SYLLABUS

M.A / M.Sc. PROGRAMME IN STATISTICS UNDER SEMESTER WISE CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER- I

PG86T101: LINEAR ALGEBRA

PG86T101: Linear Algebra-Course Outcomes

After completion of the course, the candidate will:

1. have a thorough knowledge in various aspects of linear algebra
2. have in depth knowledge in basics of vector algebra
3. have ability to use important tools such as determinants, rank, inverse and generalized inverse in statistics.
4. Acquire the knowledge of linear transformations, orthogonal bases and projections
5. Study the importance and methodologies of calculating eigen values and eigen vectors
6. have ability to understand and solve emerging research problems using the tools studied in linear algebra

UNIT – 1:

Vector spaces, subspaces, linear dependence and independence, basis and dimension of a vector space, finite dimensional vector spaces, completion theorem, examples of vector spaces over real and complex fields, linear equations.

10T + 12P

UNIT – 2:

Vector spaces with an inner product, Gram- Schmidt orthogonalisation process, orthonormal basis and orthogonal projection of a vector, linear transformations.

10T + 8P

UNIT – 3:

Algebra of matrices, row and column spaces of a matrix, elementary matrices, determinants, rank and inverse of a matrix, null space and nullity, partitioned matrices, Kronecker product.

Hermite canonical form, generalized inverse, Moore - Penrose inverse, idempotent matrices, solution of matrix equations.

10T + 12P

UNIT – 4:

Characteristics roots and Vectors, Cayley - Hamilton theorem, minimal polynomial, similar matrices algebraic and geometric multiplicity of characteristics roots, spectral decomposition of a real symmetric matrix, simultaneous reduction of a pair of real symmetric matrices, Hermitian matrices, singular values and singular decomposition, Jordan decomposition.

10T + 8P

UNIT – 5:

Real quadratic forms, reduction and classification of quadratic forms, index and signature, triangular reduction of a positive definite matrix. extrema of quadratic forms, vector and matrix differentiation.

8T + 8P

(50 Lectures)

REFERNCES:

1. Biswas, S (1984) Topics in Algebra of matrices
2. Graybill, F. A (1983) Matrices with applications in statistics, 2nd edition, Wadsworth.
3. Hadley, G (1987) Linear Algebra , Narosa
4. Rao, A. R and Bhimasankaram P (1992) Linear Algebra, Tata McGraw Hill .
5. Rao, C.R (1973) Linear statisrical Inference and its applications, 2nd ed. Wiley.
6. Rao, C.R and Mitra, S.K (1971) Generalised inverse of matrices and its applications, Wiley
7. Searle, S. R. (1982) Matrix Algebra Useful in Statistics, Wiley.
8. Raghava Rao (1972) Matrix Theory, Oxford and IBH Publishing Company.

Practical : PG86P101: Linear Algebra-Course Outcomes

Gains understanding of the tools of linear equations, generalized inverse, eigen values and eigen vectors, various quadratic forms, diagonalization of a real symmetric and also simultaneous diagonalization of real matrices using statistical softwares.

PG86T102: PROBABILITY THEORY

PG86T102 : Probability Theory-Course Outcomes

On completion of this course students will:

- Understand the concepts of random variables, sigma-fields generated by random variables, probability distributions and independence of random variables related to measurable functions.
- have knowledge about measurable functions, Lebsgue measure, Lebsgue – Stieltjes measure.
- Analyze modes of convergence, knowledge about convergence in probability, convergence in distribution function and almost sure convergence.
- Understand weak and strong laws of large numbers, prove Borel-Cantelli lemmas and central limit theorem.

UNIT – 1:

Classes of sets, fields, sigma field, minimal sigma field, Borel sigma field in R^k, sequence of sets, limit infimum and limit supremum of a sequence of sets.

8T + 8P

UNIT – 2:

Measure, probability measure, properties of measure, Cartheodary extension theorem (Statement only), monotone class theorem (statement only), Lebesgue and Lebegue Stieltje's measures on R^k.

8T + 12P

UNIT – 3:

Measurable functions, random variables, sequence of random variables;, convergence in probability (and in measure) almost sure convergence, convergence in moments, convergence in distribution. Monotone convergence theorem, Fatou's Lemma, dominated convergence theorem.

12T + 12P

UNIT – 4:

Characteristic functions, uniqueness theorem, Levy continuity theorem (statement only). Independence, weak law of large numbers, Borel – Cantelli lemma, strong law of large numbers for a sequence of random variables,

14T + 8P

UNIT – 5:

Central limit theorem for a sequence of independent random variables under Lindberg's condition and for a sequence of i i d random variables.

8T + 8P

(50 Lectures)

REFERENCES:

1. Bhat, B.R. (1981), Modern Probability Theory, Wiley Eastern
2. Billingsley, S (1979), Probability and Measure, Wiley
3. Chow, Y.S. and Teicher, H (1979) Probability theory, Narosa
4. Dudley R.M. (1989) Real Analysis and Probability, Wadsworth & Brooks/Cole.
5. Kingman, J.F.C. and Taylore S.J. (1966), Introduction to measure and probability, Cambridge University Press.
6. A.K. Basu (1999), Measure Theory and Probability, PHI

Practical : PG86P102 Probability Theory-Course Outcomes

Based on theory knowledge students are able to solve practical problems independently.

PG86T103: THEORY OF SAMPLING

PG86T103 : Theory of Sampling-Course Outcomes

After studying this course, the candidate will be:

- Able to take up a project to collect primary data.
- Able to prepare questionnaires, plan the scheme of the survey, train investigators, tabulate and dissiminate data.

