PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

DEGREE OF MASTER OF SCIENCE

CHOICE BASED CREDIT SYSTEM

SYLLABUS FOR

M.SC. STATISTICS

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2017-2018 onwards)

REGULATIONS

1. OBJECTIVES OF THE COURSE

To transform graduates with sufficient strength in statistics so as to be employed in the Industry, Research and Development unit and Academic Institutions. The course is designed to impact professional knowledge and practical skills to the students.

2. CONDITION FOR ADMISSION

A candidate who have passed B.Sc Statistics / B.Sc Mathematics / B.Sc., Computer Science (with allied Mathematical Statistics) degree of Periyar University or any of the above degree of any other university accepted as per the norms set by the Government of Tamil nadu as equivalent thereto, subject to such condition as may be prescribed thereto are permitted to appear and qualify for the M.Sc Statistics degree examination of this university after a course of study of two academic years, under CBCS.

3. DURATION OF THE COURSE

The course for the degree of Master of Science in Statistics shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

4. COURSE OF STUDY

The course of study shall comprise instruction in the following subjects according to the syllabus and books prescribed from time to time.

COURSE OF STUDY AND SCHEME OF EXAMINATION

S.No.	Paper Code	Subject Title	Hours		University Examination		
			Credits	Hours	Internal (25%)	External (75%)	Total
		I SEMESTER					
	Core I	Real Analysis and Linear Algebra	5	6	25	75	100
	Core II	Measure Theory	5	6	25	75	100
	Core III	Distribution Theory	5	6	25	75	100
	Core IV	Sampling Theory	5	6	25	75	100
	Core Practical I	Practical –I (Calculator based)	-	3	-	-	-
	Core Practical II	Practical - II - Statistical Software Practical - (Using R)	-	3	-	-	-
		TOTAL	**20**	**30**	**100**	**300**	**400**
		II SEMESTER					
	Core V	Probability Theory	5	6	25	75	100
	Core VI	Statistical Estimation Theory	5	6	25	75	100
	Core VII	Demography and Actuarial Statistics	5	6	25	75	100
	Core Practical I	Practical-I (Calculator based)	4	3	40	60	100
	Core Practical II	Practical -II Statistical Software Practical- (Using R)	4	3	40	60	100
	EDC	Business Communication	4	4	25	75	100
	Common Paper	Human Rights	2	2	25	75	100
		TOTAL	**29**	**30**	**205**	**495**	**700**

S.No.	Paper Code	Subject Title	Hours		University Examination		
			Credits	Hours	Internal (25%)	External (75%)	Total
		III SEMESTER					
	Core VIII	Testing Statistical Hypothesis	5	6	25	75	100
	Core IX	Multivariate Analysis	5	6	25	75	100
	Elective - I	Statistical Quality Control and Reliability	4	6	25	75	100
	Elective - II	Stochastic processes	4	6	25	75	100
	Core Practical III	Practical –III (Calculator based)	-	3	-	-	-
	Core Practical IV	Practical - IV Statistical Software Practical-II (Using SPSS)	-	3	-	-	-
		TOTAL	**18**	**30**	**100**	**300**	**400**
		IV SEMESTER					
	Core X	Design and Analysis of Experiments	5	6	25	75	100
	Elective - III	Advanced Operation Research	4	6	25	75	100
	Elective - IV	Applied Regression Analysis	4	6	25	75	100
	Core Practical III	Practical – III (Calculator based)	4	3	40	60	100
	Core Practical IV	Practical - IV Statistical Software Practical - (Using SPSS)	4	3	40	60	100
	Core Project	Project & Viva-Voce	4	4	25	75	100
		TOTAL	**25**	**30**	**195**	**405**	**600**

List of Core/Elective Subjects to be offered

CORE THEORY SUBJECTS

1. Real Analysis and Linear Algebra
2. Measure Theory
3. Distribution Theory
4. Sampling Theory
5. Probability Theory
6. Statistical Estimation Theory
7. Demography and Actuarial statistics
8. Testing of Hypothesis
9. Multivariate Analysis
10. Design of Experiments
11. Project & VIVA-VOCE

CORE PRACTICALS

1. Practical – I (Calculator based)
2. Statistical Software Practical-I (Using R)
3. Practical – II (Calculator based)
4. Statistical Software Practical-II (Using SPSS)

ELECTIVE Subjects (Only four)

1. Statistical Quality control and Reliability
2. Stochastic processes
3. Advanced Operation Research
4. Applied Regression Analysis.
5. Statistical Computing (C++)
6. Econometrics.

Extra Disciplinary Course:

1. Elements of Operations Research
2. Statistical Methods

Human rights. Common to all courses. Syllabus will be provided by the University.

Examination:

The examination shall be of three hours duration to each theory paper at the end of each semester. The candidate failing in any paper will be permitted to appear in the subsequent semester.

Practical examinations should be conducted at the end of even semester

At the end of fourth semester, viva-voce will be conducted on the basis of Project/Dissertation submitted by the student .The viva-voce should be conducted jointly by the guide and the external examiner.

Theory Papers:

Total marks for each course (core/elective) is 100. 25 marks for Internal and 75 marks for University Examination. The components of Internal Assessment are:

1. Test	=	10 Marks
2. Attendance	=	5 Marks
3. Seminar	=	5 Marks
4. Assignment	=	5 Marks
Total	=	25 Marks

Practical:

Total marks for each practical course is 100. 40 marks for internal and 60 marks for Written Examination. The components of Internal Assessment are:

1.Record work	=	25 Marks
2.Test	=	10 Marks
3.Attendance	=	5 Marks
Total	=	40 Marks

Project work:

The Marks for the Project work is 100 and the components are:

Internal Assessment:	**:**	**40 Marks**
(For two reviews 20+20 = 40)		
Evaluation:		
Evaluation of Project report by External Examiner and Guide	:	40 Marks
Viva-Voce conducted by External Examiner & Guide	:	20 Marks
Total	:	100 Marks

QUESTION PAPER PATTERN:

(a) For Theory

- Total marks for each theory course (University examination) is 75.
- The Question paper is divided into two parts.
- PART-A consists of 5 questions, one from each unit with internal choice. Each question carries 5 marks. All questions should be answered. Total marks for PART-A is 25.
- PART-B consists of 5 questions, one from each unit with internal choice. Each question carries 10 marks. All questions should be answered. Total marks for PART-B is 50.

