PONDICHERRY UNIVERSITY

DEPARTMENT OF STATISTICS

SYLLABUS FOR M.Sc - STATISTICS
(CBCS – Five Year Integrated)
Effective from the Academic Year 2011-2012

PONDICHERRY UNIVERSITY
CHOICE BASED CREDIT SYSTEM
SYLLABUS FOR THE M.Sc. INTEGRATED STATISTICS COURSE
Effective from the Academic Year 2011 – 2012

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	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	Mathematical Methods for Statistics	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)	Hard Core	3
VIII	STAT 421	Theory of Estimation	Hard Core	4
	STAT 422	Statistical Quality Control and Operations Research	Hard Core	4
	STAT 423	Stochastic Processes	Hard Core	4
		Soft Core	Soft Core	3
	STAT 424	Statistical Laboratory - II (Based on STAT 421, 422)	Hard 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
		Soft Core	Soft Core	3
	STAT 534	Statistical Laboratory – III (Based on STAT 531, 532, 533)	Hard Core	3
X	STAT 541	Design and Analysis of Experiments	Hard Core	4
		Soft Core	Soft Core	3
		Soft Core	Soft Core	3
	STAT 542	Statistical Laboratory – IV (Based on STAT 541)	Hard Core	3
	STAT 543	Project and Viva-Voce	Hard Core	4

Soft Core Papers

	Semester VIII		Semester IX
STAT 425	Statistical Data Mining Methods	STAT 535	Reliability Theory
STAT 426	Econometrics	STAT 536	Biostatistics
STAT 427	Demographic Techniques	STAT 537	Actuarial Statistics
STAT 428	Bayesian Inference	STAT 538	Total Quality Management
	Semester X		
STAT 544	Survival Analysis		
STAT 545	Advanced Operations Research		
STAT 546	Programming in C++		
STAT 547	Time Series Analysis		

STAT 548	Statistical Genetics		

STAT 111 - BASIC STATISTICS **CREDITS: 3**

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 – (Simple problems) Percentiles.

Unit II

Measures of variability – Range – Quartile 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 regression – Curve fitting by least squares.

Unit IV

Partial and Multiple correlation coefficients (three variables only) – Rank correlation – Simple problems.

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. Srivastava S.C. and Sangya Srivastava (2003): Fundamentals of Statistics, 1/e, Anmol Publications, New Delhi
4. Ken Black(2010): Business Statistics: Contemporary Decision Making, 6/e, John Wiley & Sons.

Books for Reference

1. Agarwal.B.L(1996): Basic statistics , 3/e, New Age International (P) Ltd.
2. Anderson.R, Sweeney.J and Williams.A (2002): Statistics for Business and Economics, 8/e, Thomson.
3. Guide to current Indian Official statistics – Central Statistical Organisation, Govt. of India.
4. Gupta.S.C. and Kapoor.V.K. (2000): Fundamentals of Mathematical Statistics , 10/e, Sultan Chand and sons.
5. Nabendu Pal and Sahadeb Sarkar (2005): Statistics concepts and Applications, Prentice-Hall of India Private Ltd., New Delhi.
6. Sheldon M.Ross (2006) : Introductory Statistics , 2/e, Elsevier Publications.
7. 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.

STAT 121 - BASIC PROBABILITY THEORY **CREDITS: 3**

Unit I

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

Unit II

Random variable - Discrete and Continuous Random variables - Distribution function and its properties - Expectation - Moment Generating function - Probability Generating function

Unit III

Chebychev's inequality - Cauchy - Schwartz inequality - 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

Weak Law of Large numbers (WLLN) - Bernoulli's Theorem, convergence in probability and distributions - Central Limit theorem for iid case

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. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi

Books for Reference

1. Bhat, B.R., Srivenkataramana, T and Rao Madhava, K.S. (1997): Statistics: A Beginner's Text, Vol. II New Age International (P) Ltd.
2. Goon, A.M., Gupta, M.K. and Das Gupta,B. (2001): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
3. Gupta,S.C. and Kapoor, V.K. (2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and sons.
4. Hoel, P.G. (1971): Introduction to Mathematical Statistics, Asia Publishing house.
5. Meyer, P.L. (1970): Introductory Probability and statistical Applications, Addison Wesley.
6. Mood, A.M., Graybill, F.A and Boes, D.C.(1974): Introduction to the Theory of Statistics, McGraw Hill.
7. Pitman, Jim (1993): Probability, Narosa Publishing House.

