Masters of Science in Statistics

Programme Structure & Syllabi for MSc. Statistics

(With effective from the academic year 2016-17 onwards)

Overview

M.Sc. Statistics is a Postgraduate degree course focusing on developing data analysis skills and theoretical knowledge in all of the core areas of statistics. It is designed to achieve broad knowledge in theoretical statistics and wide range of skills in statistical applications. These highly sought after skills in statistics are currently in demand in government agencies, IT/consulting firms and industry. The Master degree in Statistics is intended for quantitatively oriented Mathematics/Statistics students with bachelor's degrees in related field.

Duration

The duration of PG program shall be 4 semesters. The duration of each semester shall be 90 working days. A student may be permitted to complete the program, in a period of 4 continuous semesters from the date of commencement of the first semester of the programs.

Program Structure

The programme shall include two types of courses, Program Core (PC) courses and Program Elective (PE) Courses. There shall be a Program Project (PP) with dissertation to be undertaken by all students. The Programme will also include assignments, seminars / practical, viva etc., if they are specified in the Curriculum. In the third and the fourth semesters the students can choose electives that will suit the needs of students, from the electives specified in the syllabus. There shall also be a Program Project or dissertation to be undertaken by all students. Every program conducted under Credit Semester System.

Viva Voce

Comprehensive Viva-voce shall be conducted at the end semester of the program and it shall cover questions from all courses in the program.

Project work

Project work shall be completed by working outside the regular teaching hours under the supervision of a teacher in the concerned department. There should be an internal assessment and external assessment for the project work. The external evaluation of the Project work is followed by presentation of work including dissertation and Viva-Voce.

Examinations

There shall be end-semester examination at the end of each semester. Project evaluation and Viva -Voce shall be conducted at the end of the program only. Project evaluation and Viva-Voce shall be conducted by external examiner and one internal examiner. There shall be one end-semester examination of 3 hours duration in each lecture based course and practical course. The examinations for which computers are essential should be conducted in the computer lab supervised by an external examiner.

Evaluation and Grading

Evaluation

The evaluation scheme for each course shall contain two parts; (a) in-semester evaluation and (b) end-semester evaluation. 20 marks shall be given to in-semester evaluation and the remaining 80 marks to end-semester evaluation. Both in-semester and end semester evaluation shall be carried out by using in mark system. Both internal and external marks are to be mathematically rounded to the nearest integer.

End-Semester Examinations

The examinations shall be at the end of each semester. There shall be one end-semester examination of 3 hours duration in each lecture based course and practical course.

In-semester evaluation

The internal evaluation shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and attendance in respect of theory courses and based on written tests, lab skill/records/viva and attendance in respect of practical courses. The marks assigned to various components for in-semester evaluation is as follows.

Components of In-semester Evaluation (For theory)

Components	Component Marks
Assignment	4
Seminar	4
Two Test papers	8
Attendance	4
Total	20

Components of In-semester Evaluation (For Practical)

Components	Component Marks
Attendance	4
Laboratory Involvement	4
Written/Lab Test	4
Record	4
Viva	4
Total	20

Components of In-semester Evaluation (For Project)

Components	**Marks**
Topic/Area selected	2
Experimentation/Data collection	4
Punctuality	2

Compilation	4
Content	4
Presentation	4
Total	**20**

a)Evaluation of Attendance

% of attendance	Mark
90 and above	4
85 to 90	3
80 to 84	2
75 to 79	1
< 75	0

(Decimals are to be rounded to the next higher whole number)

b) Evaluation of Assignment

Components	**Marks**
Punctuality	1
Content	1
Conclusion	1
Reference/Review	1
Total	**4**

c) Evaluation of Seminar

Components	**Marks**
Content	1
Presentation	2
Reference/Review	1
Total	**4**

Pattern of Questions

The questions will be according to the objectives, weightage and the difficulty levels prescribed.

Weightage to Objectives

Objectives	%
Understanding	25
Critical Evaluation	50
Application	25

Weightage to difficulty levels

Level of difficulty	%
Easy	20
Average	60
Difficult	20

Pattern of questions for end semester examination

A question paper shall be a judicious mix of objective type, short answer type, short essay type /problem solving type and long essay type questions according to the following pattern.