(b) For Practical

- Total marks for each practical (university examination) is 60.
- The candidate should attend 3 questions out of 5 questions each carrying 20 marks.

Classification of Results:

(i) Passing Minimum:

A candidate shall be declare to have passed the examination if the candidate secures not less than 50% of the marks in the Semester Examination and in IA in each course (or) practical. The candidate should get a minimum of 50% marks in semester examination (SE) as well as a minimum of 50% marks in Internal Assessment (IA), i.e., a minimum of 38 marks out of 75 in SE and minimum of 12 marks out of 25 in IA in the theory courses.

For practical courses, the distribution of marks will be 40 for IA & 60 for practical examination. The candidate should get a minimum of 20 marks out of 40 in IA and a minimum of 30 out of 60 in practical examination. The submission of record note book is a must in the practical examinations.

For the project work and viva-voce a candidate should secure 50% of the marks for pass. The candidate should compulsorily attend viva-voce examination to secure pass in the paper (Project).

Candidates who do not obtain the required minimum marks for a pass in a course or practical or project report shall be required to appear and pass the same at a subsequent appearance.

(ii) Minimum Credits to be earned	**:**	**90 credits**
For Human Rights	:	2 credits
Total	**:**	**92 Credit**

(iii) Marks and Grades:

The following table gives the marks, grade points, letter grades and classification to indicate the performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in a paper / course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90-100	9.0-10.0	O	Outstanding
80-89	8.0-8.9	D+	Excellent
75-79	7.5-7.9	D	Distinction
70-74	7.0-7.4	A+	Very Good
60-69	6.0-6.9	A	Good
50-59	5.0-5.9	B	Average
00-49	0.0-4.9	U	Re-appear
ABSENT	0.0	AAA	ABSENT

Ci = Credits earned for course i in any semester.

Gi = Grade point obtained for course i in any semester

n = Refers to the semester in which such courses were credited.

a) Semester:

GRADE POINT AVERAGE (GPA) =

$$GPA = \frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

b) The Entire Programme:

CUMULATIVE GRADE POINT AVERAGE (CGPA) =

$$CGPA = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses of the entire programme}}$$

CGPA	GRADE	CLASSIFICATION OF FINAL RESULT
9.5 – 10.0	O+	First Class – Exemplary
9.0 and above but below 9.5	O	
8.5 and above but below 9.0	D++	First Class with Distinction
8.0 and above but below 8.5	D+	
7.5 and above but below 8.0	D	
7.0 and above but below 7.5	A++	First Class
6.5 and above but below 7.0	A+	
6.0 and above but below 6.5	A	
5.5 and above but below 6.0	B+	Second Class
5.0 and above but below 5.5	B	
0.0 and above but below 5.0	U	Re-appear

* The candidates who have passed in the first appearance and within the prescribed semester of the PG Programme (Core, Elective, Non-major Electives and Extra-Disciplinary courses alone) are eligible.

Dissertation:

The topic of the dissertation shall be assigned to the candidate before the end of second semester. The student should prepare the plan of work for the dissertation at the end of second semester. In case the student wants to avail the facility from other organisations / university / laboratory, they will undertake the work with the permission of the guide and acknowledge the alien facilities utilized by them. The students should prepare three copies of dissertation and submit the same for the evaluation by Examiners.

Format to be followed:

The format / certificate for dissertation to be submitted by the students are given below.

Format of the preparation of project work

(a) Title page

(b) Bonafide Certificate

(c) Acknowledgement

(d) Table of Contents

CONTENTS

A. Format of the title page

TITLE OF THE DISSERTATION

Dissertation submitted to the Periyar University

in partial fulfillment of the requirement for the Degree of

Master of Science

in

STATISTICS

By

NAME OF THE STUDENT

REG. NO.

(College Logo)

COLLEGE NAME

(AFFILIATED TO PERIYAR UNIVERSITY)

PLACE with Pin Code

MONTH – YEAR

M.SC. STATISTICS
SEMESTER - I
CORE I - REAL ANALYSIS AND LINEAR ALGEBRA

UNIT I

Open Sets in 'R' – its structure – Accumulation points and the Bolzano – Weierstrass theorem in R' – Closed Set in R' – Extension to n – dimensional Eucledian space – Bolzano - Weierstrass theorem in R' – Heine Borel Covering theorem – Compactness.

UNIT II

Sequences of real – valued function of single variable, and its examples . Uniform convergence and its continuity- Cauchy condition for uniform convergence.

Real valued function of two variable – Limit – Continuity - Partial derivatives – Differentiability.

UNIT III

Characteristic roots and vectors. Cayley-Hamilton theorem. Minimal polynomials-similar matrices-Algebraic and geometric multiplicity of characteristic roots-Spectral decomposition of a real symmetric matrix-reduction of a pair of real symmetric matrices.

UNIT IV

Real quadratic forms, reduction and classification of quadraticforms-extrema of quadratic forms-index and signature. Reduction of positive definite matrix.

UNIT V

Generalized Inverse of a matrix. Moore and Penrose generalized inverse in the solution of system of equation. Least square properties of Moore and Penrose generalized inverse and simple applications of M-P inverse.

BOOKS FOR STUDY AND REFERENCE:

1. Goldberg, R. (1970) Methods of Real Analysis, Oxford and IBH publishing Co Pvt Ltd.
2. Apostol, T.M. (1985) Mathematical Analysis, Narosa publishing, New Delhi.
3. Rao, A.R. and Bhima Sankaran (1992) Linear Algebra, Tata McGraw Hill.
4. Rao, C.R. and Mitra, S.K. (1971) Generalized inverse of matrices and its applications, John Wiley and Sons Inc.
5. Biswas, S. (1984) Topics in algebra of Matrices, Academic Publications.
6. Malik, S.C. & Savita Arora Mathematical Analysis, New Age International (P).

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - I
CORE II -MEASURE THEORY

UNIT I

Algebra of sets-Countable sets – field –monotonic field-monotonic class-field generated by a class of subsets-Borel sets- Borel field.

UNIT II

Set functions – countably additive set functions – finitely additive set functions. Measure functions. Properties of measure functions – Outer measure functions – Extension measure –completion of a measure function (concepts only).

UNIT III

Lebesque measure and its properties. Lebesque-Stieltjes measure-examples. Measurable functions- Borel measurable functions –Approximation theorem.