- Able to identify the nature of population sampling methodology to be adopted and recognize right tool for analysis.
- Able to handle various kinds of non sampling errors to collect non erroneous data.
- Able to carry out sampling surveys on sensitive issues.

UNIT – 1:

Concept of Random Sampling, Sampling Design, Sampling Scheme and Sampling Strategy. Review of SRSWR, SRSWOR, Stratified and Systematic Sampling Procedures.

12T & 12P

UNIT – 2:

Sampling with varying probabilities: Procedures of selecting sample, PPSWR, PPSWOR, Desraj's Ordered Estimates, Murty's unordered Estimates. I P P S: Horvitz – Thompson Estimator and it's properties, Midzuno – Sen scheme of sampling, Rao – Hartly – Cochran procedure.

13T + 12P

UNIT – 3:

Ratio and Regression Estimators with their properties. Cluster sampling, Sub sampling with units of equal and unequal sizes. Double sampling procedures used in Ratio, Regression estimators and in stratification and PPS sampling.

13T + 16P

UNIT – 4:

Non Sampling Errors: Errors in Surveys, Model for measurement of observational error. Nonresponse error: Hansen – Hurwitz, Deming's, Politz - Simons Techniques. RRT: Warner's Model.

12T & 8P

(50 Lectures)

REFERENCE:

1. Cochran W.G. (1984) Sampling Techniques. Wiley Eastern, New Delhi.
2. Desraj (1976) Sampling Theory. Tata Mc. Graw Hill.
3. Mukhyopadhyay. P (1998) Theory and Methods of Survey Sampling. Prentice Hall of India Pvt. Ltd.
4. Murthy M.N. (1977) Sampling Theory and Methods. Statistical Publishing Society, Calcutta.

5. Singh and Chaudhary F.S. (1986) Theory and Analysis of Sample Survey Designs. Wiley Eastern New Delhi.
6. Sukhatme P.V. Sukhatme B.V. Sukhatme S. and Ashok C (1984) Sampling Theory of Surveys with Applications. Indian Society of Agricultural Statistics, New Delhi.

Practical : PG86P103 : Theory of Sampling-Course Outcomes

The candidate will acquire knowledge on selecting random samples under sampling scheme like SRS and PPS. Calculating various estimators and their precisions.

PG86T104: PROGRAMMING IN C AND SIMULATION

PG86T104 : Programming in C and Simulation-Course Outcomes

After studying this course, the candidate will:

- be able to be develop logic of problem solving.
- Develop C-Programs for problems of different branches of statistics.
- Acquire knowledge of higher/advanced features C-Programming.
- Artificially simulate various environments.

UNIT – 1:

Programming in C: Structure of C Programme, Variables, Data types, Operations and Expressions. Input – Output functions and Format specification.

10T &12P

UNIT – 2:

Control statements: do, do-while and for loops. if, if-else and switch statements. Arrays, Functions, Pointers, Structures, Unions, File handling, C – Processors, C – Standard, Library and Header files.

25T & 20P

UNIT – 3:

Simulation: Generation of Binomial, Beta, Geometric Exponential, Poisson, Normal Random Variables. Statistical Applications- using C-Programming Language.

15T & 16P

(50 Lectures)

REFERENCE:

1. Kerighan and Ritchie (1997). The C-Programming Language. PHI
2. E-Balaguruswamy (1990) Programming in C McGraw- Hill.
3. J. Jayasri (1992) The C-Language Trainer with C-Graphic and C++ Sage India Ltd.

Practical : PG86P104 : C-Programming Practical-Course Outcomes

Demonstrates understanding of logic, syntax and working of C-programs on various aspects of statistical Analysis and simulation of statistical Models.

Semester – II

PG86T201: PROBABILITY DISTRIBUTIONS

PG86T201 : Probability Distributions- Course Outcomes

On completion of this course students will be able to:

- Understand the most common discrete and continuous probability distributions and their real life applications.
- Compute marginal and conditional distributions from joint distributions.
- Get familiar with transformation of univariate and multivariate densities. Understanding of distribution helps to understand the nature of data and to perform appropriate analysis.
- Acquire the application knowledge of compound, Truncated, mixture and non-central probability.

UNIT – 1:

Standard discrete distributions: Bernoulli, Binomial, Poisson, Geometric, Hypergeometric, Negative binomial, Logarithmic series, Rectangular and Multinomial distributions.

12T & 12P

UNIT – 2:

Standard continuous distributions: Normal, Lognormal, Cauchy, Uniform, Exponential, Logistic, Weibull, Double exponential, Gamma, Bivariate normal, Bivariate exponential distributions.

12T & 12P

UNIT – 3:

Conditional, Compound, Truncated and Mixture of distributions. Functions of random variables and their distributions.

6T & 8P

UNIT – 4:

Sampling Distributions: Central and Non-central chi-square, t and F distributions and their properties. Distribution of quadratic forms under normality.

12T & 8P

UNIT – 5:

Order Statistics: Distributions of order statistics and their properties with applications. Joint and Marginal distributions of order statistics. Distributions of range and median.

8T & 8P

(50 Lectures)

REFERENCES:

1. Dudewicz E.J and Mishra S.N. (1988) Modern Mathematical Statistics. Wiley
2. Johnson and Kotz (1972) Distributions in Statistics, Vol I, II and III, Houghton and Miffin
3. Rohatgi, V.K. (1984) An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern
4. Rao, C.R. (1973) Linear Statistical Inference and its applications, 2nd Edn. Wiley Eastern.

