

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

M.A. /M.Sc. STATISTICS (CBCS) 2022-23

Semester- IV

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 STA 01 – CT 11	Core Course- 11 Demography	4-1-0	5	80	20	100
II	M4 STA 02 – CT 12	Core Course- 12 Project Work and Viva-Voce/ Dissertation	1-1-2	4	80	20	100
III	M4 STA 03 – CP 06	Core Course P- 06 Practicals Based on CT 11	0-0-6	3	80	20	100
IV	M4 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
V	M4 STA 0X- DSE 0X	DSE- 0 X	3-1-0	4	80	20	100
VI	M4 STA 0X- DSE 0X	DSE- 0 X	2-0-4	4	80	20	100
VII	M4 STA 07-SC 0X	Skill Course- 0X	2-0-0	2	80	20	100

Discipline Specific Elective Course (DSE) for Semester IV

Note: Students are to opt any three DSE courses among the following as per the availability of faculty and with the permission of the Head of the Department.

Course no.	Course Code PSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 STA 01 - DSE 01	DSE- 01 Econometrics	3-1-0	4	80	20	100
II	M4 STA 02- DSE 02	DSE - 02 Linear Models & Regression Analysis	3-1-0	4	80	20	100
III	M4 STA 03- DSE 03	DSE - 03 Practical Based on two papers Selected as DSE	2-0-4	4	80	20	100
IV	M4 STA 04- DSE 04	DSE - 04 Advanced Statistical Inference	3-1-0	4	80	20	100

V	M4 STA 05- DSE 05	DSE - 05 Theory of Reliability	3-1-0	4	80	20	100
VI	M4 STA 06- DSE 06	DSE - 06 Theory of Sample Surveys	3-1-0	4	80	20	100
VII	M4 STA 07- DSE 07	DSE – 07 Sequential Analysis	3-1-0	4	80	20	100
VIII	M4 STA 08- DSE 08	DSE – 08 Economic Statistics	3-1-0	4	80	20	100
IX	M4 STA 09- DSE 09	DSE - 09 Computer-Intensive Statistical Methods	3-1-0	4	80	20	100
X	M4 STA 10- DSE 10	DSE - 10 Knowledge Discovery and Data Mining	3-1-0	4	80	20	100
XI	M4 STA 11- DSE 11	DSE - 11 Survival Analysis	3-1-0	4	80	20	100

Skill Course (SC) for Semester IV

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

Course no.	Course Code PSSSCCXX	Title of the Course	L-T-P	No. of Credits	Max. Marks		Total
					University Exam.	Internal Assessment	
	1	2		3	4	5	6
I	M4 STA 07-SC 01	Skill Course Elective - 01 Numerical Analysis	2-0-0	2	80	20	100
II	M4 STA 07-SC 02	Skill Course- 02 Official Statistics-II	2-0-0	2	80	20	100
III	M4 STA 07-SC 03	Skill Course Elective -3 Statistical Methods For Total Quality Management-II	2-0-0	2	80	20	100
IV	M4 STA 07-SC 04	Skill Course Elective - 04 Investments Under Uncertainty-II	2-0-0	2	80	20	100
V	M4 STA 07-SC 05	Skill Course Elective - 05 Actuarial Statistics-II	2-0-0	2	80	20	100

SEMESTER IV M. Sc. STATISTICS 2022-23

There will be one core course, one core project work, one core course practical and three Discipline specific elective papers.

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SEMESTER IV M. Sc. STATISTICS 2022-23

M4 STA 01 –CT 11

DEMOGRAPHY

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

**External Assessment 80
Internal Assessment 20**

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.

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.

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).

UNIT IV

Models of population growth and their fitting 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.

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.

Books Recommended:

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

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M4 STA 02–CT 12

Project Work and Viva-Voce/ Dissertation

L-T-P	1-1-2
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TIME: 3 hours

External Assessment 80

Internal Assessment 20

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 IIIrd 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.

References :

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.

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M4 STA 03- CP 06

PRACTICALS BASED ON CT-11

L-T-P	0-0-6
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Duration: 4 Hours

External Assessment 80
Internal Assessment 20

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

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

Students will be required to do practicals, based on topics listed below, using R-Software:

List of Practical

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.

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M4STA 01-DSE 01
ECONOMETRICS

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

External Assessment 80
Internal Assessment 20

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.

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.

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

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.

Unit V

Definition of causality - Granger causality - testing of causality - Cointegration, Bivariate cointegration tests - multivariate cointegration.

Books Recommended:

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.

Books for Reference:

1. Apte, P.G. (1990): Text book of Econometrics. Tata McGraw Hill.
2. Intrulligator, M.D. (1980): Econometric models - Techniques and Applications, Prentice Hall of India.
3. Kleiber, C. and Zeileis, A. (2008): Applied Econometrics with R, Springer, NY.
4. A. Koutsoyiannis (2001): Theory of Econometrics, 2/e, Palgrave Macmillan Ltd.

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M4STA 02-DSE 02

LINEAR MODELS AND REGRESSION ANALYSIS

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

External Assessment 80

Internal Assessment 20

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.

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.

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.

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.

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.