UNIT IV

Measure integration – Properties of integrals – sequence of Measurable functions – mode of convergence of measurable functions – monotone and dominated convergence theorems.

UNIT V

Product measure – product measure functions-properties – Product measure theorem – Fubini's theorem (concept) and its applications in probability. Radon- Nikodym theorem (concept) and its applications.

BOOKS FOR STUDY AND REFERENCE:

1. De Barra, G. (1991) Measure theory and Integration, Wiley Eastern Ltd.,
2. Basu, A.K. (1999) Measure theory and Probability, PHI.
3. Ash, R.B. (2000) Probability & Measure Theory, 2nd Edition, Academic Press.
4. Royden, H.L. (1968) Real Analysis, 2nd Edition, Macmillan.
5. Burrill.W. (1972) Measure Integration and Probability, Academic Press,
6. Gupta, R.P. et al (1999) Measure theory, Real Analysis – III, Pragati Prakashan, Meerat.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - I
CORE III - DISTRIBUTION THEORY

UNIT I

Quick review of the following distributions – Discrete Distribution: Binomial, Poisson, Geometric, Hypergeometric, Multinomial, Negative binomial, Gamma and Beta distributions. Continuous Distribution: Normal, Bernoulli, Exponential, Lognormal and Cauchy (Application and Properties).

UNIT II

Bivariate and multivariate distributions; Concepts of joint, marginal and conditional distributions. Detailed study of Bivariate Binomial and Bivariate normal distribution. Functions of random variables and their distribution: sum and difference, products and quotients of random variables. Concept of truncated distribution and compound distribution (Binomial, Poisson).

UNIT III

Multivariate normal distribution and its properties: Marginal and conditional distribution; characteristic function and its uses. Distribution of linear functions of normal variables.

UNIT IV

Sampling distribution of statistics from normal samples leading to Normal, t, chi-square, and F (non-central) - properties of these distribution.

Unit V

Order statistics and their distribution; single & two order statistics. Distribution of median, range. Asymptotic distribution of extreme order statistics.

BOOKS FOR STUDY AND REFERENCE:

1. Hogg, R.V and Craig, A.T. (1972) — An Introduction to Mathematical Statistics, 3rd Edition, Amerind.
2. Rohatgi, V.K. (1988) — An Introduction to probability theory and Mathematical Statistics, Wiley Eastern.
3. Anderson.T.W. (1983) — An Introduction to Multivariate Statistical Analysis, 2nd Edition, John Wiley.
4. Johnson and Kotz. (1970) — Distributions in Statistics, Vol I, II and III, John Wiley & Sons, New York.
5. Mood, Graybill and Boes. (1974) — Introduction to the theory of statistics, 3rd Edition. Mc Graw Hill.
6. Parimal Mukhopadhyey. (2006) — Mathematical Statistics, 3rd edition, New Central Book Agency.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - I
CORE IV - SAMPLING THEORY

UNIT I

Principal steps in a sample survey– Drafting a questionnaire .Errors in Surveys-Non Response, types of Non-Response, Call -Backs, a mathematical model of the effects of Call-Backs. Interpenetrating sub sample. Randomized response Technique: Warner's model-related and unrelated questionnaire method.

UNIT II

Finite population sampling techniques: SRSWR/WOR, stratified and systematic and related results on estimation of population mean and total - Allocation problems in stratified random sampling.

UNIT III

Ratio and Regression estimators based on SRSWOR and stratified random sampling. Multivariate ratio estimator (concept only). Cluster sampling – clusters of equal size – Estimation of mean and its variance.

UNIT IV

Unequal probability sampling: PPSWR/WOR. Cumulative total and Lahiri's scheme. Methods and related estimators of finite population mean/total. Hurwitz – Thompson estimators – Des Raj ordered estimator and Murthy's unordered estimator.

UNIT V

Two stage sampling with equal first stage units – estimation of mean and its variance. Double Sampling: Double sampling for stratification – DS for Ratio estimation – DS for Regression estimation.

BOOKS FOR STUDY AND REFERENCE:

1.	Cochran, W.G. (1977)	Sampling Techniques, Wiley Limited.
2.	Singh, D. and Choudhary F.S.(1986)	Theory and analysis of sample survey Designs, Wiley Eastern Limited.
3.	Parimal Mukhopadhyey (1988)	Theory and Methods of Survey Sampling, Prentice Hall of India.
4.	Des Raj. (1967)	Sampling Theory, Tata McGraw Hill, New Delhi.
5.	Desraj and Chandek. (1998)	Sample survey theory, Narosa Publishing House, New Delhi.
6.	Hansen, Hurwitz, Madow (1953)	Sample survey methods and theory, Vol I & II.
7.	Dr. Sampath	Sampling Techniques

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - II
CORE V - PROBABILITY THEORY

UNIT I

Probability measure – properties – Discrete probability space and general probability space, conditional probability space. Functions and inverse functions – Random variables – Induced probability space by random variables.

UNIT II

Distribution functions – properties – Decomposition theorem – Correspondence theorem – Distribution function of vector random variable - conditional distribution function – properties – Concept of Independence – Kolmogorov 0-1 Law – Borel Cantelli Lemma.

UNIT III

Expectation and moments – properties, conditional expectation – properties. Inequality – Markov, Holder, Jenson, Chebychev's and Liapounov. Convergence of sequence of random variables – modes of convergence and their relationship.

UNIT IV

Characteristic Function of random variables – properties – Inversion theorem – Simple examples – Uniqueness theorem, Levy continuity theorem (statement only). Law of Large numbers – WLLN for independent and i.i.d case – SLLN for independent and i.i.d case.

UNIT V

Weak and complete convergence of distribution function – Helly - Bray theorem. Central Limit theorem -generalization of LLN, CLT for independent random variables – Liapounov's form – Lindeberg – Feller CLT for i.i.d random variables – Lindeberg – Levy theorem.

BOOKS FOR STUDY AND REFERENCE:

1. Rohatgi,V.K.(1985) An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd.
2. Bhat, B.R. (1981) Modern Probability Theory, Wiley Eastern Ltd. New Delhi.
3. Feller.W. (1968) Introduction to Probability and Application, Wiley Eastern Company.
4. Fisz, M (1963) Probability Theory and Mathematical Statistics, John Wiley, Sons, New York.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - II
CORE VI - STATISTICAL ESTIMATION THEORY

UNIT I

Criteria of Point Estimation – Standard parametric models of distributions. Consistent estimation of real valued parameters. Invariance of consistent estimators. Unbiasedness, Sufficiency, Neyman Factorization criterion, Exponential families, distribution admitting sufficient statistics.