Practical: PG86P201 Probability Distributions-Course Outcomes

Course Outcomes : Based on theory knowledge students are able to do practical problems independently.

PG86T202: THEORY OF POINT ESTIMATION

PG86T202 : Theory of Point Estimation-Course Outcomes

On completion of this course, the candidate will:

- Learn various aspects of estimation including characteristics of an estimator.
- Have knowledge on various families of distributions and their advantages in obtaining estimators.
- Learn different methods of estimation and their advantages.
- Develop a logic to analyse the situation and apply appropriate statistics tools.

UNIT – 1:

Likelihood Function, Group Families, Exponential class of densities and it's properties, Fisher Information, Sufficiency, Neyman – Fisher factorization Theorem, Minimal sufficient statistics and their construction, Completeness, bounded completeness and relation with minimal sufficiency, ancillary statistics, Basu's Theorem and it's Applications.

20T & 20P

UNIT – 2:

Unbiased Estimators, Characterization of UMVUE, Rao – Blackwell and Lehmann – Scheffe Theorem and their uses. 8T & 8P

UNIT – 3:

Cramer- Rao inequality for single parameter case, Chapman - Robbins bounds and Bhattacharya bounds.

7T & 8P

UNIT – 4:

Methods of Estimation: Method of moments, method of minimum chi-square, method of maximum likelihood and it's properties, Method of scoring and it's applications. Asymptotic effiency of MLE, CAN and BAN estimators.

15T & 12P

(50 Lectures)

REFERENCES:

1. Kale B.K (1999) A first course on parametric inference. Narosa.
2. Lehmann E. L (1988) Theory of point estimation. John wiley & Sons
3. Rohatgi V.K (1984) An introduction to probability theory mathematical Statistics. Wiley eastern, New Delhi.
4. Zacks, S (1971) Theory of Statistical Inference. Wiley, Newyork.

Practical : PG86P202 : Theory of Point Estimation –Course Outcomes

On completion of this course, the candidate learns the technique of:

1) Computing various estimators under different situations.
2) Will learn different approaches to obtain estimators using various methods.

Any one of the Optional
PG86T203: DEMOGRAPHY – Special Paper

PG86T203A: Demography-Course Outcomes

On completion of this course, the candidate will:

- have information regarding sources and methods of demographic data.
- acquire in depth knowledge of various measures of mortality and fertility.
- have ability to conduct socio-economic survey using tools such as sample survey and vital statistics registration system.
- Acquire the knowledge of construction of life tables for various categories of demography.
- Study the importance and methodologies of population growth and projections.
- Develop the ability to understand and solve emerging research problems.

UNIT – 1:

Demography and its interdisciplinary nature, sources of demographic data, Coverage and Content errors. The use of balancing equation, Chandrasekaran and Deming formula to check completeness of registration data. Use of Whipple's, Myers's and UN Indices.

12T & 12P

UNIT – 2:

Measures of Mortality: Various measures of mortality, infant mortality rate, cause specific death rates and standardized death rates. Measures of Fertility: Period and cohort fertility measures, use of birth order statistics, child – women ratio, Brass P/F ratio to estimate current levels of fertility, Measures of reproduction and replacement. Sheps and Perrin stochastic human reproductive process.

15T & 16P

UNIT – 3:

Life Tables: Types of life tables, inter – relationships between life table functions, construction of life tables using Reed – merrel and Greville's Method. Probability distribution of life table functions and their optimum properties. Population estimation and Projections: Mathematical, Statistical and Demographic Methods, Component method.

15T & 12P

UNIT – 4:

Stable and Quasi – stable population: Derivation of Lotka's stable population model and its properties, Intrinsic growth rate and its derivation, age structure and birth rate of a stable population, mean length of generation, momentum of population growth, Quasi – stable population under changing fertility and mortality situations.

10T & 4P

(50 Lectures)

REFERENCES:

1. Shryock, Henry S, Jacob S, Siegel and Associates (1964) Methods and materials of demography (condensed edition) Academic press, London.
2. Barclay, George W. (1968) Techniques of population analysis, John Wiley and sons, New York.
3. Keyfitz N. (1968), Introduction to the Mathematics of Population. Addison-Wesley Publishing Co, Reading, Messachusetts.
4. Chiang C.L. (1968), Introduction to stochastic processes in Biostatistics, John Wiley and sons, New York.
5. R. Ramkumar (1986), Technical Demography, Wiley Eastern, New Delhi.
6. Sudhendu Biswas (1988), Stochastic Processes in Demography and Applications, Wiley Eastern, New Delhi.

Practical : PG86P203A: Demography-Course Outcomes

Provides framework of different sources and methods of demographic data and facilitates, the knowledge of various measures for data on births and deaths, also the applications of these measures in finding life expectancy, population projections, calculation growth rates etc.

PG86T205: ACTUARIAL STATISTICS – Special Paper

PG86T203B : Actuarial Statistics-Course Outcomes

On completion of this course, the candidate will:

- Learn various aspects of insurance and utility functions.
- Have knowledge on various insurance polices and calculation of their premiums.
- Have in-depth knowledge in computing life annuities, benefits premiums and benefit reserves.
- Help insurance companies to develop new advantageous polices.

UNIT – 1:

The Economics of insurance: Utility theory, insurance and utility, elements of insurance, optimal insurance. Individual risk models for a short term; Models for individual claim random variables, sums of independent random variables, approximations for the distribution of the sum, application to insurance.