	Total no. of questions	Number of questions to be answered	Marks of each question	Total marks
	12	10	2	20
	10	6	5	30
	4	2	15	30
TOTAL	**26**	**18**	x	**80**

Grades for Courses

For all courses (theory & practical), grades are given on a 10-point scale based on the total percentage of marks ***(ISA+ESA)*** as given below

Percentage of Marks	**Grade**	**Grade Point (GP)**
95 and above	S Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	A- Good	7
55 to below 65	B^+ Above Average	6
50 to below 55	B Average	5
40 to below 50	C Pass	4
Below 40	F Fail	0
	Ab Absent	0

Credit Point and Credit Point Average

Credit Point (CP) of a course is calculated using the formula

CP = C × GP, where C = Credit; GP = Grade point

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula

SGPA= TCP/TC, where TCP = Total Credit Point of that Semester

TC = Total Credit of that Semester

Cumulative Grade Point Average (CGPA) of a Programme is calculated using the formula

$$CGPA = \sum(TCP \times TC) \div \sum TC$$

CGPA shall be rounded off to two decimal places

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	Grade
Equal to 9.5 and above	***S Outstanding***
Equal to 8.5 and below 9.5	***A+ Excellent***
Equal to 7.5 and below 8.5	***A Very Good***
Equal to 6.5 and below 7.5	***A- Good***
Equal to 5.5 and below 6.5	***B+ Above Average***
Equal to 5.0 and below 5.5	***B Average***
Equal to 4.0 and below 5.0	***C Pass***
Below 4.0	***F Failure***

A separate minimum of 40% marks each for in-semester and end semester (for both theory and practical) and aggregate minimum of 40% are required to pass for a course. To pass in MSc Statistics programme, a separate minimum of Grade C is required for all the individual courses. If a candidate secures F Grade for any one of the courses offered in a Semester/Programme only F grade will be awarded for that Semester/Programme until he/she improves this to C grade or above within the permitted period. Candidate who secure C grade and above, shall be eligible for higher studies. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the end-semester examination for the same semester, subsequently. A student who fails to secure a minimum marks/grade for a pass in a course will be permitted to write the examination along with the next batch. There will be no supplementary examinations. A candidate will be permitted to improve the marks/CGPA of

a programme within a continuous period of four semesters immediately following the completion of the programme. If a candidate opts for the betterment of a programme, he/she has to appear for the entire semester. The consolidation of marks/grade/grade points after the betterment examination is limited to one time

SYLLABUS – M.Sc. STATISTICS

SEMESTER	COURSE CODE	COURSE TITLE	CREDIT	HOURS
	PG1STAC01	MEASURE AND PROBABILITY	4	5
	PG1STAC02	DISTRIBUTION THEORY	4	5
	PG1STAC03	ANALYTICAL TOOLS FOR STATISTICS	4	5
	PG1STAC04	SAMPLING THEORY	4	5
	PG1STAC05	STATISTICAL COMPUTING USING R	4	5
I	**TOTAL**		**20**	**25**
	PG2STAC06	ADVANCED PROBABILITY THEORY	4	5
	PG2STAC07	MULTIVARIATE DISTRIBUTIONS	4	5
	PG2STAC08	THEORY OF ESTIMATION	4	5
	PG2STAC09	STOCHASTIC PROCESSES	4	5
	PG2STAC10	STATISTICAL COMPUTING USING MATLAB/R	4	5
II	**TOTAL**		**20**	**25**
	PG3STAC11	TESTING OF STATISTICAL HYPOTHESES	4	5
	PG3STAC12	DESIGN AND ANALYSIS OF EXPERIMENTS	4	5
	PG3STAC13	MULTIVARIATE ANALYSIS	4	5
	PG3STAC14	STATISTICAL COMPUTING USING SPSS	4	5
	PG3STAE01	STATISTICAL QUALITY CONTROL	4	5
	PG3STAE02	SURVIVAL ANALYSIS	4	5
	PG3STAE03	CATEGORICAL DATA ANALYSIS	4	5
III	**TOTAL**		**20**	**25**
	PG4STAC15	TIME SERIES ANALYSIS	3	5
	PG4STAC16	ECONOMETRIC METHODS	3	5
	PG4STAC17	OPERATIONS RESEARCH	3	5
	PG4STAC18	STATISTICAL COMPUTING USING SAS	3	5
	PG4STAE04	POPULATION DYNAMICS	3	5
	PG4STAE05	RELIABILITY MODELING AND ANALYSIS	3	5
	PG4STAE06	ACTURIAL STATISTICS	3	5
	PG4STAE07	OFFICIAL STATISTICS	3	5
	PG4STAPD	PROJECT/ DISSERTATION	3	
	PG4STAPV	VIVA-VOCE	2	
IV	**TOTAL**		**20**	**25**

TOTAL CREDITS: 80

PG1STAC01-MEASURE AND PROBABILITY

UNIT I

Sequences and limit of sets, field and sigma field, monotone class, minimal sigma field, Borel field of R and of R^n, measurable space, measure, measure space, finite and sigma finite measures, properties of measures. Definitions of Counting measures, Lebesgue measure. Definition of integral of a measurable function and its elementary properties. Monotone convergence theorem, Fatou's Lemma, Bounded convergence theorem and Lebesgue dominated convergence theorem.