UNIT II

Completeness, Bounded completeness, Minimal Sufficient statistics, method of constructing minimal sufficient statistics - minimum variance unbiased estimators. Rao - Blackwell theorem, Lehmann- Scheffe theorem.

UNIT III

Necessary and sufficient condition for UMVUE-Inequality approach to UMVUE-Fisher measure of Information. Cramer-Rao Inequality. Different forms of Cramer-Rao Inequality. Chapman – Robbins bound. Efficiency of an estimator-Extension of Cramer-Rao Inequality. Bhattacharya bound.

UNIT IV

Method of Maximum Likelihood Estimation. Cramer and Huzurbazar theorem Solution of likelihood equations – Method of scoring – Method of minimum variance bound estimation – Method of moments. Interval estimation – confidence level, construction of confidence intervals using pivots, shortest length confidence interval.

UNIT V

Bayesian Inference – Bayes theorem – concepts of prior distribution and its classification – Posterior distribution. Bayes estimation – Bayes estimates for Binomial, Poisson and Normal distribution using conjugate priors (Sec 3.4, 4.3, 6.8 of Bansal A.K-6).

BOOKS FOR STUDY AND REFERENCE:

1. Rohatgi. V.K. (1988) — An Introduction to Probability and Mathematical Statistics, Wiley Eastern Ltd, New Delhi.
2. Kale. B.K. (1999) — A First Course on Parametric Inference, Narosa publishing House.
3. Lehmann. E.L. (1983) — Theory of Point Estimation, John Wiley, NewYork.
4. Cassella and Berger. (2002) — Statistical Inference, Thompson, New Delhi.
5. Radhakrishna Rao.C. (1973) — Introduction to Linear Statistical Inference and its Applications, Wiley Eastern.
6. Bansal. A.K. (2007) — Bayesian parametric Inference, Narosa publishing House, New Delhi.
7. Manoj Kumar Srivastava, Abdul Hamid khan & Namita Srivasta (2014) — Statistical Inference – Theory of Estimation, PHI Publications.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - II
CORE VII - DEMOGRAPHY AND ACTUARIAL STATISTICS

UNIT I

Demographic data – Sources, Coverage and Content errors in demographic data-Balancing equations and Chandrasekaran Deming formula - Vital Registration system – Adjustment of age data - Whipple, Myer and UN Indices

UNIT II

Measures of fertility: CBR, GFR, TFR, GRR and NRR - Stochastic models for reproduction, Distribution of time to first birth, inter-live birth intervals and number of birth for homogenous group of women.

UNIT III

Measures of mortality – Life tables and its relation with survival function-Life table function at non-integer age (fractional ages) - Analytical laws of mortality – Gompertz's law and Makeham's law – Select, Ultimate and Aggregate mortality tables

UNIT IV

Abridged life table - Construction of abridged life table - methods by Reed and Merrell, Greville's, Kings and JIA method - Utility theory – Insurance and utility theory

UNIT V

Models for individual claims and their sums - Multiple life function – joint life status and lost survivor status

BOOKS FOR STUDY AND REFERENCE:

1. Ramkumar. R (1986) Technical Demography, Wiley eastern Ltd, New Delhi.
2. Rogers.A. (1975) Introduction to Mathematical Demography, Johnwiley, Newyork.
3. Biswas.S. (1988) Stochastic processes in Demography and applications, Wiley eastern limited.
4. A Listoris Neill. (1977) Life contingencies.
5. Bowers, N.L. Gerber.H.V. Hickman J.C, Jones D.A. and Nesbitt.C.J. (1986): Actuarial mathematics, Society of Actuarial, Ithaca, Illinois, USA (Second edition).
6. Dixit et all (2008) Mathematical basis of life assurance, IC 81, Insurance Institute of India, Bombay

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - II
PRACTICAL –I (CALCULATOR BASED)

(Based on Core courses: Sampling theory, Statistical Estimation Theory & Demography)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-I examination should be conducted at the end of II Semester.

UNIT I

(a) Estimation of population mean, total and SE in stratified Random Sampling

(b) Estimation of population mean, total and SE in Systematic sampling.

(c) Ratio estimation and Regression estimation for population mean, total and its variance (SRS).

(d) Estimation of mean, total and variance in Cluster sampling and two stage cluster sampling with equal size clusters.

UNIT II

(a) PPS sampling with replacement.

(b) Double sampling for stratification.

(c) Double sampling for Ratio estimation & Regression estimation.

UNIT III

(a) UMVUE in one parameter exponential family of distribution.

(b) Maximum likelihood estimation & Methods of Moments.

(c) Interval estimation based on i) Normal ii) t iii) x2 iv) F distributions

UNIT IV

Fitting of Population Growth Models

(a) Gompertz's Law.

(b) Makeham's Law.

(c) Logistic Law - Method of partial sums & Method of three selected points.

UNIT V

(a) Computation of Mobility measures.

(b) Probability of living and dying rate of mortality.

(c) Estimation and other measures from mortality table.

(d) Construction of Abridged life tables

i) Reed and Merrell ii) JIA Method iii) Greville's methods

M.SC. STATISTICS
SEMESTER - II
PRACTICAL II - STATISTICAL SOFTWARE PRACTICAL (Using R)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-II examination should be conducted at the end of II Semester.

Problems Relating to:

1. Using R command – Operations on vectors, logical vector, index vector and matrices
2. Graphical procedures – Bar charts, Box plots, Histograms using single & multiple groups.
3. Creating and Manipulation of data frames, using various user defined functions.
4. Calculations of probability functions and generation of random samples for various discrete and continuous distributions.
5. Writing R Functions for Descriptive statistics, Correlations and Regression coefficient
6. Statistical Inference : Confidence interval for Proportion, Mean, Median
7. Analysis of variance - One way and Two way ANOVA

M.SC. STATISTICS
SEMESTER - III
PAPER VIII - TESTING STATISTICAL HYPOTHESES

UNIT I

Test of Hypotheses. Concepts of testing hypotheses. Non-Randomized and randomized test- Critical region, Test function, Two types of errors, Level of significance, Size of the test, Power function. MP test - Neyman - Pearson fundamental Lemma.