10T & 12P

UNIT – 2:

Survival distributions and Life tables: Probability for the age at death, the survival function, time until death for a person age x, Curtate-Future-Life times, force of mortality, relation of life table functions to the survival function. The deterministic survivorship group, other life table characteristics recursion formulae, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

10T & 12P

UNIT – 3:

Life Insurance: Insurance payable at the moment of death, level benefit insurance, Endowment insurance, Deferred insurance, Varying benefit insurance, insurance payable at the end of the year of death, Relationship between insurance payable at the moment of death and at the end of the year of death, Differential equations for insurance payable at the moment of death.

10T & 12P

UNIT – 4:

Life Annuities: Continuous Life annuities, discrete life annuities, life annuities with monthly payment.

Benefit Premiums: Fully continuous premium, fully discrete premiums, true monthly payment premiums.

Benefit Reserves: Fully continuous benefit reserves, other formulas for fully continuous benefit reserves.

10T & 8P

UNIT – 5:

Multiple Life Functions: Joint distribution of future Life times, the joint life status, the last- survivor status, copulas, special mortality assumptions, Gompertz and Makeham Laws.

Multiple Decrement Models: Two random variables, random survivorship groups, deterministic survivorship group. Basic relationships inform distribution assumption for multiple decrements.

Collective Risk Models for a Single Period: The distribution of aggregate plans, selection of basic distributions the distribution of N, the individual claim amount distribution.

10T & 4P

(50 Lectures)

REFERENCES:

1. Newton L Bowers, Jr; Gerber Hans, U; Hickman James, C; Jones Donald A; Nesbitt Cecil, J. (2000) – Actuarial Mathematics – The Society of Actuaries, Schaumburg, Illinois, U.S.A.

Practical : PG86P205 : Actuarial Statistics

The candidate will acquire skills :

1. of calculating increment, decrement, enmities, premiums and benefit reserves for various policies.
2. Of recognizing various actuarial models.

PG86T203C : Statistical Methods(OEC)

Course Outcomes

On completion of this course, the candidate will learn:

- Various methods of collecting and organizing data
- Various statistical measures such as population mean and variance.
- Measures of association between two variables.
- Different tests which are applicable to other disciplines.

UNIT – 1:

Data: Introduction, collection of data, kinds of data, tabulation of data, diagrammatic and graphical representation of data with examples. Measures of central tendency: Introduction, arithmetic mean geometric mean, harmonic mean, median, mode, for grouped and ungrouped data with examples.

10 Hrs

UNIT – 2:

Measure of dispersion: Introduction, range, quartiles, interquartile range, mean deviation, variance, coefficient of variation for grouped and ungrouped data with examples.

Skewness and Kurtosis: Introduction, measures of Skewness and Kurtosis with examples.

10 Hrs

UNIT – 3:

Concept of Probability: Introduction, different approaches to definition of probability, probability of composite event, addition rule, multiplication rule, Bayes formula. Theoretical probability distributions: Binomial, Geometric, Poisson, Normal, Exponential.

10 Hrs

UNIT – 4:

Correlation and regression: Scatter diagram, coefficient of correlation, fitting of linear regression, method of least squares, coefficient squares, coefficient of variation, relation between regression and correlation.

10 Hrs

UNIT – 5:

Testing of Hypothesis: Introduction, parametric tests, one sample and two sample z, t tests, paired t test, F test, X^2 test, test for correlation. Nonparametric tests: Run test, Sign test, Signed rank test, Wilcoxon's rank sum test, and Spearman's test for rank correlation.

10 Hrs

(50 Lectures)

REFERENCES:

1. Das, M.N. (1993) Statistical Methods and concepts, Wiley Eastern Ltd.
2. Medhi, J (1992) Statistical Methods, New Age International Ltd.
3. Miller, I, Freund J.E. and Johnson R.A. (1992) Probability and Statistics for Engineers. Prentice Hall of India Private Ltd.

Semester – III

PG86T301: ELEMENTARY STOCHASTIC PROCESSES

PG86T301: Elementary Stochastic Processes-Course Outcomes

After studying this course,

- The candidate will acquire knowledge of stochastic processes, modeling real life situations through stochastic processes.
- Study stochastic processes like Poisson, pure birth, Yule-Fuly, Birth and Death, Weiner, Branching processes.
- Know how better modeling can be made using stochastic processes.
- Develop critical Analysis capacity through stochastic processes.

UNIT – 1:

Introduction to stochastic processes (SP), classification of SP according to state space and time domain. Finite and countable state Markov chains (MC), Chapman – Kolmogorov's equations, calculation of n-step transition probabilities and their limits, stationary distribution, classification of states, transient MC, random walk and gambler's ruin problems.

16T & 16P

UNIT – 2:

Continuous time Markov processes: Kolomgorov-Feller differential equation, Poisson process, pure birth process, Yule – Furry process, birth and death processes, Weiner process as a limit of random walks, first passage time and other problems, diffusion process.

14T & 16P

UNIT – 3:

Renewal Theory: Elementary renewal theorem and applications, key renewal theorem and its uses, study of residual life time process, discrete time renewal theory.

Stationary process: weakly stationary and strongly stationary processes, spectral decomposition, moving average and auto regressive processes. 14T & 12P

UNIT – 4:

Branching process: Galton-Watson branching process, probability of ultimate extinction, distribution of population size, and statistical inference in MC and Markov process.

