

PONDICHERRY UNIVERSITY

DEPARTMENT OF STATISTICS



SYLLABUS FOR M.Sc - STATISTICS
(CBCS – Five Year Integrated)
Effective from the Academic Year 2013-2014

PONDICHERRY UNIVERSITY
CHOICE BASED CREDIT SYSTEM
SYLLABUS FOR THE M.Sc. INTEGRATED STATISTICS COURSE
Effective from the Academic Year 2013 – 2014

| SEMESTER | COURSE CODE | TITLE OF THE COURSE | NATURE OF THE COURSE | NO. OF CREDITS |
|----------|-------------|--|----------------------|----------------|
| I | STAT 111 | Basic Statistics | Hard Core | 3 |
| II | STAT 121 | Basic Probability Theory | Hard Core | 3 |
| III | STAT 231 | Probability Distributions | Hard Core | 3 |
| | STAT 232 | Introduction to Sampling Theory | Hard Core | 3 |
| IV | STAT 241 | Basic Estimation Theory | Hard Core | 3 |
| | STAT 242 | Practical – I | Hard Core | 2 |
| V | STAT 351 | Elements of Testing Statistical Hypotheses | Hard Core | 3 |
| | STAT 352 | Statistical Quality Control and Operations Research | Hard Core | 3 |
| | STAT 353 | Practical – II | Hard Core | 2 |
| VI | STAT 361 | Principles of Experimental Design | Hard Core | 3 |
| | STAT 362 | Applied Statistics | Hard Core | 3 |
| | STAT 363 | Practical – III | Hard Core | 2 |
| VII | STAT 411 | Linear Algebra and Matrix Theory | Hard Core | 4 |
| | STAT 412 | Probability Theory | Hard Core | 4 |
| | STAT 413 | Sampling Theory | Hard Core | 4 |
| | STAT 414 | Distribution Theory | Hard Core | 4 |
| | STAT 415 | Statistical Laboratory – I (Based on STAT 413 and SYSTAT) | Hard Core | 3 |
| VIII | STAT 421 | Theory of Estimation | Hard Core | 4 |
| | STAT 422 | Statistical Quality Control and Total Quality Management | Hard Core | 4 |
| | STAT 423 | Stochastic Processes | Hard Core | 4 |
| | STAT 424 | Statistical Laboratory - II (Based on STAT 421, 422 and SPSS) | Hard Core | 3 |
| | | Soft Core | Soft Core | 3 |
| IX | STAT 531 | Multivariate Statistical Analysis | Hard Core | 4 |
| | STAT 532 | Testing of Statistical Hypotheses | Hard Core | 4 |
| | STAT 533 | Linear Models and Regression Analysis | Hard Core | 4 |
| | STAT 534 | Statistical Laboratory – III (Based on STAT 531, 532, 533 and SPSS) | Hard Core | 3 |
| | | Soft Core | Soft Core | 3 |
| X | STAT 541 | Design and Analysis of Experiments | Hard Core | 4 |
| | STAT 542 | Statistical Laboratory – IV (Based on STAT 541 and R - language) | Hard Core | 3 |
| | STAT 543 | Project and Viva-Voce | Hard Core | 4 |
| | | Soft Core | Soft Core | 3 |
| | | Soft Core | Soft Core | 3 |

Soft Core Papers

| | Semester VIII | | Semester IX |
|----------|---------------------------------|----------|----------------------|
| STAT 425 | Biostatistics | STAT 535 | Reliability Theory |
| STAT 426 | Decision Theory | STAT 536 | Time Series Analysis |
| STAT 427 | Econometrics | STAT 537 | Actuarial Statistics |
| STAT 428 | Bayesian Inference | STAT 538 | Statistical Genetics |
| | Semester X | | |
| STAT 544 | Survival Analysis | | |
| STAT 545 | Operations Research | | |
| STAT 546 | Statistical Data Mining Methods | | |
| STAT 547 | Demographic Techniques | | |
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Unit I

Definition of statistics – Scope and limitations of statistics – Primary and Secondary data- Collection and presentation of data – summarizing data – frequency distribution – Measures of location – mean – median – mode – Percentiles - Simple problems.

Unit II

Measures of dispersion – Range – Quartile deviation – Mean deviation - Standard deviation – coefficient of variation – Moments about the origin and mean – Skewness, Kurtosis and their measures.