References :

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 Weisberg, S. (1982): Residuals and Inference in Regression, Chapman and Hall.

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M4 STA 03 - DSE 03

PRACTICALS BASED ON DSE 01 & DSE 02

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

External Assessment 80

Internal Assessment 20

External Assessment 80: Practicals : 60 Marks

Viva-voce : 20 Marks

(Practicals based on Econometrics & Linear models and Regression Analysis)

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

Note: Students will be required to do practicals, based on topics listed below, using R-Software:

List of Practicals:

1. OLS estimation and prediction in GLM.
2. Use of dummy variables (dummy variable trap) and seasonal adjustment.
3. GLS estimation and prediction.
4. Tests for Heteroscedasticity: pure and mixed estimation.
5. Tests for autocorrelation. BLUE procedure.
6. Ridge regression.

7. Instrumental variable estimation.
8. Estimation with lagged dependent variables.
9. Identification problems-checking rank and order conditions.
10. Estimation in recursive systems.
11. 2SLS and 3SLS estimation.
12. Fitting of Multiple linear regression models.
13. Estimation of regression coefficient, fitting of multiple linear regressions.
14. Non-linear regression.
15. Logistic Regression.
16. Residual Analysis for model adequacy, detection of outliers and influential observations.
17. Variable Selection procedures.
18. Collinearity Diagnostics.

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M4 STA 04 –DSE 04
ADVANCED STATISTICAL INFERENCE

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Books Recommended:

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

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M4 STA 05 –DSE 05
THEORY OF RELIABILITY

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Univariate shock models and life distributions arising out of them.

Reference Books:

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

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M4 STA 06 – DSE 06
THEORY OF SAMPLE SURVEYS

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

External Assessment 80

Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Books recommended:

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

Reference Books:

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

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M4 STA 07 –DSE 07
SEQUENTIAL ANALYSIS

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

External Assessment 80

Internal Assessment 20

UNIT I

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

UNIT II

Robbins and stein's procedures, inverse binomial sampling.

UNIT III

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

UNIT IV

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

UNIT V

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

Books Recommended:

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

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M4 STA 08 –DSE 08

ECONOMIC STATISTICS

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

Index numbers of prices and quantities and their relative Merits.

UNIT V

Construction of index numbers of wholesale and consumer prices.

Books Recommended:

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

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M4 STA 09 –DSE 09

COMPUTER-INTENSIVE STATISTICAL METHODS

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Smoothing with kernels: density estimation simple nonparametric regression.

Reference Books:

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

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M4 STA 10 –DSE 10

KNOWLEDGE DISCOVERY AND DATA MINING

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

Association rules and prediction data attributes applications to electronic commerce.

Reference Books:

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

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M4 STA 11 –DSE 11
SURVIVAL ANALYSIS

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

External Assessment 80
Internal Assessment 20

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

Reference Books:

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

Skill Course (SC) for Semester IV

M4 STA 07-SC 01

Skill Course Elective 01

NUMERICAL ANALYSIS

L-T-P	2-0-0
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TIME: 3 hours

External Assessment 80

Internal Assessment 20

UNIT I

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

UNIT II

Convergence of iteration process in the case of several unknowns.

UNIT III

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

UNIT IV

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

UNIT V

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

Books Recommended:

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

M4 STA 07-SC 02
Skill Course Elective 02
OFFICIAL STATISTICS-II

UNIT I

System of collection of Agricultural statistics.

UNIT II

Crop forecasting and estimation, productivity.

UNIT III

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

UNIT IV

Statistics related to industries, foreign trade.

UNIT V

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

References:

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

Guide to Official Statistics (CSO), 1999.

Statistical System in India (CSO) 1995).

Principles and Accommodation of National Population Censuses, UNESCO.

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

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

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

M4 STA 07-SC 03

Skill Course Elective 03

STATISTICAL METHODS FOR TOTAL QUALITY MANAGEMNET-II

UNIT I

Planning and analysis of fractional factorial experiments.

UNIT II

Basic ideas of response surface methodology and contour plots.

UNIT III

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

UNIT IV

Process capability and performance indices. Evolutionary operations.

UNIT V

Measuring customer satisfaction, American customer Satisfaction index model.

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

References:

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

M4 STA 07-SC 04
Skill Course Elective 04
INVESTMENTS UNDER UNCERTAINTY-II

UNIT I

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

UNIT II

index models and diversification, CAPM and index model.

UNIT III

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

UNIT IV

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

UNIT V

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

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

References:

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

Additional References:

Arrow, K. J. (1971), Essays in the Theory of Risk Bearing, North Holland.
Hull John C. (1993) options, Futures and other Derivative Securities. 2nd Ed.
Prentice Hall.

M4 STA 07-SC 05
Skill Course Elective 05
ACTUARIAL STATISTICS-II

UNIT I

Insurance and Annuities

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

UNIT II

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

UNIT III

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

UNIT IV

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

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

UNIT V

Net Premium reserves: Continuous and discrete net premium reserve, reserves on a semicontinuous basis, reserves based on true monthly premiums, reserves on an apportionable or discounted continuous basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.
Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses.

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

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

References:

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

Additional References:

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

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