UNIT II

UMP test, MLR property, UMP tests for one sided test in one parameter exponential and MLR family of distributions .Non existence of UMP test for simple hypotheses against two sided alternatives in one parameter exponential family.

UNIT III

Generalized Neyman - Pearson fundamental Lemma (statement only).UMP test for two sided alternatives in one parameter exponential family .Unbiased test, UMP unbiased test, Similar test , Neyman Structure test, Likelihood Ratio test (Concepts & properties).

UNIT III

Sequential Probability Ratio Test- Optimum properties of the SPRT- The Fundamental Identity of Sequential analysis, OC and ASN function of sequential plans. Simple examples

UNIT V

Non-parametric test; Empirical distribution, Kolmogorov – Smirnov goodness of fit for one sample and two sample problems, Sign test, Run test, Wilcoxon Signed- Rank test, Median test, Mann- Whitney U test.

BOOKS FOR STUDY AND REFERENCE:

1. Rohatgi,V.K. (1988) An Introduction to Probability and Mathematical statistics, Wiley Eastern Ltd, New Delhi.
2. Kale. B.K. (1999) A First course on parametric inference, Narosa publishing house.
3. Lehman. E.L. (1986) Testing Statistical Hypotheses, John Wiley and sons.
4. Rao.C.R. (1985) Linear Statistical Inference and its Applications, Wiley Eastern Ltd.
5. Casella and Berger. (2002) Statistical inference, Thompson, New Delhi
6. Conover. (1980) Practical Non-parametric statistics, 2nd edition, John Wiley & Sons.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - III
CORE XI - MULTIVARIATE ANALYSIS

UNIT I

Estimation of the mean vector and the covariance matrix of a multivariate normal distribution. Partial and multiple correlation coefficients and their null distribution. Concept of path analysis – construction of path diagram and its use in linear regression model.

UNIT II

Inference problems concerning the mean vector when the covariance matrix is known (one and two sample problems); likelihood ratio criterion and its application; Mahalanobis D-square and its application. Inference concerning the mean vector (s) when the covariance matrix is unknown (one and two sample problem); Generalized T-square statistics, its distribution and its application; The relationship between T-square and D-square.

UNIT III

Wishart distribution (WD) (no derivation) and its properties; characteristic function of WD and its uses; test for covariance matrix. Sphericity` test; test for the equality of covariance matrices; testing the independence of sets of variates. Multivariate analysis of variance (one way and two way classification concepts only).

UNIT IV

Canonical correlation and variates; Estimation and interpretation. Classification problems, standard of good classifications; procedure of classification with two or more populations with known and unknown distributions. Classification procedures when the parent distribution are normal; Estimation of misclassification probabilities; Fisher's discriminant function and its uses.

UNIT V

Principal component analysis; Definitions and maximum likelihood estimators. Computation and interpretation of principal components. Factor analysis - the basic model - common and specific factors – communality - Estimation of factor loadings. Principal factor method, maximum likelihood method - factor rotations. Cluster analysis - similarity and distance measures - clustering techniques; Hierarchical techniques and Agglomerative methods.

BOOKS FOR STUDY AND REFERENCE:

1. Anderson. T.W. (1983) — An introduction to multivariate statistical analysis, 2nd edition, John Wiley.
2. Johnson and Wichern (1996) — Applied multivariate statistical analysis, 3rd edition, PHI (P) Ltd.
3. Morrison. D.F. (1978) — Multivariate statistical methods, Academic 2nd edition, McGraw Hill.
4. Agarwal.B.L. (2010) — Theory and Analysis of experimental designs; CBS Publishers & Distributors Pvt. Ltd.
5. Hair et all (2009) — Multivariate Data analysis, 6th edition, Pearson Publications.
6. Rao.C.R. (1973) — Introduction to linear statistical Inference and its applications, Wiley Eastern.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - III
ELECTIVE I - STATISTICAL QUALITY CONTORL AND RELIABILITY

UNIT I

Statistical process control : Moving average control chart – EWMA control chart. CUSUM control chart : two sided and one sided procedures , V – mask technique, Tabular cusum and decision interval. Economic design of X- chart – single assignable cost model only.

UNIT II

Multivariate Quality Control Chart : Control of Means and process variability. Modified Control Chart (chart only) and Acceptance control charts. Statistical process control with auto correlated data: Sources and effects of auto correlation in process data – Model – Based approaches and Model – free approaches.

UNIT III

Acceptance sampling plan for variables: Advantages and disadvantages – Single sample plans – one sided and two sided specifications – known and unknown sigma. Continuous sampling plans : CSP-1, CSP-2 and CSP-3 - properties – (statement only).

UNIT IV

Reliability : Definition, applications, Reliability function, Cumulative distribution function – Failure rate function – Hazard rate function – Reliability in terms of hazard rate and failure rate density – Bath tub Curve – Conditional Reliability.

Reliability measures: Mean time to failure, Variance of failure distribution, median time to failure and mode time to failure – Simple problems.

UNIT IV

Life time distribution: Exponential failure model – Derivation – Properties – Estimation of mean life and reliability estimation (with Complete Samples) – UMVUE estimation. Two parameter exponential model – Estimation of mean life and reliability estimation with complete samples.

BOOKS FOR STUDY AND REFERENCE:

1. Montgomery. D.C. (2005) Introduction to Statistical Quality Control, 5th edn. John Wiley (For Unit – I, II & III)
2. Charles E. Ebling (2000) An introduction to Reliability and Maintainability. (For Unit – IV)
3. Sinha S.K. and Kale. S.K (1998) Life testing and Reliability Estimation (For Unit – V)
4. Duncan. A.J. (1986) Quality Control and Industrial Statistics, Irwin Homewood
5. Grant., E.L. and Leavenworth.R.S. (1980) Statistical Quality Control, McGraw Hill

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - III
ELECTIVE II - STOCHASTIC PROCESSES

UNIT I

Introduction to stochastic process (SP) – classification of SP according to state space and time domain. countable state markov chain (MC). Chapman- Kolmogorov equations. Calculation of 'n' step transition probability.

UNIT II

Discrete state space – continuous time MC. Kolmogorov differential equations. Poisson process, birth and death process .Application to queues and storage problem. Random walk.

UNIT III

Markov process – continuous time and continuous state space - time homogenous markov process – Kolmogorov's equation. Wiener process as a limit of random walk, first passage time Diffusion process with Wiener process.