Unit III

Measures of association between attributes - coefficient of association and contingency; Measures of relation between two variables – correlation and Rank correlation – Kendall's Tau - Simple problems

Unit IV

Partial and Multiple correlation coefficients (three variables only) – regression – Curve fitting by least squares – linear and quadratic

Unit V

Present official statistical system in India relating to population, agriculture, Industrial production, trade and prices - Methods of collecting official statistics, their reliability and limitations - Principal publications containing such statistics - Official agencies responsible for their collection and their functions.

Books for Study

1. Hooda.R.P.(2003): Statistics for Business and Economics , 3/e, Mac Millan .
2. Medhi.J. (1992): Statistical Methods an Introductory Text , Wiley Eastern Ltd.
3. Gupta.S.C. and Kapoor.V.K. (2000): Fundamentals of Mathematical Statistics , 10/e, Sultan Chand and sons.
4. Agarwal.B.L(1996): Basic statistics , 3/e, New Age International (P) Ltd.

Books for Reference

1. Anderson.R, Sweeney.J and Williams.A (2002): Statistics for Business and Economics, 8/e, Thomson.
2. Guide to current Indian Official statistics – Central Statistical Organisation, Govt. of India.
3. Sheldon M.Ross (2006) : Introductory Statistics , 2/e, Elsevier Publications.
4. Murray R. Spiegel and Larry J. Stephens (2005): Schaum's Outline of Theory and Problems of Statistics, 3/e, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.

Unit I

Events - Sample Space - Mathematical and Statistical definitions of Probability - Axiomatic definition of Probability –Addition and multiplication theorems - Conditional probability – Bayes' Theorem - Simple problems.

Unit II

Random variables - Discrete and Continuous - Distribution function and its properties - Expectation - Chebychev's inequality - Cauchy - Schwartz inequality

Unit III

Moment Generating function - Probability Generating function - characteristic function, its properties and uses.

Unit IV

Concept of Bivariate distributions - conditional and marginal distributions -Notion of Independence of Random variables - Conditional Expectation - Simple problems

Unit V

Definition of convergence in probability and distributions - Weak Law of Large numbers (WLLN) - Central Limit theorem for i.i.d case (statement only)

Books for Study

1. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi
2. Hogg, R.V. , Mc Kean J W and Craig, A.T.(2005): Introduction to Mathematical Statistics, 6/e Pearson Edition
3. Parzen E (1962):Modern Probability Theory and its applications, John Wiley and Sons

Books for Reference

1. Gupta,S.C. and Kapoor, V.K. (2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and sons.
2. Bhat, B.R., Srivenkataramana, T and Rao Madhava, K.S. (1997): Statistics: A Beginner's Text, Vol. II New Age International (P) Ltd.
3. Goon, A.M., Gupta, M.K. and Das Gupta,B. (2001): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
4. Mood, A.M., Graybill, F.A and Boes, D.C.(1974): Introduction to the Theory of Statistics, McGraw Hill.

Unit I

Discrete Distributions: Bernoulli, Binomial - Poisson - Geometric – Negative Binomial and Hypergeometric distributions and their characteristics.

Unit II

Continuous Distributions: Uniform - Exponential - Normal - Gamma - Beta distributions and their characteristics.

Unit III

Cauchy distribution - Laplace distribution - Bivariate Normal distribution - Conditional and marginal distributions

Unit IV

Definition of Sampling distributions and standard error - Sampling distributions: t, F and chi-square distributions - Interrelationship among t, F and chi-square distributions and their characteristics

Unit V

Concept of Order statistics - Distribution of the Order Statistics including that of maximum and minimum - Distribution of the sample Range and median

Books for Study

1. Rohatgi, V.K. and Saleh (2002): An Introduction to Probability Theory and Mathematical Statistics, John Wiley.
2. Hogg, R.V. , Mc Kean J W and Craig, A.T.(2005): Introduction to Mathematical Statistics, 6/e Pearson Edition
3. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi

Books for Reference

1. Gupta, S.C. and Kapoor, V.K.(2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons
2. Goon, A.M., Gupta, M.K. and Das Gupta,B. (2001): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
3. Mood, A.M., Graybill, F.A and Boes, D.C.(1974): Introduction to the Theory of Statistics, McGraw Hill.
4. Irwin Miller and Marlyees Miller (2002): John E Freund's Mathematical Statistics, 6/e, PHI

Unit I

Concept of sampling - Need for sampling - population and sample - sampling unit and sample frame - Types of Population - Basic properties of population - sample survey and census - Principal steps in a Sample survey - Notion of sampling error.