STAT 231- PROBABILITY DISTRIBUTIONS **CREDITS: 3**

Unit I

Discrete Distributions: Bernoulli, Binomial - Poisson - Geometric - Multinomial 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

Sampling distributions - 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. Gupta, S.C. and Kapoor, V.K.(2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons
2. Hogg, R.V. , Mc Kean J W and Craig, A.T.(2005): Introduction to Mathematical Statistics, 6/e Pearson Edition
3. Irwin Miller and Marlyees Miller (2002): John E Freund's Mathematical Statistics, 6/e, PHI
4. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi

Books for Reference

1. Anderson,R., Sweeney,J and Williams,A.(2002): Statistics for Business and Economics, 8/e , Thomson.
2. Johnson, S. and Kotz (1972): Distributions in Statistics, Vol. I , Vol. II, Houghton and Miffin.
3. Rao, C.R.(1973): Linear Statistical Inference and its applications 2/e, Wiley eastern.
4. Richard, A. Johnson (2002): Probability and Statistics for Engineers, 6/e, PHI, New Delhi.
5. Rohatgi, V.K. and Saleh (2002): An Introduction to Probability Theory and Mathematical Statistics, John Wiley.
6. William Mendenhall and Robert J. Beewer (1991): Introduction to Probability and Statistics, 8/e, PWS-Kent Publishing Company.

STAT 232 - 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 - NSS and CSO and their functions.

Books for Study

1. Singh D and Choudhary F.S. (1986): Theory and Analysis of Sample Survey and Designs, New Age International.

Books for Reference

1. Cochran, W.G. (1977): Sampling Techniques, 3/e, Wiley.
2. Desraj (2000): Sample survey theory, Narosa Publishing House.
3. Murthy M.N. (1967): Sampling theory and methods, Statistical Publishing society, Calcutta.
4. Sukhatme etal (1984): Sampling theory of surveys with applications, Iowa State University Press and IARS.
5. Sampath (2000): Sampling Theory and Methods, Narosa Publishing house.

STAT 241 -BASIC ESTIMATION THEORY **CREDITS: 3**

Unit I

Basic problem of statistical Inference; Point estimation; Properties of estimators; Unbiasedness and consistency; conditions for consistency; sufficiency; factorisation theorem (without proof) - Applications.

Unit II

Efficiency; minimum variance unbiased estimators and their properties ; Cramer-Rao Inequality, Rao - Blackwell Theorem and their applications.

Unit III

Methods of Estimation: Methods of moments, least square and minimum chi-square methods; Statement of their properties and applications.

Unit IV

Method of maximum likelihood and its applications; properties of maximum likelihood estimators, asymptotic properties (without proof). Bayes' Estimators: Notions of Prior and Posterior distributions, improper and conjugate prior and Bayes' Estimators.

Unit V

Confidence intervals: Basic Notions; Confidence Intervals for the mean, proportion and variance (for the case of one and two populations) and correlation coefficients- 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. Ken Black(2010): Business Statistics: Contemporary Decision Making, 6/e, John Wiley & Sons.
3. Bansilal, Sanjay Arora and Sudha Arora (2006): Introducing Probability and Statistics, 2/e, Satya Prakashan Publications, New Delhi

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. Gupta, S.C. and V.K. Kapoor (2000): Fundamental Mathematical Statistics, Sultan Chand and Co.
4. Mood,A.M., Graybill, A.M. and Boes, D.C. (1974): Introduction to theory of Statistics , Mc Graw Hill.
5. Goon, A.M., Gupta, M.K.and Das Gupta,B. (2001): An Outline of statistical theory , Vol. II , 6/e, World Press, Calcutta.
6. Miller.I and Miller.M (2002): John E. Freunds Mathematical statistics, Pearson Education.