6T & 4P

(50 Lectures)

REFERENCES:

1. Medhi J (1994), Stochastic Processes, 2nd edn., Wiley Eastern Ltd., New Delhi.
2. Bhat U.N. (1984), Elements of Applied Stochastic processes, 2nd edn., Wiley, New York.
3. Basawa I.V. and Prakash Rao B.L.S. (1980) Statistical Inference for stochastic processes, Academic press, New York.
4. Karlin S and Taylor H.M. (1975), A first course in stochastic processes, 2nd edn., Academic press, New York.

Practical : PG86P301 : Elementary Stochastic Processes-Course Outcomes

Acquaint with use of stochastic Models in different areas of applications of statistics.

PG86T302: TESTING OF HYPOTHESES

PG86T302: Testing of Hypotheses-Course Outcomes

After studying this course, the candidate:

- Increases confidence in their ability to formulate different research problems
- Develops ideas and research skills
- Gets in-depth knowledge of various research tools in the form of parametric and non-parametric methods.
- Learns to construct UMA and UMAU confidence intervals, likelihood ratio tests, etc.
- Study the importance of sequential analysis using Wald's SPRT and its functions, OC and ASN.

UNIT – 1:

Introduction to testing of hypotheses: size and power of a test. Neyman-Pearson lemma, MP test, MLR Property and UMP test.

10T & 12P

UNIT – 2:

Generalization of NP-lemma, UMPU tests, Bounded completeness, Similar regions. Tests with Neyman structure, UMPU test for multi-parameter exponential families. Comparison of two binomial and Poisson populations.

10T & 8P

UNIT – 3:

Confidence intervals and their connection with the tests of hypotheses. UMA, UMAU confidence intervals, shortest length confidence intervals.

Likelihood ratio tests, large sample properties. Chi-square goodness-of-fit tests for simple and composite hypothesis.

10T & 12P

UNIT – 4:

Nonparametric methods-run test, sign test, signed-rank test, median test, Wilcoxon-Mann-Whitney test, Kolmogorov – Smirnov tests, Tests involving rank correlation, Linear rank statistics, Large sample properties and applications.

10T & 8P

UNIT – 5:

Sequential analysis, need for sequential tests, SPRT and its properties, termination property, fundamental identity and Wald's equation, OC and ASN functions. SPRT for testing hypothesis in binomial, Poisson, normal and exponential distribution-computation of OC and ASN functions.

10T & 8P

(50 Lectures)

REFERENCES:

1. Lehmann E.L. (1986)Testing Statistical Hypothesis, Wiley, New York.
2. Rohatgi V.K. (1984). An Introduction to Probability Theory and Mathematical Statistics. Wiley Eastern, New Delhi.
3. Dudewicz E.J. and Mishra S.N. (1988) Modern Mathematical Statistics, Wiley and Sons, New York.
4. Ferguson T.S. (1967), Mathematical Statistics- Decision Theoretic Approach. Academic Press, New York.
5. Kendall M.G. and Stuart A (1968) Advanced Theory of Statistics, Vol II, Charles Griffin and Co., London.
6. Rao C.R (1973). Linear Statistical inference. Wiley Eastern, New Delhi.
7. Wald A (1947) Sequential Analysis, Wiley New York.
8. Gibbons J.D. (1985). Non Parametric Statistical inference. Marcel Dekkar, New York.
9. Randles R.H. and Wolfe D.A. (1979) Introduction to Theory of Non-Parametric Statistics. Wiley, New York.
10. Cramer H. (1957) Mathematical Methods of Statistics. Princeton University Press, New Jersey.

Practical : PG86P302 : Testing of Hypotheses-Course Outcomes

It improves their ability to handle and address the research problems in Statistics, Biology, Economics, Sociology, Anthropology etc. Learn applications of parametric and non-parametric methods.

PG86T303 : STATISTICAL ORIENTED R – PROGRAMMING

PG86T303 : Statistical Oriented R-Programing-Course Outcomes

After completion of this course, the candidate will be able to:

- Know various aspect of R-Programming language.
- Write R-Programs for various statistical concepts.
- Carry out simulation to complex statistical problems.
- Use and interpret inbuilt tests in R-programming.

UNIT – 1:

Introduction to R: R as a Statistical software and language, R preliminaries, methods of data input, data accessing or indexing, built – in functions. Graphics with R, getting help, saving storing and retrieving data.

12T & 16P

UNIT – 2:

Analysis using R: problems based on descriptive statistics, probability distributions, statistical inference, correlation and regression, linear models and time series analysis.

13T & 32

(25 Lectures)

REFERENCES:

1. Goran Brostrom, Statistical Programming in R, Umea Universitet, Statistiska institutionen, Mandatory Reading instructions: Tillhandahalls elektroniskt.
2. D.M. Smith, W.N. Venables, The R Development Core Team, An Introduction to R.
3. John Braun, Duncan James Murdoch, A First Course in Statistical Programming with R, Cambridge, N.Y: Cambridge University Press: 2007:163s: ISBN: 978-0-521-87265-2 (inb.)
4. Brian D. Ripley, W.N.q (William N.) Venables, S Programming, New York: Springer: cop.2000:x,264s:ISBN: 0-387-98966-8(alk.paper).
5. John M. Chambers, Software for Data Analysis: Programming with R, New York, N.Y: Springer: cop. 2008: 498p: ISBN:978-0387-75935-7(hbk).
6. Sudha G. Purohit, Sharad D. Gore and Shailaja R. Deshmukh (2008) Statistics Using R, Narosa Publishing House.