Unit II

Simple Random Sampling with and without replacement - Estimation of Population mean and proportion and their variances- Determination of sample size.

Unit III

Stratified sampling - Principles of stratification - Estimation of population mean and its variance - Allocation techniques - Estimation of gain due to stratification

Unit IV

Systematic sampling - Estimation of population mean and its sampling variance - Circular systematic sampling - comparison of systematic, simple random and stratified random sampling - cluster sampling with equal sized clusters - estimation of population mean and variance.

Unit V

Large scale sample surveys - Sources of Non sampling errors and methods of controlling them - NSSO and CSO and their functions.

Books for Study

1. Cochran, W.G. (1977): Sampling Techniques, 3/e, Wiley.
2. Singh D and Choudhary F.S. (1986): Theory and Analysis of Sample Survey and Designs, New Age International.

Books for Reference

1. Desraj (2000): Sample survey theory, Narosa Publishing House.
2. Murthy M.N. (1967): Sampling theory and methods, Statistical Publishing society, Calcutta.
3. Sukhatme P.V. etal (1984): Sampling theory of surveys with applications, Iowa State University Press and IARS.
4. Sampath S.(2000): Sampling Theory and Methods, Narosa Publishing house.
5. Parimal Mukhopadhyay(2009): Theory of Sample Surveys, Prentice Hall of India

Unit I

Basic problem of statistical Inference: Point estimation - Properties of estimators: Unbiasedness and consistency - Conditions for consistency – Sufficiency - Factorization theorem (without proof) – Simple problems

Unit II

Efficiency - Minimum Variance Unbiased Estimators (MVUE) and their properties - Cramer-Rao Inequality - Rao - Blackwell Theorem – Simple Problems

Unit III

Methods of Estimation: Methods of moments – Simple problems - Method of least squares – Method of minimum chi-square

Unit IV

Method of maximum likelihood estimation (MLE) – Properties of maximum likelihood estimators - Asymptotic properties of MLE (without proof) - Method of Scoring

Unit V

Confidence intervals: Basic Notions - Confidence Intervals for the mean, proportion, variance (for the case of one and two populations) and correlation coefficient - Large sample Confidence Intervals

Books for Study

1. Hogg, R.V. , Mc Kean J W and Craig, A.T.(2005): Introduction to Mathematical Statistics, 6/e Pearson Edition
2. Gupta, S.C. and V.K. Kapoor (2000): Fundamental Mathematical Statistics, Sultan Chand and Co.
3. Mood,A.M., Graybill, A.M. and Boes, D.C. (1974): Introduction to theory of Statistics , Mc Graw Hill.
4. Goon, A.M., Gupta, M.K.and Das Gupta,B. (2001): An Outline of statistical theory , Vol. II , 6/e, World Press, Calcutta.

Books for Reference

1. Larson(1982): Introduction to Probability Theory and Statistical Inference, 3/e, John Wiley.
2. Rohatgi,V.K. and Saleh, A.K.(2002): An Introduction to Probability and Statistics , 2/e, John Wiley.
3. Rao, C.R(1998): Linear Statistical Inference and its Applications, Wiley Eastern Ltd,.
4. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi
5. Miller.I and Miller.M (2002): John E. Freunds Mathematical statistics, Pearson Education.

I. BASIC STATISTICS

1. Measures of Central Tendency and Dispersion
2. Moments, Skewness and Kurtosis
3. Fitting of straight line, second degree parabola
4. Simple correlation, regression, rank correlation
5. Partial and multiple correlation
6. Measures of association

II. SAMPLING THEORY

1. Use of random numbers and Simple random sampling
2. Stratified random sampling – Proportional allocation and Optimum allocation
3. Systematic sampling
4. Cluster sampling (equal size)

III. ESTIMATION

1. Method of Maximum Likelihood
2. Method of Moments
3. Confidence Intervals

STAT 351 -ELEMENTS OF TESTING STATISTICAL HYPOTHESES CREDITS: 3

Unit I

Concept of hypothesis testing - Types of errors and power - most powerful tests - Neyman-Pearson Fundamental Lemma and its applications - Notion of Uniformly most powerful tests

Unit II

Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions - Large sample properties

Unit III

Tests of significance (under normality assumption): Test for single mean and proportion for small and large samples – Test for correlation and variance

Unit IV

Test for equality of means and variances of two population (large and small samples) – Test for equality of proportions – Chi-square test for goodness of fit and test for independence of attributes

