sources and ensure its reliability and validity. They will understand the importance of selecting appropriate data collection methods and techniques.
- Data Analysis: apply statistical analysis techniques to the collected data. They will gain proficiency in using statistical software or programming languages to perform descriptive and inferential statistics. They will understand how to interpret and draw meaningful conclusions from statistical results.
- Research Skills: develop essential research skills, including the ability to critically review existing literature and studies related to the chosen topic. They will learn how to synthesize information, identify research gaps, and apply theoretical frameworks to their empirical findings.

- Theoretical Understanding: By exploring relevant theoretical concepts and frameworks, students will enhance their understanding of the subject matter. They will learn to connect empirical findings with theoretical foundations and analyze the implications of their research in a broader context.
- Report Writing: Students will learn to effectively communicate their research findings through clear and concise report writing. They will understand the structure and components of a statistical report, including the introduction, methodology, data analysis, discussion, and conclusion. They will also develop skills in organizing information, presenting data visually, and using appropriate citations.
- Presentation Skills: Through presenting their statistical report to an audience, students will enhance their presentation skills. They will learn to effectively convey complex statistical information, engage the audience, and respond to questions or feedback. They will gain confidence in public speaking and improve their ability to communicate research findings orally.
- Critical Thinking and Problem-Solving: Students will develop critical thinking skills by analyzing and interpreting data, identifying patterns, and drawing evidence-based conclusions. They will learn to identify and address potential challenges or limitations in their research process and make informed decisions to overcome them.
- Collaboration and Supervision: Students will learn to work collaboratively with their peers and seek guidance from their faculty supervisor. They will understand the importance of effective communication, teamwork, and accountability in a project-based setting.
- Application of Statistical Concepts: By working on a real-life human interest topic, students will gain practical experience in applying statistical concepts and techniques to solve real-world problems. They will understand the relevance and utility of statistical analysis in various fields and industries.

## **Syllabus:** (90 Hours)

The Project Work will be spread over the whole semester. Project may be undertaken by the group of students and each teacher can guide upto 10 students, which can be relaxed by the Head of the department. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses using some advance statistical softwares/ packages such as R/ STATA/ SPSS/ Latex etc. performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of total 100 marks assigned to the project, 80 marks will be assigned on the evaluation of the project work separately by both the examiners and 20 marks will be assigned jointly by the examiners on the oral presentation and viva – voce).

**Guidelines of Project Work**

1. A project work is compulsory and shall be offered in semester IV. Project submission is in Semester IV but the allocation of students should be done at the starting of III$^{rd}$ semester.
2. A project work may be taken individually or by a group of students (not more than 10 per batch).
3. Project work shall be supervised by faculty members assigned by the Head/ Incharge of the department , as the case may be at the starting of third semester.
4. The orientation of Project work shall be neither of a theory paper nature nor of a lab/practical nature but shall be in the form of dissertation.
5. Students, will decide Project Topic/ Area in consultation with the supervisor. Project work may be carried out in a group of students depending upon the depth of fieldwork/ problem involved.
6. Review meetings are to be done periodically (fortnightly/monthly) to the allocated students by the respective supervisors.
7. Students may be given 4 to 6 weeks during the semester, for their industrial work/ data collection/ survey or any other fieldwork involved in the project.
8. The project work should be selected in such a way that there is enough scope to apply and demonstrate the statistical techniques learnt in the course.

9. In this project, students should prefer mainly statistical softwares/ packages such as R/ STATA/ SPSS/ Latex etc. for their analysis and writing the reports. However, students may use MS-word/ Excel for their execution too.

10. At the end of the session, a report on the work done should be submitted in two copies. If a team of two students jointly do a project work then they must submit individual reports separately (not copy of the same report).

11. The project report shall clearly state the selected problem, the statistical methodologies employed for data collection and analysis and the conclusions arrived at. Details of previous studies in the area of work and related references should also be given.

12. The project work will be assessed for a maximum of 100 (80+ 20 internal assessment) marks. Each student shall give a presentation at the time of submission of their project work which will be evaluated internally for a maximum of 60 marks. There will be an external viva-voce examination for a maximum of 20 marks by an internal and an external examiner. The parameters for viva voce include (i) Clarity of presentation (ii) Clarity of the content / concept (iii) response to the queries and (iv) relevance of topic for carrying out the project.