STAT 242 - PRACTICAL I **CREDITS: 2**
(Based on STAT 111, STAT 232 and STAT 241)

I. BASIC STATISTICS

1. Diagrammatic Representation – Bar Chart, Pie Diagram
2. Construction of Frequency Tables and their graphical representations
3. Measures of Central Tendency, Dispersion, Moments, Skewness and Kurtosis
4. Fitting of straight line, second degree parabola and exponential curves
5. Simple correlation, regression, rank correlation
6. Partial and multiple correlation
7. 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 and Minimum Chi-Square
3. Bayesian Estimation
4. Confidence Intervals

STAT 351 -ELEMENTS OF TESTING STATISTICAL HYPOTHESES CREDITS: 3

Unit I

Neyman -Pearson formulation of the Hypothesis testing problem; concept of hypotheses - 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

Standard tests of significance relating to mean, proportion and variance (for one and two populations), tests for correlation coefficients - Large sample tests

Unit IV

Non Parametric Tests: Sign test, Signed rank test, Median test , Mann-Whitney test, Goodness of fit test; Chi-square and Kolmogorov –Smirnov test (Description, properties and applications only)

Unit V

Linear Models: Estimation of parameters - Gauss –Markov theorem - Tests of significance for the parameters in the model

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. Larson(1982): Introduction to Probability Theory and Statistical Inference, 3/e, John Wiley.
2. Gupta, S.C. and V.K. Kapoor (2000): Fundamentals of 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.
5. Miller.I and Miller.M (2002): John E. Freunds Mathematical statistics, Pearson Education.
6. Ken Black(2010): Business Statistics: Contemporary Decision Making, 6/e, John Wiley &

Sons.

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, $\overline{X}$ -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 - M-method and Two-Phase method.

Unit IV
Transportation Problem: North west corner, Least cost and Vogel's approximation methods; Assignment problem and its algorithm; Traveling Salesman Problem.

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, 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 Leiberman. G.J. (1962): Introduction to Operations Research, CBS Publications.

STAT 353 - PRACTICAL II **CREDITS: 2**
(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, Bartlett's test.
3. Test based on t statistic: Single mean, Difference of means, Paired t test, Correlation coefficient, Regression coefficient.
4. Tests based on F statistic: Equality of two population variances
5. Non-parametric tests – Sign test, Wilcoxon test, Mann-Whitney U test, Median test, Run test, Chi-square goodness of fit test and Kolmogorov –Smirnov one sample test

II. STATISTICAL QUALITY CONTROL

1. $\overline{X}$ 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

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 and randomized block designs - 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 – Model – Estimation of parameters – Method of analysis – Missing Plot technique in LSD - Analysis of covariance - One-way classification only

Unit IV

Multiple Comparison tests: LSD , Student-Newman–Keuls test , Duncan's Multiple range test, Tukey's test - Transformations to stabilize the variance .

Unit V

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

Books for Study

1. Das.M.N. and Giri.N.C. (1986): Design and Analysis of Experiments, Wiley eastern.
2. Gupta .S.C. and Kapoor.V.K.(2000): Fundamentals of Applied Statistics, Sultan Chand.

Books for Reference

1. Kempthorne. O. (1965): The Design and Analysis of Experiments , Wiley eastern.
2. Goon.A.M, Gupta and Dasgupta.B. (2001): An Outline of statistical theory, vol. II, 6/e World Press Calcutta.
3. Montgomery.C.D (1976): Design of Experiments, John Wiley and Sons.
4. Parimal Mukhopadhyay(2005):Applied Statistics, 2/e, Books and Allied (P) Ltd, Kolkata.

STAT 362 - 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: CBR, ASBR, GFR and TFR, Crude, Specific and standardized rates - Measures of migration, Population growth rates; GRR and 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.

STAT 363 - PRACTICAL III **CREDITS: 2**
(Based on STAT 361 and STAT 362)

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
6. Analysis of Covariance – CRD

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 indices.
5. Crude specific and Standardised death rates
6. Construction of life tables and abridged life tables.