Unit V

Non Parametric Tests: Sign test, Signed rank test, Median test , Mann-Whitney test, Run test and One sample Kolmogorov –Smirnov test (Description, properties and applications only)

Books for Study

1. Rohatgi, V.K. and Saleh, A.K.(2002): An Introduction to Probability and Statistics , 2/e, John Wiley.
2. Hogg, R.V. , Mc Kean J W and Craig, A.T.(2005): Introduction to Mathematical Statistics, 6/e Pearson Edition
3. Manoj Kumar Srivastava and Namita Srivastava (2009): Statistical Inference – Testing of Hypotheses, Prentice Hall of India
4. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi

Books for Reference

1. Gupta, S.C. and V.K. Kapoor (2000): Fundamentals of Mathematical Statistics, Sultan Chand and Co.
2. Mood, A.M., Graybill, A.M. and Boes, D.C.(1974): Introduction to Theory of Statistics , Mc Graw Hill.
3. Goon, A.M., Gupta, M.K. and Das Gupta, B. (2001): An Outline of Statistical Theory, Vol. II, 6/e, World Press , Calcutta.
4. Miller, I and Miller, M (2002): John E. Freund's Mathematical statistics, Pearson Education.
5. Gibbons, J.D. (1985) : Non Parametric Statistical Inference , 2/e , Marckel Decker.

STAT 352 - STATISTICAL QUALITY CONTROL AND OPERATIONS RESEARCH

CREDITS: 3

Unit I

Need for SQC in industries; Process control: Chance and assignable causes of variation - specification and tolerance limits; process capability- Statistical basis for control charts: \bar{X} , R, p and c charts - their construction and analysis

Unit II

Product control: Acceptance sampling by attributes; Producer's and Consumer's risk- Notions of AQL, LTPD and AOQL - Single and double sampling plans: OC, AOQ, ASN and ATI Curves

Unit III

Linear Programming Problem - Graphical solution - Simplex method - Artificial variables Techniques – Big M-method and Two-Phase methods

Unit IV

Transportation Problem: Initial Basic Solution by North West Corner Rule, Least Cost and Vogel's Approximation Methods – Optimal Solution by Modified Distribution (MODI) Method -Assignment problem - Simple Problems

Unit V

Network analysis by CPM / PERT: Basic concepts: Constructions of the network - concepts of slack and float in network analysis - Determination of the floats and critical path.

Books for Study

1. Montgomery .D.C (1985): Introduction to Statistical quality control, 2/e, John Wiley.
2. Taha H.A. (1982): Operational Research: An Introduction, 4/e, McMillan.

Books for Reference

1. Gupta.S.C. and V.K. Kapoor (2000): Fundamentals of Applied Statistics, Sultan Chand and sons.
2. Kanti Swarup.P.K, Gupta and Manmohan (1985): Operation Research, Sultan Chand and Sons.
3. J.K. Sharma (2001): Operation Research: Theory and Applications, MacMillan, India.
4. Goel and Mittal (1982): Operation Research, Pragati Pakashan, Meerut.
5. Ott, E.R. (1975): Process Quality Control; Mc Graw Hill.
6. Hillier. F.S. and Lieberman. G.J. (1962): Introduction to Operations Research, CBS Publications.

(Based on STAT 351 and STAT 352)

I. STATISTICAL INFERENCE

1. Large Sample Tests: Means, Variances and Proportions
2. Tests based on Chi-square statistic: Population variance, Homogeneity of correlation coefficient
3. Test based on t statistic: Single mean, Difference of means, Paired t test, Correlation coefficient
4. Tests based on F statistic: Equality of two population variances
5. Testing the independence of attributes
6. Fitting of Binomial and Poisson distributions and test the goodness of fit
7. Non-parametric tests – Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test and Kolmogorov –Smirnov one sample test

II. STATISTICAL QUALITY CONTROL

1. \bar{X} and R chart
2. p chart and np chart
3. Control chart for number of defects
4. Single Sampling Plan – OC, ATI, AOQ curves
5. Double Sampling Plan - OC, ATI, AOQ curves
6. Simple Linear Regression – Model fitting – Test for regression coefficients and confidence intervals
7. Multiple Regression (Two Independent variables) - Model fitting – Test for regression coefficients and confidence intervals

Unit I

Basic Principles for designing statistical experiments: Randomisation, Replication and local control techniques - Determination of experimental units and notion of experimental error - Analysis of variance with one-way and two-way classifications - Models and Methods of analysis.