UNIT IV

Stationary process and time series- wide sense and strict sense stationary process – moving average and auto regressive process. Covariance function - Bochner's function (statement), Khintchine's representation of wide sense stationary process.

UNIT V

Renewal theory – renewal function and its properties – Elementary and key renewal theorems.

BOOKS FOR STUDY AND REFERENCE:

1. Medhi.J. (1982) Stochastic process, Wiley Eastern.
2. Basu. A.K. (2003) Introduction to stochastic processes, Newsa Publishing House.
3. Ross. S.M. (1983) Stochastic Process, Wiley, New York.
4. Karlin and First course in Stochastic Process-Vol.I&II, Academic Press. Taylor.H.M. (1975)

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
CORE X - DESIGN AND ANALYSIS OF EXPERIMENTS

UNIT I

Linear models- Estimability of linear parametric functions-Generalized Gauss-Markov theorem on linear estimation (BLUE) –Fixed, mixed and random effect models- ANOVA for one-way and two-way classified data – ANOCOVA for one-way and two-way classification with one concomitant variable.

UNIT II

Introduction to design of experiments – Efficiency of CRD,RBD & LSD– Missing plot techniques for RBD and LSD with one (or) two missing observations – Need and scope of Split-plot design – SPD as main effect confounded design.

UNIT III

General factorial experiments-analysis of symmetrical 2^n ($n \leqslant 4$),3^n ($n \leqslant 2$), and asymmetrical (p x q) factorial – construction and analysis of confounded (complete and partial) design.

UNIT IV

General block designs- concepts of connectedness, balancedness and orthogonality. – BIBD and its parametric relations – Information (C) matrix and criteria for connectedness of block designs - Intra and Inter block analysis of BIBD – Youden square design and its intra block analysis.

UNIT V

PBIBD with 'm' associate classes – classifications and parametric relations of PBIBD (2) – Intra block analysis of PBIBD(2) – Need and scope of response surface experiments- applications of experimental designs to quality management technique.

BOOKS FOR STUDY AND REFERENCE:

1. Joshi. D.D. (1987) Linear Estimation and design of Experiments, Wiley Eastern.
2. Das. M.N and Giri.N.O. (1979) Design and Analysis of Experiments, Wiley Eastern.
3. Montgomery. D.C.(1994) Design and Analysis of Experiments, 3rd edition, John Wiley.
4. Agarwal. B.L. (2010) Theory and Analysis of experimental Designs, CBS Publishers,
5. Anderson & Mclean. (1974) Design of experiments : A realistic approach, Marcel Dekker, I.C.
6. Cochran & Cox. (1992) Experimental Designs, 2nd edn, John Wiley & Sons.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
ELECTIVE III - ADVANCED OPERATION RESEARCH

UNIT I

Linear Programming Problems – Graphical method, Simplex method – Big – M method – Two Phase method – Dual Simplex method

UNIT II

Integer programming problem – All integer programming – Mixed integer programming – Gomory's cutting plane method – Branch and Bound method.

UNIT III

Non –linear programming problem – Multivariable function. Constrained multivariable optimization with equality and inequality constraints. Lagrangian method – Khun – Tucker conditions. Quadratic programming problem (QPP) – Wolfe's modified simplex method – Beale's method.

UNIT IV

Dynamic programming problem – Characteristics of DPP – Bellman's principles of optimality – General algorithm – Stage coach problem – Cargo loading model – Work force size model – Investment model –LPP as DPP.

UNIT V

Queuing models – Specification and effectiveness measures. Steady – state solutions of M/M/1 and M/M/c models with associated distributions of queue – length and waiting time (Infinite Capacity only). Steady – state solution of M/Ek/1 and G/M/1 queues- M/G/1 queue and Pollazcek Khinchine result.

BOOKS FOR STUDY AND REFERENCE:

1. Taha. H.A. (1999) Operational Research: An Introduction, Prentice Hall India.

2. Sharmaa J.K. (2002) Operation Research, Mac Millan.

3. Rao.S.S. (1992) Optimization Theory & Application, Wiley, New Delhi.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
ELECTIVE IV - APPLIED REGRESSION ANALYSIS

UNIT I

Multiple Linear Regression. Estimation of Model parameters. Least square estimation of the regression coefficients-properties of least square estimators. Maximum likelihood estimation-Tests for the significance of regression- test on individual regression coefficients –Confidence interval on the regression coefficients- Confidence interval estimation of mean response-Prediction –Standard regression coefficients-Unit normal scaling-Unit length scaling.

UNIT II

Residual analysis. Definition and properties of residuals-methods of scaling residuals-Residual plots- PRESS statistic- formal test for lack of fit. Variance - Stabilizing transformation-transformations to linearize models-Generalized and weighted least squares. Indicator variables-concept and use.

UNIT III

Model building problem-variable selection-Stepwise regression methods. Multicollinearity - sources and effects of multicollinearity –Diagnostics and methods for detecting multicollinearity.

UNIT IV

Polynomial regression. Polynomial model in one variable. Piecewise Polynomial fitting (Splines) - Non parametric regression. Kernel regression –Locally Weighted regression. Polynomial model in two or more variables.

Non-linear regression-nonlinear least square-transformation to linear model-parameter estimation.

UNIT V

Generalized Linear Models (GLM). Logistic regression-Estimation of parameters in logistic regression models-Interpretation of parameters in logistic regression models. Poisson regression-GLM-link function and linear prediction- parameter estimation in GLM.

BOOKS FOR STUDY AND REFERENCE:

1. Montgomery. D.C. Peck E.A. Vining. G.G. (2003) — Linear Regression Analysis, John Wiley &sons, Inc, New York. (chapters 1,2,3,8,9,11).
2. Draper. N.R. and Smith. H. (1998) — Applied regression Analysis, John Wiley
3. Chaterjee. et all (1977) — Regression Analysis by example, John Wiley.
4. Maddala. (1977) — Econometrics, McGraw Hill.
5. Johnston. (1972) — Econometrics, McGraw Hill.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
CORE PRACTICAL – III (Calculator Based)

(For the candidates admitted from 2017 - 2018 onwards)

(Based on papers: Multivariate Analysis, Testing of Hypothesis, Design of Experiments and Statistical Quality Control & Operation Research)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-III examination should be conducted at the end of IV Semester.

UNIT I

(a) Finding partial, multiple correlation & Regression coefficients from Σ matrix.

(b) Testing for partial, multiple correlation and regression coefficients.