Practical : PG86P303 : Statistical Oriented R-Programing-Course Outcomes

The candidate will be able to

1. Feed the data and carry out the analysis.
2. Import data from other sources.

Optional (any one)

PG86T304: OPERATIONS RESEARCH– Special Paper

PG86T304A : Operations Research-Course Outcomes

After completion of this course, the candidate will be able to:

- about linear programming and various methods to solve liner programming problem.
- About transportation problem and assignment problem and calculating minimum cost.
- About analyzing various kinds of quarries and their waiting times.
- About various inventory models and obtaining economic order quality under there models.
- To be helpful in various sectors like marketing research, industries, etc to detect the problems and give optimum solutions.

UNIT – 1:

Linear programming, Graphical methods, basic theorems, simplex method and simplex algorithm & two phase method, Charne's M –technique, revised simplex method, duality in LPP, duality theorems, dual simplex method, economic interpretation, sensitivity analysis.

15T & 16P

UNIT – 2:

Transportation and assignment algorithms, balanced and unbalanced transportation problems, degeneracy, Hungarian method of assignment.

10T & 8P

UNIT – 3:

Queuing Models chief characteristics. Analysis of M/M/1, M/M/C queues with steady state probabilities.

10T & 12P

UNIT – 4:

Inventory Models: Deterministic EOQ Models (without shortage costs), probabilistic single period model with instantaneous demand (No Set up cost Model), models with price breaks (one & two price breaks), (s, S) policy.

10T & 12P

(50 Lectures)

REFERENCES:

1. Ackoff R. L. & Sasieni M. W. (1991) Fundamentals of operations Research. Wiley Eastern.
2. Bazarre M.S.& Zarvis J.J. (1977) Linear Programming & Network flows. John Wiley.
3. Gross D and Harris C.M (1974) Fundamentals of Queueing Theory. Wiley, New York
4. Gupta R.K. (1993) Operations Research Krishna Prakashan Mandir, Meerut.
5. Kantiswarup Gupta P.K and Man mohan (1977) Operations Research. S. Chand and Sons, New Delhi.
6 Mittal K.V. (1990) Optimization Methods. Wiley eastern Ltd. New Delhi.
7. Murty K.G. (1983) Linear Programming, John Wiley & Sons.
8. Taha H .A (1998) Operations Research. Prentice-Hall of India.

Practical : PG86P304A : Operation Research-Course Outcomes

The candidate will learn the skills of

1. Practically solve various problems of linear programming, transportation problem and assignment problem.
2. To solve problem on queuing to analyze average queue, waiting time and inventory problems to calculate economic order quantity.

PG86T304B : ECONOMETRICS – Special Paper

PG86T304B : Econometrics-Course Outcomes

On completion of this course, the candidate will:

- develop professional competence in analysis of economic and time series data.
- be able to understand the evolutionary practices of Linear/Multiple linear regression models, assumptions and consequences of violations of the requirements of the model.
- be able to achieve professional competency in the field of analysis of econometric models through simultaneous equation models.
- Acquint with contemporary trends in estimation of econometrics models.

UNIT – 1:

Introduction: Origin, definition, methodology, scope and limitations of econometrics.

The two – variable linear regression model: Relationships between economic variables, two variable linear regression model, least squares estimators.

Multiple linear regression models: Model descriptions and assumptions, least squares estimators, selection of variables in multiple regression model.

10T & 12P

UNIT – 2:

Analysis of residuals: Presence of outliers, omitted variables, nonlinear relationship, correlated disturbances heteroscedasticity.

Multicollinearity: The plausibility of the assumption of non-multicolinear regresssors, consequences of multicollinearlty, tests for detecting multicollinearity, solutions for multicollinearity.

10T & 8P

UNIT – 3:

Autocorrelation: Introduction and plausibility of serial dependence, sources of autocorrelation, tests for autocorrelation, solutions for autocorrelation, methods for estimating the parameters of autocorrelation, serial correlation.

Autoregressive and Distributed Lag Models: Autoregressive model, distributed lag model, methods of estimation of lagged models.

10T & 12P

UNIT – 4:

Errors in variables: Introduction, solution for single equation models, reverse regression, instrumental variable method, proxy variables. Stochastic regressions: Introduction, bivariate normal distribution.

10T & 4P

UNIT – 5:
Simultaneous equation models: The problem of identification.

Single equation methods of estimation: reduced form method or indirect least squares (ILS), the method of instrumental variables (IV), two-stage least squares (2SLS), limited information maximum likelihood (LIML), k-class estimators.

System methods of estimation: Three-stage least squares (3SLS), full information maximum likelihood (FIML).

10T & 12P
50 Lectures

Reference:

1. Baltagi B.H. (2000) Econometrics, Springer.
2. Gujarati D.N. (2003) Basic Conometrics, McGraw-Hill.
3. Maddala G.S. (2002) Introduction to Econometrics, John Wiley.

Practical : PG86P304B : Econometrics-Course Outcomes

Able to understand practices in applications of Econometric Models in various economic problems.

PG86T304C: APPLIED STATISTICS (OPEN ELECTIVE)

PG86T304C : Applied Statistics (OEC)- Course Outcomes

: On completion of this course students will be able to :

- Explain the concepts of Statistical Quality Control and associated techniques.
- Construct appropriate Quality Control Charts and Forecasting models useful in monitoring a process.
- Apply various samplings inspection plants to real world problems for both theoretical and applied research.
- Assess the ability of a particular process to meet customer expectations.
- Develop an appropriate quality assurance plan to assess the ability of the service to meet requisite national and international quality standards.
- Understand to identify whether a process is in statistical control or not.
- Understand to estimate Trend, Seasonal and Cyclic components of time series.
- Understand past and future behavior of phenomena under study.
- Understand how a product quality can be improved and elimination of assignable causes of variations.