13. If there is found any shortcoming in the project work, then the HOD decision shall be final in this regard.

**Suggested Books and Reference:**

1. Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern.

2. Dominowski, R.L. (1980): Research Methods, Prentice Hall Inc., New Jersey.

3. Mishra, R.P. (1980): Research Methodology, Handbook Concept Publishing Company, New Delhi.

4. IIPS (1996): Research Methodology, IIPS, Mumbai.

# M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9116T**

**Title of the Course** : **Theory of Reliability**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to study the estimate errors in life testing model and suggest ways of improving tests to minimized errors.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Reliability growth models and techniques to plot it.
- Concept and measures components of reliability.
- Various distributions to tests the model.
- Notion o ageing various classes.
- Shock models.

## Syllabus:

### UNIT I

Reliability: Reliability growth models probability plotting techniques for Basic ideas of accelerated life testing. (12 Hours)

### UNIT II

Reliability concepts and measures components and systems coherent systems reliability of coherent systems Life distributions reliability function hazard rate. (12 Hours)

### UNIT III

common life distributions-exponential, Weibull, gamma etc Estimation of parameters and tests in these models. (12 Hours)

### UNIT IV

Notions of ageing IFR, IFRA, NBU DMRL and NBUE Classes and their duals. (12 Hours)

### UNIT V

Univariate shock models and life distributions arising out of them. (12 Hours)

**Suggested Books and Reference:**


| | | | |
|---|---|---|---|
| 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. |

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9117T**

**Title of the Course** : **Linear Models and Regression Analysis**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to provide basic concepts of linear models and regression analysis using statistical techniques to develop relationship between explanatory and response variables.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Theory of linear estimation, generalized inverse of a matrix etc.
- ANOVA and multiple comparison tests etc.
- Simple, multiple regression models, homogeneity of variances etc.
- Selection of input variables and model selection
- Robust regression

## Syllabus:

**UNIT I**

Theory of linear estimation, Gauss-Markov linear models, estimable functions, error and estimation space, least squares estimation, variance and covariance of least squares estimator, estimation of error variance, estimation with correlated observations, properties of least square estimators, generalized inverse of a matrix and solution of normal equations, variances and covariance of least square estimators. (12 Hours)

**UNIT II**

One way and two-way classifications, fixed, random and mixed effects models, Analysis of variance (two-way classification only), Multiple comparison tests due to Tukey, Scheffe and Student-Newmann-Karl. (12 Hours)

**UNIT III**

Simple linear regression, multiple regression model, fit of polynomials and use of orthogonal polynomials, Residuals and their plots as tests for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of outliers. Remedies. Multi co-linearity, ridge regression, sub-set selection of explanatory variables, Mallows Cp Statistics. (12 Hours)

**UNIT V**

Selection of input variables and model selection – Methods of obtaining the best fit – Stepwise regression, Forward selection and backward elimination – Multicollinearity – Collinearity diagnostics – Causes, Consequences and Remedy –Departure from normality Introduction to general non-linear regression, least squares in non-linear case, Estimating the parameters of a non-linear system. (12 Hours)

**UNIT V**

Robust regression – Linear absolute deviation regression – M estimators – Robust regression with rank residuals – Resampling procedures for regression models – methods and its properties (without proof) - Jackknife techniques and least squares approach based on M-estimators. (12 Hours)

**Suggested Books and Reference:**


1. Goon, A.M., Gupta, M.K. and Das Gupta, B. (1967): An Outline of Statistical Theory, Vol, The World Press Pvt. Ltd., Calcutta.
2. Rao, C.R. (1973); Linear Statistical Inference and its Application, Wiley Eastern.

3. Graybill, I.A. (1961): An Introduction to Linear Statistical Models, Vol. 1, McGraw Hill Book Co. Inc.
4. Draper, N.R. and Smith H. (1998); Applied Regression Analysis, 3rd Ed. Wiley.
5. Weisberg, S. (1985): Applied Linear Regression, Wiley.
6. Cook, R.D. and Weisherg, S. (1982): Residuals and Inference in Regression, Chapman and Hall.

