PONDICHERRY UNIVERSITY

DEPARTMENT OF STATISTICS

SYLLABUS FOR M.Sc. 5 YEAR INTEGRATED STATISTICS
(CBCS Pattern)
Effective from the Academic Year 2014-2015
**PONDICHERRY UNIVERSITY**
**CHOICE BASED CREDIT SYSTEM**
**SYLLABUS FOR THE M.Sc. 5 YEAR INTEGRATED STATISTICS COURSE**
*Effective from the Academic Year 2014 – 2015*

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**CHOICE BASED CREDIT SYSTEM**
**SYLLABUS FOR THE M.Sc. INTEGRATED COMPUTER SCIENCE, MATHEMATICS COURSE**
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SEMESTER I

STAT 111 - BASIC STATISTICS

CREDITS: 3

Unit I
Definition of statistics – Scope and limitations of statistics – Types of data – Nominal, Ordinal, Ratio, Interval scale data - Primary and Secondary data – Data presentation tools – One dimensional, two dimensional data presentation – line diagram – Box plots – stem and Leaf plots – Scatter plots

Unit II

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

Text Books


Reference Books

SEMESTER I

STAT 112 - BASIC PROBABILITY THEORY

CREDITS: 3

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 – Variance - 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)

Text Books

Reference Books
SEMESTER II

STAT 121- DISTRIBUTION THEORY - I  

UNIT I
Discrete Distributions: Definition, properties and simple problems of Bernoulli, Binomial - Poisson - Geometric – Discrete Uniform distributions - Power Series distributions

UNIT II
Definition, properties and simple problems of Negative Binomial - Multinomial – Hypergeometric distributions

UNIT III
Continuous Distributions: Definition, properties and simple problems of Uniform - Exponential - Normal distributions

UNIT IV
Definition, properties and simple problems of Cauchy - Gamma (one and two parameters) - Beta distributions (First and Second kind)

UNIT V
Definition, properties and simple problems of Lognormal - Logistic - Pareto distributions

Text Books


Reference Books


* Properties of distribution related to mean, variance, m.g.f. and recurrence relations
SEMESTER II

STAT 122 - APPLIED STATISTICS  CREDITS: 3

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
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.

Text Books

Reference Books
SEMESTER III

STAT 231 – DISTRIBUTION THEORY – II

CREDITS: 4

Unit I
Bivariate Normal distribution - Conditional and marginal distributions – Simple problems

Unit II
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 III
Concept of Truncation - Truncated Binomial – Truncated Poisson distribution and their characteristics

Unit IV
Compound distribution – Notion, simple characteristics of Compound Binomial – Compound Poisson distributions

Unit V
Order statistics – Definition and uses - Distribution of $r^{th}$ order statistics – Joint distribution of $r^{th}$ and $s^{th}$ order statistic – Distribution of the sample Range and mid range - Simple problems

Text Books


Reference Books

SEMESTER III

STAT 232 – INTRODUCTION TO SAMPLING THEORY

CREDITS: 3

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.

Text Books


Reference Books

SEMESTER IV

STAT 241 -BASIC ESTIMATION THEORY CREDITS: 4

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

Text Books


Reference Books

SEMESTER IV

STAT 242 - OPERATIONS RESEARCH  

CREDITS: 3

Unit I

Unit II
Linear Programming Problem – Formulation - Graphical solution - Simplex method - Artificial variables Technique – Big M-method - Concepts of Duality – Conversion of primal problem to dual - simple problems

Unit III
Transportation Problem- Initial Basic Solution by North West Corner Rule and Vogel’s Approximation Methods – Optimal Solution by Modified Distribution (MODI) Method - Assignment problem - Simple Problems

Unit IV
Game Theory – Pure and Mixed strategies, saddle point - Optimal Solution of two person zero sum games – Graphical solution of (2 x n) and (m x 2) games – Solving games using Dominance property.

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.

Text Books

Reference Books
I. 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)

II. ESTIMATION THEORY

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

STAT 351 - ELEMENTS OF TESTING STATISTICAL HYPOTHESES  CREDITS: 4

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)

Text Books

Reference Books
SEMESTER V

STAT 352 – REGRESSION ANALYSIS

UNIT I
Simple Regression model: Description of data model – Assumption about the explanatory variable - Estimation and test of hypotheses - Confidence Intervals – Predicted values and standard errors – Evaluation of fit.

UNIT II
Analysis of residual - Residual plots – Transformation of variables – transformation to stabilize variance – Removal of heteroscedasticity

UNIT III
Multiple regression model: Description of data model – Properties of least square estimators – Predicted values and standard errors – Multiple correlation coefficient - Selection of variables – Forward selection procedure – Backward elimination procedure – Stepwise method (algorithms only).

UNIT IV
Test of hypothesis on the linear model — Testing a subset of regression coefficients equal to zero – Testing of equality of regression coefficients.

UNIT V
Multicollinearity and its effects on inference and forecasting – Detection of multicollinearity – Remedial measures

Text Books:
1. S.Chatterjee and B.Price (1977): Regression Analysis by Example, John Wiley & Sons, New York. Chapter 1,2,3 and relevant sections in chapters 4,5,6,7,8,9

Reference Books:
SEMESTER V

STAT 353 - PRACTICAL II

CREDITS: 2

(Based on STAT 351 and STAT 352)

I. STATISTICAL INFERENCE and REGRESSION ANALYSIS

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
8. Simple Linear Regression – Model fitting – Test for regression coefficients and confidence intervals
9. Multiple Regression (Two Independent variables) - Model fitting – Test for regression coefficients and confidence intervals
SEMESTER VI

STAT 361 - PRINCIPLES OF EXPERIMENTAL DESIGN  CREDITS: 3

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

Text Books

Reference Books
Unit I

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

Unit III
Control charts for attributes – p, np, c and u charts – their construction and analysis.

Unit IV
Product control: Acceptance sampling by attributes; Producer’s and Consumer’s risk- Notions of AQL, LTPD and AOQL – Concepts of Single and Double sampling plans

Unit V
OC, AOQ, ASN, ATI curves for Single and Double sampling plans – Concept of Sequential sampling plan for attributes.

Text Books

Reference Books
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. STATISTICAL QUALITY CONTROL

6. $\bar{X}$ and R chart
7. p chart and np chart
8. Control chart for number of defects
9. Single Sampling Plan – OC, ATI, AOQ curves
10. Double Sampling Plan - OC, ATI, AOQ curves