Unit II

Completely Randomized Design (CRD) and Randomized Block Design (RBD)- Models and estimates of parameters and their standard error - Analysis of data arising from such designs, Analysis when one or two observations are missing.

Unit III

Latin Square Design (LSD) – Model – Estimation of parameters – Method of analysis – Missing Plot technique in LSD

Unit IV

Multiple Comparison tests: Least Significant Difference, Student-Newman-Keuls test , Duncan's Multiple Range test, Tukey's test

Unit V

Factorial Experiments: 2^2 , 2^3 and 3^2 designs; estimation of main effects and interactions and their standard errors

Books for Study

1. Das, M.N. and Giri.N.C. (1986): Design and Analysis of Experiments, Wiley eastern.
2. Montgomery, C.D (1976): Design of Experiments, John Wiley and Sons.

Books for Reference

1. Goon.A.M, Gupta and Dasgupta.B. (2001): An Outline of statistical theory, vol. II, 6/e World Press Calcutta.
2. Gupta .S.C. and Kapoor.V.K.(2000): Fundamentals of Applied Statistics, Sultan Chand.
3. Parimal Mukhopadhyay(2005):Applied Statistics, 2/e, Books and Allied (P) Ltd, Kolkata.

Unit I

Index Numbers; Construction of index numbers ; fixed and chain base index numbers; weighted index numbers; standard index numbers ; Tests for index numbers ; cost of living index number and its construction.

Unit II

Time Series Analysis: Time Series models - Components of a time series - Methods of trend and isolation – Moving average, Seasonal indices, Ratio to trend, Link relative methods - Cyclical fluctuations

Unit III

Sources of Demographic data: Measures of mortality – Crude and specific rates, standardized rates, Infant mortality rate - Complete life table - its construction and uses. Abridged life tables

Unit IV

Measures of fertility: Crude Birth Rate (CBR), Age Specific Fertility Rate (ASFR), General Fertility Rate (GFR) and Total Fertility Rate (TFR) - Crude, Specific and standardized rates - Measures of migration, Population growth rates - Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR)

Unit V

Educational Statistics, methods of standardization of scales and tests; Z- scores, standard scores, T- scores and percentile scores ; validity of test score and its determination; Intelligence Quotient, its measurement and uses.

Books for Study

1. Kapoor.V.K. and Gupta.S. (2000): Fundamentals of Applied Statistics,Sultan Chand and Sons.
2. Parimal Mukhopadhyay(2005):Applied Statistics, 2/e, Books and Allied (P) Ltd, Kolkata.

Books for Reference

1. Goon.A.M., Gupta.M.K. and DasGupta .B (1999) : Fundamental of Statistics , Vol. II, World Press , Calcutta.
2. Bogue.D.J.(1969) : Principles of Demography , John Wiley.
3. Misra.B.D.(1982): An Introduction to the Study of Population, South Asian Publishing.

I. DESIGN OF EXPERIMENTS

1. Completely Randomised Design
2. Randomised Block Design and R.B.D. with one or two missing values
3. Latin Square Design and L.S.D. with one missing value
4. 2^2 Design, 2^3 Design and 3^2 Design
5. Total Confounding in 2^3 experiments

II. APPLIED STATISTICS

1. Time series: Straight line trend by method of least squares, moving average method
2. Seasonal fluctuations: Method of simple averages, Ratio to trend method, Ratio to moving average method and Link relative method.
3. Index numbers: Calculation of indices using Laspeyre's, Paasche's, Marshall-Edgeworth, Bowley's and Fisher's formula.
4. Cost of Living Index Number
5. Crude specific and Standardised death rates
6. Construction of life tables and abridged life tables.

1. A project work is compulsory and shall be offered in semester IV. It will have 4 credits.
2. A project work may be taken individually or by a group of two students.
3. Project work shall be supervised by a faculty member assigned by the Head of the Department in the beginning of the semester.
4. 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.
5. At the end of the semester, a report on the work done should be submitted (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).
6. 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 and related references should also be given.
7. The project work will be assessed for a maximum of 100 marks. Each student will give a seminar before the end of the semester on their project work which will be evaluated internally for a maximum of 40 marks. There will be an external viva-voce examination for a maximum of 10 marks by an internal and an external examiner. The project report will be valued by the same external and internal examiner for a maximum of 50 marks.