(c) Testing Ho : $\mu = \mu o$ When $\sum$ is known & When $\sum$ is unknown.

(d) Testing Ho : $\mu(1) = \mu(2)$ When $\sum$ is known & When $\sum$ is unknown.

(e) MLE's for μ and Σ in a p –variate normal distribution.

(f) Test for dispersion matrix of p- variate Normal distribution (All Asymptotic tests)

i) Ho : $\sum = \sum_0$ ii) Ho : $\sum_1 = \sum_2$ iii) Ho : $\mu = \mu o$ and $\sum = \sum_0$

g) First principal component and its variance –Extraction method

UNIT II

(a) Most powerful test – Binomial, Normal, Exponential.

(b) UMP Test : One –sided - Normal, Exponential and two – sided Bernoulli

(c) UMPU Test : Binomial, Normal, Exponential

(d) Sequential Probability Ratio Test (SPRT)

i) Bernoulli ii) Normal iii) Exponential

(e) Non – Parametric Tests : Wilcoxon signed Rank Test , Mann – Whitney U Test, Kolmogorov – Smrinov (One sample and Two Sample) Test.

UNIT III

(a) Statistical Analysis of RBD with two observations missing.

(b) Statistical Analysis of LSD with two observations missing.

(c) Statistical analysis of 23 and 32 factorial experiments

(d) Statistical analysis of BIBD (intra block analysis only)

UNIT IV

(a) Construction of moving average control chart.

(b) Construction of EWMA control chart.

(c) Acceptance sampling plan for variables – construction of one sided - procedure schemes, known and unknown sigma plans – O.C.curves.

Unit V

(a) Integer Programming Problem :

I Gomory's Cutting Plan Method for Pure IPP.

ii) Gomory's Cutting Plan Method for Mixed IPP.

(b) Quadratic Programming problem

I Wolfe's modified Simplex Method

ii) Beale's Method

M.SC. STATISTICS
SEMESTER - IV
PRACTICAL IV - STATISTICAL SOFTWARE PRACTICAL
(Using SPSS)

The Maximum mark is 100 with 40 marks for Internal and 60 Marks for the University examination. The candidate should attend 3 questions out of 5 questions each carrying 20 marks. The Core Practical-I examination should be conducted at the end of II Semester.

Problems relating to:

1. Functions of Statistics (Classification, Diagrams and Graphical representation of Data)
2. Descriptive Statistics
3. Calculation of Probabilities under various distributions
4. Correlation & Regression – Partial and Multiple Correlations, Multiple Regression
5. Curve Fitting, Time series and Forecasting
6. Confidence Intervals for mean, variance, proportions
7. Inferential Statistics for Single through multiple samples. (Chi – Square, t, f and z test)
8. Non – Parametric tests.
9. Experimental Design: One way ANOVA , Two way ANOVA – Factorial designs – Multiple comparison tests
10. Multivariate : Principal component and discriminant analysis – Factor Analysis

M.SC. STATISTICS
SEMESTER - IV
PROJECT WORK

Project/Dissertation work shall be carried out under the supervisor of a Faculty member on the recommendation of the Head of the Department. Three copies of the Project report should be submitted the beginning of the fourth semester. The Marks for the Project work is 100 and the components are:

Internal Assessment	:	40 Marks
(For two reviews 20+20 = 40)		
Evaluation of Project report by External Examiner and Supervisor	:	40 Marks
Viva-Voce by External Examiner and Supervisor	:	20 Marks

The Evaluation of the Project will be based on Project Report and a VIVA-VOCE examination to be conducted by the Supervisor and an External Examiner.

M.SC. STATISTICS
SEMESTER - IV
ELECTIVE PAPER V -STATISTICAL COMPUTING (C++)

OBJECTIVE:

To impart the knowledge of programming skills in C++

UNIT I

Object Oriented Programming (OOPs) Paradigm – Basic Concepts of OOPs – Object Oriented Languages. A Simple C++ Program – More C++ Statements – Structure of C++ Program. Tokens, Keywords – Identifiers and Constants – Basic Data Types – User-defined Data Types – Operator in C++ – Scope Resolution Operator – Expressions and their Types – Control Structures.

UNIT II

Functions in C++: Introduction – The main function – Function Prototyping – Inline Functions – Default Arguments – Function Overloading – Math Library Functions. Classes and Objects: Specifying a Class – A C++ Program with Class – Defining Member Functions – Nesting Member Functions – Private Member Functions – Arrays within a class – Friendly functions – Memory Allocation of Objects – Array of Objects – Local Classes.

UNIT III

Constructors – Copy Constructor – Dynamic Constructors – Constructing Two-dimensional Arrays, Destructors. Operator Overloading – Introduction – Defining Operator Overloading – Overloading Unary Operators – Overloading Binary Operators – Rules for Overloading Operators. Function Overloading – Function Overloading with Arguments – Special Features of Function Overloading.

UNIT IV

Inheritance: Introduction – Types of Base Classes – Types of Derivation – Public – Private – Protected – Defining Derived Classes –Single Inheritance – Making a Private Member Inheritable – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Polymorphism – Introduction – Virtual Functions.

UNIT V

Managing Console I/O Operations: C++ Streams – C++ Stream Classes – istream, ostream, iostream, fstream, ifstream, ofstream, filebuff. Unformatted I/O Operations – Formatted I/O Operations –Managing output with Manipulators. Classes for File Stream Operations – Opening and Closing a file – Detecting end-of-file.

TEXT BOOK:

1. E. Balagurusamy: Object Oriented Programming with C++, Tata McGraw-Hill Publishing

Company Limited, New Delhi, 4th Edition, 2008.

REFERENCE BOOK:

1. Venugopal, Rajkumar, Ravishankar Mastering C++, Tata McGraw-Hill Publishing Company Limited, New Delhi

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
ELECTIVE PAPER VI - ECONOMETRICS

OBJECTIVE:

To impart the knowledge of programming skills in C++

UNIT I

Nature and scope of Econometrics: Production and cost analysis -price and income Elasticity of demand. Price Elasticity and supply – Torquivisits model of demand Inferior goods-Models building –Bias in construction of models.

UNIT II

The General Linear Model (GLM) and its extension. Ordinary Least square (OLS) estimation and prediction .Generalized Least square (GLS) estimation and prediction and their properties – problem of hetroscedasticity and multicollinearity pure and mixed estimation .Grouping of observations and equations.