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9118T**

**Title of the Course** : **Economics Statistics**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to study the basic concept of economic statistics using time series methods and index numbers.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Components of Time Series.
- Concept of Correlogram, Autoregressive models of first and second order.
- Method of Income distribution.
- Index Number and its construction.

## Syllabus:

### UNIT I

Economic Statistics: Components of time series Methods of their determination, variates difference e method Yule slutsky effect. (12 Hours)

### UNIT II

Correlogram, Autoregressive models of first and second order Periodogram analysis. (12 Hours)

### UNIT III

Income distribution - Pareto and Engel curves, Concentration curve Methods of estimating national income Intersectoral flows, Inter Industry table. (12 Hours)

### UNIT IV

Index numbers of prices and quantities and their relative Merits. (12 Hours)

### UNIT V

Construction of index numbers of wholesale and consumer prices. (12 Hours)

**Suggested Books and Reference:**


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

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9119T**

**Title of the Course** : **Econometrics**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to study the statistical methods to develop theories or test existing hypothesis in economics or finance.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Nature and Scope of Econometrics - Review of GLM, OLS.
- Heteroscedasticity, Instrumental variable estimation.
- Simultaneous linear equations model.
- Recursive systems, k-class estimators.
- Definition of casualty and types.

## Syllabus:

### Unit I

Nature and Scope of Econometrics - Review of General Linear Model (GLM) and its extensions, Ordinary Least Squares (OLS) estimation and prediction, Generalized Least Squares (GLS) and prediction, Multicollinearity. (12 Hours)

### Unit II

Heteroscedasticity - Pure and mixed estimation. Autocorrelation, its consequences and tests , Theil BLUS procedure, Ridge regression, Linear regression with stochastic regressors - Instrumental variable estimation - Errors in variables - Autoregressive linear regression, lagged variables, Distributed lag models, Estimation of lags by OLS method, Koyck's geometric lag model. (12 Hours)

### Unit III

Simultaneous linear equations model - Identification problem - Restrictions on structural parameters - rank and order conditions - Restrictions on variances and covariances - Estimation in simultaneous equations model. (12 Hours)

### Unit IV

Recursive systems, 2 SLS estimators, limited information estimators, k-class estimators, 3 SLS estimator, full information maximum likelihood method, prediction and simultaneous confidence intervals. (12 Hours)

### Unit V

Definition of causality, Granger causality, testing of causality, Co-integration, Bivariate co-integration tests, multivariate co-integration. (12 Hours)

**Suggested Books and Reference:**


1. Damodar Gujarati and Dawn Porter (2009): Basic Econometrics, McGraw Hill.
2. Johnston, J. (1984): Econometric methods, 3/e, McGraw Hill.
3. Nachane. D.M. (2006): Econometrics: Theoretical Foundations and Empirical Perspective, Oxford University Press.
4. Apte, P.G. (1990): Text book of Econometrics. Tata McGraw Hill.
5. Intrulligator, M.D. (1980): Econometric models - Techniques and Applications, Prentice Hall of India.
6. Kleiber, C. and Zeileis, A. (2008): Applied Econometrics with R, Springer, NY.
7. A. Koutsoyiannis (2001): Theory of Econometrics, 2/e, Palgrave Macmillan Ltd.

# M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9120T**

**Title of the Course** : **Survival Analysis**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Lecture** (40 Hours for content delivery and 20 Hours for subject/ class activity, problem solving, diagnostic assessment and formative assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to study the basic concepts of survival analysis and to estimate and analyzing the expected duration of time for survival function.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- Concept of time order and random coursing.
- Life tables and elementary properties.
- Estimation of Survival Analysis.
- Tests of exponentiality against non- parametric classes.
- Competing risk model and decrement life table.