UNIT – 1:

Time Series: Introduction, components of time series, measurement of trend, measurement of seasonal variations. Index Numbers: Introduction, price index numbers, quantity index numbers, chain index numbers, cost of living index number, time reversal test, factor reversal test.

8 Hrs

UNIT – 2:

Vital Statistics: Introduction, methods of obtaining vital statistics, mortality rates, fertility rates, measurement of population growth.

6 Hrs

UNIT – 3:

Analysis of Experiments: Introduction, principles of experimental design, ANOVA, completely randomized design, randomized block design, factorial experiments.

10 Hrs

UNIT – 4:

Sampling Theory: Introduction, simple random sampling, stratified random sampling, systematic sampling, sampling and non-sampling errors.

10 Hrs

UNIT – 5:

Control Charts (Process Control): Introduction, control charts for variables ($\bar{x}$ and R charts), control charts for attributes (P-chart), Control charts for number of defects per unit (C-chart), demerit control charts. Acceptance Sampling Plans (Product control): Basic terminologies: AQL, LTPD, AOQ, AOQL, ASN, OC curve, producer's risk, and consumer's risk. Single sampling plan, double sampling plan.

16 Hrs

(50 Lectures)

REFERENCES:

1. R. Ramkumar (1986) Technical Demography, Wiley Eastern, New Delhi.
2. J. Medhi (1992) Statistical Methods. New Age International (P) Ltd. New Delhi.
3. M.N. Das (1993) Statistical Methods and Concepts. Wiley Eastern Ltd.
4. Irwin Miller, John E Fread and Richard A Johnson (1992) Probability and Statistics for Engineers. Prentice Hall of India New Delhi.
5. D.C. Montgomery (1991) Design and Analysis of Experiment. John Wiley and sons.
6. D.C. Montgomery (1996) Introduction to Statistical Quality Control.

Semester – IV

ST PG86T401: MULTIVARIATE ANALYSIS

PG86T401 : Multivariate Analysis-Course Outcomes

Course Outcomes: On completion of this course students will be able to:

- Understand the concept of Multivariate analysis and its usefulness.
- Understand data requirements for Multivariate analysis.
- Perform exploratory analysis of multivariate data, such as plot multivariate data, calculating descriptive statistics, testing for multivariate normality.
- Conduct statistical inference about multivariate means including hypothesis testing and different types of confidence intervals estimation.
- Undertake statistical analyses using appropriate multivariate techniques, which include principal component, factor analysis and discriminant analysis.

UNIT – 1:

Random sampling from multivariate normal distribution, maximum likelihood estimators of parameters, distribution of sample mean vector. Wishart distribution and its properties, distribution of sample generalised variance. Null distribution of sample correlation coefficients, distribution of regression coefficients. Application in testing and interval estimation.

14T & 16P

UNIT – 2:

Hotelling's - T^2, Null distribution of Hotelling's T^2 - statistic. Applications in tests on mean vector for single and several multivariate normal populations.

6T & 4P

UNIT – 3:

Multivariate linear regression model, estimation of parameters, testing linear hypothesis about regression co-efficients. Likelihood ratio criterion. Multivariate analysis of variance of one - way and two-way classified data.

8T & 8P

UNIT – 4:

Classification and discrimination procedures for discrimination into one of two mulitvariate normal populations. Sample discriminant function, tests associated with discriminant function, probabilities of misclassification and their estimation, classification into more than two multivariate normal populations. Penrose size and shape factors.

12T & 18P

UNIT – 5:

Introduction to Principle component analysis, Factor analysis, Cluster analysis, Canonical Correlations and Multi dimensional scaling.

10T & 12P

(50 Lectures)

REFERENCES:

1. Anderson, T.W. (1983) An Introduction to Multivariate statistical Analysis. Wiley.
2. Johnson and Wichern (1986) Applied multivariate Analysis. Wiley
3. Kshirsagar, A.M. (1972) Multivariate Analysis, Marcel – Dekker.
4. Morrison, D.F. (1976) Multivariate Statistical Methods. McGraw Hill.
5. Muirhead, R.J. (1982) Aspects of multivariate statistical theory. Wiley.
6. Srivastava, M.S. and Khatri C.G. (1979) An introduction to Multivariate Statistics. Worth Holland
7. Mardia, K.V., Kent J.T. and Bibby J.M. (1979) Multivariate Analysis. Academic Press.

PG86T402: LINEAR MODELS

PG86T402: Linear Models-Course Outcomes

The course provides a thorough knowledge in various aspects of Linear Models

- Gain knowledge in basics of linear estimation
- Ability to understand important tools of linear estimation in Gauss-Markov set-up.
- Acquire the knowledge of application of multiple linear regression in various fields.
- Study the importance of analysis of variance (ANOVA) technique and its different methodologies.
- Ability to understand and solve different experimental designs such as RCBD, BIBD, PBIBD and Symmetric BIBD in emerging research problems.

UNIT – 1:

Gauss-Markov setup, estimability of linear parametric functions, normal equations and least squares estimation. Error and estimation spaces, variance and covariance of least square estimates. Estimation of Error variance, Linear Estimation in the correlated setup. Least squares Estimates with restriction on the parameters, simultaneous estimates of linear parametric functions.

10T & 12P

UNIT – 2:

Distibution of Quadratic Forms for normal variables, related theorem (without proof), Tests of hypotheses in general linear models, Tests of hypotheses for one and more than one linear parametric functions. ANOVA table, power of F – Test. confidence intervals and regions. multiple compararion procedures of, simultaneous confidence intervals.