UNIT III

Single equation linear model –dynamic case; Autocorrelation and its consequences Testing for Autocorrelation; Theil's BLUS procedure .Estimation and Prediction Estimation of parameters of a linear model with auto correlated disturbances and distributed lag models – Errors in variable models.

UNIT IV

Simultaneous linear equation model – Examples. Identification problem .Estimation Using LIM, Instrumental Variables. 2 –SLS methods.

UNIT V

K class estimators; Full information Maximum Likelihood methods .3-SLS estimators- Simultaneous LSE and integrated LST methods .Monte Carlo studies and simulation –Concepts of structural change –Tests of structural change

BOOKS FOR STUDY AND REFERENCE:

1.Johnston. (1984)	Econometrics models (3rd edition), McGraw Hill, Tokyo.
2.Intrulligator.M.D. (1980)	Econometric models :- Techniques and Applications, Prentice Hall of India.
3.Walters. A. (1970)	An introduction to Econometrics , McMillan & Co.
4. Gold Berger. (1964)	Econometric theory, Wiley.
5. Allen. R.G.D. (1965)	Mathematical Economics, McMillan & Co.
6. Maddala. (1977)	Econometrics, McGraw Hill.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
EDC PAPER I - Elements of Operations Research

UNIT I

Operations Research: Introduction-Origin and development of O.R-Definition and Applications of O.R. – Models in O.R.-classification of models-advantages and limitations of models. General solution for O.R models. Methodology of O.R.

Linear programming problem. Formulation of LPP.

UNIT II

Graphical method of solving LPP. Simplex method –Big M method. Concept of duality in LPP. Formulation of dual problems only.

UNIT III

Transportation problems: Finding initial basic feasible solution-test for optimality by MODI method. Assignment Problem: Hungarian method of solving A.P. Maximization in Assignment problem.

UNIT IV

Sequencing: problem of sequencing- basic terms used in sequencing- processing 'n' jobs through two machines- processing 'n' jobs through 'k' machines- processing two jobs through 'k' machines.

UNIT V

Game Theory: Definition-types of games- The Maximin - Minimax principle. Games without saddle points (mixed strategies)-graphical method of 2 x n and m x 2 games - Dominance property.

BOOKS FOR STUDY AND REFERENCE:

1. Kanti Swarup. (2007) Operations Research, Sultan Chand & Sons, New Delhi.

2. Sharma. J.K. (2002) Operations Research, McMillan & co.

3. Kalavathy.S. (2002) Operations Research, Vikas Publishing House, New Delhi.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

M.SC. STATISTICS
SEMESTER - IV
EDC PAPER II - Statistical Methods

UNIT I

Definition of Statistics and its applications in various disciplines. Collection of data. Classification, tabulation and graphical representation of data. Construction of univariate and bivariate frequency distributions. Charts and Diagrams and Graphs: bar diagrams, Pie diagram. Histogram, frequency and cumulative frequency curves.

UNIT II

Measures of central tendency: concept and uses. Mean, Median, Mode, Geometric Mean and Harmonic mean.

Measures of variation: concept and uses. Range, Quartile deviation, standard deviation and coefficient of variation. Measures of Skewness.

UNIT III

Census and Sample surveys. Concept of sample and sampling-.Principles of sampling. Advantages and limitations of sampling. Random sampling: simple random sampling, Stratified random sampling. Systematic sampling and Cluster sampling.Non-random sampling: Quota sampling, convenience and Judgment sampling, snow ball sampling.

UNIT IV

Simple linear correlation: meaning and its uses. Scatter diagram-Karl pearson (product moment) correlation-rank correlation.

Simple linear regression: meaning and its uses. Difference between correlation and regression. Regression equations.

UNIT V

Definition and utility of Time series analysis. Components of Time series. Measurement of Trend: Method of moving averages and Method of Least Squares. Measurement of Seasonal variations: Method of Simple averages.

BOOKS FOR STUDY AND REFERENCE:

1. Gupta. S.P. (2007) Statistical Methods, Sultan Chand & Sons, New Delhi
2. Agarwal.D.R. (2003) Quantitative Methods, Virinda Publications, New Delhi.
3. Richard Levin. (2000) Statistics for Management, Prentice Hall India.

QP Pattern: Unit wise internal choice with maximum 75 marks

Part A: 5 x 5 = 25 & Part B: 5 x 10 = 50

(For the candidates admitted from 2017 - 2018 onwards)

MODEL QUESTION PAPER

M.Sc, DEGREE EXAMINATION

BRANCH II - STATISTICS

First Semester

Core IV - SAMPLING THEORY

Time :Three hours Maximum:75 marks

PART A - (5 x 5 = 25 marks)

Answer ALL questions.

All questions carry equal marks.

1. (a) Mention the important steps involved in drafting a questionnaire. (Or)
   (b) What is meant by non-response? Write down its types.
2. (a) In SRSWOR, show that the sample mean square is an unbiased estimate of the population mean square (Or)
   (b) Explain circular systematic sampling.
3. (a) Explain separate and combined regression estimators. (Or)
   (b) Define multivariate ratio estimator.
4. (a) Explain Lahiri's method of selecting sample under PPSWR scheme. (Or)
   (b) Derive Horwitz-Thompson estimator for population total.
5. (a) Describe the sub sampling procedure. (Or)
   (b) In double sampling for stratification, show that the sample mean is an unbiase estimate of the population mean

PART B - (5 x 10 = 50 marks)

Answer ALL questions.

All questions carry equal marks.

6. (a) Explain the principal steps involved in sample survey? (Or)
   (b) Derive Warner's model in randomized response technique.
7. (a) If f.p.c is ignored, then show that
   $V_{op}t < V_{prop} < V_{rand}$ (Or)
   (b) Compare systematic sampling with stratified and simple random sampling when the population consists of linear trend.
8. (a) Define ratio estimator. Derive the variance of the ratio estimator and also obtain its relative bias. (Or)
   (b) Obtain an unbiased estimate of population mean and its variance in cluster sampling.
9. (a) Define Desraj's ordered estimator. Also derive the expression for the variance of the estimate of the population total. (Or)
   (b) In the case of pps sampling with replacement, obtain an unbiased estimator of the population total and variance of the estimator.
10. (a) Suggest an estimator for population mean in two stage sampling and obtain its variance. (Or)
    (b) Discuss double sampling for stratification and derive the standard error of estimate.