## Syllabus:

### 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. (12 Hours)

### UNIT II

Life tables, failure rate mean residual life and their elementary properties Ageing classes - and their properties Bathtub Failure rate. (12 Hours)

### UNIT III

Estimation of survival function-Actuarial Estimator Kaplan-Meier Estimator Estimation under the assumption of IFR/DFR. (12 Hours)

### 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 covariates' Rank test for the regression coefficients. (12 Hours)

### UNIT V

Competing risk model, parametric and non - parametric inference for this model. Multiple decrement life table. (12 Hours)

**Suggested Books and Reference:**


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.

## M. Sc. STATISTICS SEMESTER – IV 2024-25

**Code of the Course** : **STA9121P**

**Title of the Course** : **Practical's Based on STA9013T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to practice the problem based on demographic data using MS-excel and R Language.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of

- To calculate various rate and ratio.
- To compute death rates, birth rates, NRR, GRR etc..
- To construct life table of various kind.
- To logistic curve for projection.

**Syllabus:** (120 Hours)

1. Calculations of various rate, ratio, percentages etc.
2. Population Pyramids
3. Computations of various Death rates.
4. Computations of various Birth rates, NRR, GRR etc.
5. Construction of Life Tables-Abridged, Lotka Life Tables
6. Constructions of Makehams and Gompertz curves
7. Logistic curve fitting for projection.

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9122P**

**Title of the Course** : **Practical's Based on STA9116T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to hands-on to MS-excel for practicing problem based on Theory of Reliability.

**Course Learning Outcomes:**

At the end of class students will gain knowledge of problems based on

- Stress-strain model
- Life testing models
- Various ageing hazard factor such as IFR, IFRA etc.

## Syllabus: (120 Hours)

1. Draw probability curves of reliability functions.
2. Problem based on life time distributions and their reliability functions.
3. Estimation of various lifetime models.
4. Testing of Hazard function of above mention life time models.

## M. Sc. STATISTICS SEMESTER - IV 2024-25

**Code of the Course** : **STA9123P**

**Title of the Course** : **Practical's Based on STA9117T & STA9119T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to hands-on to MS-excel for practicing problem based on Linear Models & Regression Analysis and Econometrics.

**Course Learning Outcome:**

At the end of class students will gain knowledge of problems based on

- Simple & multiple regression
- Multicollinearity and Ridge Regression
- Nonlinear regression
- Nonparametric regression & Logistic regression
- GLM and OLS
- Heteroscedasticity
- Simultaneous linear equation model
- k-class estimators

**Syllabus:** (120 Hours)

1. Simple Linear Regression
2. Multiple Regression
3. Variable Selection Problem
4. Multicollinearity and Ridge Regression
5. Nonlinear regression
6. Nonparametric regression
7. Logistic regression (binary and multiple)
8. Poisson/Negative binomial regression
9. OLS estimation and prediction in GLM.
10. Tests for Heteroscedasticity: pure and mixed estimation.

## M. Sc. STATISTICS SEMESTER – IV 2024-25

**Code of the Course** : **STA9124P**

**Title of the Course** : **Practical's Based on STA9118T & STA9120T**

**Level of the Course** : **NHEQF Level 6.5**

**Credit of the Course** : **4**

**Type of the Course** : **Discipline Specific Elective (DSE)**

**Delivery type of the Course** : **Practical** (80 Hours for Hands-on software and problem solving + 40 Hours for assessment)

**Prerequisites** :

B.Sc./B.A. with Statistics as a core subject.

**Objectives of the Course** :

The course aims to hands-on to MS-excel for practicing problem based on Economics Statistics and Survival Analysis.

**Course Learning Outcome:**

At the end of class students will gain knowledge of problems based on

- Auto regressive models,
- Correlogram
- Income distributions
- Index numbers
- Censoring schemes
- Life tables
- Estimation & testing of survival functions
- Competing risk models

**Syllabus:** (120 Hours)

1. Plotting of time series data.
2. Plots of ACF and PACF
3. Fitting AR (p) and MA (q) models and Forecasting.
4. Residual analysis and diagnostic checking.
5. Trends and seasonality analysis.
6. Test for auto correlation.
7. Problems on Index numbers.
8. Fitting of Exponential, Gamma.
9. Fitting of Weibull, Lognormal, Pareto Distributions.
10. Rank test for the regression coefficients.
11. Estimate survival function
12. Determine death density function and hazard function