8T & 8P

UNIT – 3:

Application of Gauss – Markov theory to the analysis of one-way, two – way classification without and with interaction with equal number of observations per cell. Estimation and related tests of hypoheses. Posthoc tests: Tukey, Scheffe and Bonferroni

12T & 8P

UNIT – 4:

General block designs: Two-way classification with unequal number of observations per cell without interaction. Concept of connectedness, balancedness and ortongonality and reted tests of hypotheses.

Balanced Incomplete bock designs (BIBD): Definition, parametric relationship, inter and intra-block analysis and Symmetric BIBD.

10T & 8P

UNIT – 5:

Missing Plot techniques and its application to RBD and LSD

Analysis of Covariance for one-way and two-way classification models, estimation of parameters and related tests of hypotheses and applications. Introduction to random effects models.

10T & 12P

(50 Lectures)

REFERENCES:

1. Chakravarthy M.C. (1971) Mathematics of Design and Analysis of Experiments. Asia Publishing House.
2. Joshi, D.D. (1987) Linear Estimation and Design of experiments. Wiley Eastern.
3. Kshirsagar, A.M. (1983) Linear Models, Marcel Dekker.
4. Das M.N. and Giri, N.C. (1988) Design and Analysis of experiments. Wiley Eastern. Ltd.
5. Montgomery D.C. (1991) Design and Analysis of experiments, John Wiley and sons.
6. Ogawa, J (1974) Statistical Theory of the analysis of the experimental design. Marcel Dekker.
7. Rao C.R. (1985) Linear Statistical Inference and its applications. Wiley Eastern.
8. Searle S.R. (1971) Linear Models. John Wiley & Sons.

Practical : PG86P402: Linear Models-Course Outcomes

Provides an idea of formulation of linear models and estimation of parameters. It facilitates the practical knowledge of ANOVA models and designs of experiments. Also gives the applications these tools in laboratory and agricultural experiments.

PG86T403: SQC AND RELIABILITY THEORY

PG86T403 : SQC & Reliability Theory-Course Outcomes

After completion of this course, the candidate

- will develop professional competence in applications of statistical tools in Industry.
- Will be able to develop control charts in various situations of quality improvement programs in industry.
- Will be able model and assess reliabilities of components/systems under different setups and configuration of components.
- Will be able to use these tools in finance, insurance, health science, etc.

UNIT – 1:

Process Control: Control charts for $\bar{x}$ and s, demerits, extreme values. Moving average control charts, geometric moving average control charts, group control charts, multivariate quality control charts, sloping control lines.

Use of sequential runs in constructing control limits, CUSUM charts and its relation with SPRT. Control charts versus ANOVA and Chi-square tests.

12T & 12P

UNIT – 2:

Product Control: single, double and multiple sampling plans for attributes, curtailed sampling plans. OC, AOQ, ASN and ATI functions for these plans. Designing single and double sampling plans. Chain sampling plans. Sampling plans by variables, Continuous sampling plans CSP1, CSP2, CSP3 and multilevel sampling plans.

10T & 12P

UNIT – 3:

Reliability Theory: Life distributions, survival functions, failure rate, Integrated hazard function, residual life time, mean residual life time. Common Life Distributions: binomial, negative binomial, Poisson, exponential, Weibull, gamma, Pareto and log-distributions. Notion of aging: IFR, IFRA, DMRL, NBU, NBUE classes of life distributions and their dual.

10T & 8P

UNIT – 4:

System reliabilities: Series, parallel, k-out-of-n, standby redundant systems and their reliabilities.

Maintenance policies: Age replacement policy and Block replacement policies and their characteristics. Reliability modeling: Introduction to shock models, stress-strength models and proportional hazard models.

8T & 8P

UNIT – 5:

Inference in Reliability: Type I and Type II Censoring schemes, likelihood functions based on these sampling schemes for exponential distribution. Reliability estimation (complete and censored samples) for exponential distribution, testing reliability hypotheses (exponential distribution).

12T & 8P

(50 Lectures)

REFERENCES:

1. Montgomery D.C. (1996) Introduction to Statistical Quality Control, Wiley, New York.
2. Grant E.L. (1980) Statistical Quality Control McGraw Hill, New York.
3. Weetherhill G.B. and Brow D.W. (1991) Statistical Process Control. Chapman and Hall, London.
4. Barlow R.E. and Proschan F (1975) Statistical Theory of Reliability and Life Testing. Holt-Rinhart and Winston, New York.
5. Sinha S.K. and Kale B.K. (1990) Life Testing and Reliability Estimation. Wiley Eastern, New Delhi.
6. Mann N.R, Schaffer R.F and Singpurwalla N.D. (1974) Methods for Statistical Analysis of Reliability and Life Data. Wiley New York.
7. Zacks S (1992) Introduction to Reliability Analysis. Springer - Verlag, New York.
8. J.V. Deshpande and Sudha G. Purohit (2005) Life time data: Statistical Models and Methods. World Scientific.

Practical : PG86P403 : SQC & Reliability Theory-Course Outcomes

Demonstrates the practices and working of control charts in different situations. Use of Professional knowledge of Acceptance sampling Plans and Reliability Theory in Industry and Health Science.

PG86P404 Project Work:

Course outcomes

After completing the project work, the candidate will learn;

- Work in team, develop leadership quality, skill of information collection.
- Present the collected information with graphs, analyze and interpret the data, draw conclusions thereby helping administrators in framing policies.