UNIT II

Probability space and elementary properties of probability measure. Monotone and continuity property of probability measures. Independence of finite number and sequence of events. Borel-Cantelli Lemma, Borel 0-1 criterion, conditional probability and Baye's theorem.

UNIT III

Random variable, vector random variable, properties of random variables. Probability distribution, Distribution function and its properties. Jordan decomposition theorem, Correspondence theorem (statement only). Mathematical expectation, moments and its properties. Basic, Chebychev's, Markov, Liaponov's, Jensen, Cr, Cauchy-Swartz, Holders, Minkowski's inequalities.

UNIT IV

Sequence of random variables and its stochastic convergence. Convergence almost surely, convergence in probability, convergence in distribution, convergence in r^{th} mean, properties, counter examples and their inter-relationship. Independence of finite and sequence of random variables weak and complete convergence of distribution, Kolmogorov's inequality and Helly-Bray Lemma (statement only).

Reference Books

1) Ash R.B. (1972) Real Analysis and Probability, Academic press.
2) Ash R.B. and Doléans-Dade C.A. (2000) Probability and measure theory, Academic Press
3) Basu A.K. (2012). Measure Theory and Probability, Second Edition, PHI Learning Pvt. Ltd, New Delhi.
4) Bhat B.R. (2014) Modern Probability theory (An introductory text book), Fourth edition, New Age International.
5) Billingsley P. (2012) Probability and Measure, Anniversary edition, Wiley Eastern ltd.
6) Laha R.G. and Rohatgi V.K. (1979) Probability theory, John Wiley.
7) Loeve M. (1977) Probability Theory, Fourth edition, Springer-Verlag.
8) Rohatgi V.K. and Saleh M. (2015) An introduction to probability and statistics, Third edition, Wiley.
9) Robert G. Bartle (2001), A Modern Theory of Integration, American Mathematical Society (RI), ISBN: 978-0-8218-0845-0

PG1STAC02-DISTRIBUTION THEORY

UNIT I

Probability Generating functions, Moment generating functions and their properties, Discrete Distributions:- Bernoulli, Binomial, Geometric, Poisson, Negative binomial and Hyper geometric. Power series and Ord family of distributions- Definition, Identification of members, Relationship among moments.

UNIT II

Continuous Distributions:- Rectangular, Exponential, Weibull, Beta, Gamma, Pareto, Normal, Lognormal, Cauchy, Laplace, Logistic, Inverse Gaussian. Pearson family and Exponential family of distributions – Definition and Identification of members.

UNIT III

Functions of Random variables and their distributions. Probability integral transform, Distributions of sums, products and ratios of independent random variables, Truncated distributions, Compound distributions.

UNIT IV

Sampling distributions:- Chi-square, t and F distributions (central and non-central forms), Order statistics and their distributions:- joint and marginal distributions; Distributions of sample median, range and mid–range (Exponential and Uniform)

Reference Books

1) Arnold B.C, Balakrishnan N. and Nagaraja H.N. (1992) A first Course in Order Statistics.
2) Biswas S. and Srivastava G.L (2008) Mathematical Statistics: A text book, Alpha Science International Ltd
3) Gupta S.C. and Kapoor V.K. (2000) Fundamentals of Mathematical Statistics, S. Chand & Co, New Delhi.
4) Hogg R.V and Craig A.T. (2013) Introduction to Mathematical Statistics, Macmillian publishing company.
5) Johnson N.L, Kotz S. and Balakrishnan N. (1991) Continuous Univariate distributions I & II, Wiley.
6) Johnson N.L, Kotz S. and Kemp A.W. (1992) Univariate discrete distributions, Wiley.
7) Kotz S, Balakrishnan N. and Johnson N.L. (2000) Continuous Multivariate distributions, Wiley.
8) Rohatgi V.K. and Saleh M. (2015) An introduction to probability and statistics, Third edition, Wiley.
9) Robert G. Bartle (2001), A Modern Theory of Integration, American Mathematical Society (RI), ISBN: 978-0-8218-0845-0

PG1STAC03-ANALYTICAL TOOLS FOR STATISTICS

UNIT I

Sequence and series of real numbers, Convergence of sequence and series of real numbers-Definitions and problems, Continuity, Uniform continuity, Differentiability. Functions of several variables: maxima and minima, Method of Lagrangian multipliers, Laplace transform and its application to Differential equations, Fourier transform (Definition only)

UNIT II

Vector spaces, Subspaces, Linear independence of vectors, Basis and dimension of a vector space, Inner product and orthogonal vectors, Gram-Schmidt orthogonalization process, Orthonormal basis, Matrix and its properties, Rank of a matrix, Partitioned matrices.

UNIT III

Linear equations, Rank-Nullity theorem, Characteristic roots and vectors, Cayley-Hamilton theorem, Characteristic subspaces of a matrix, Nature of characteristic roots of some special types of matrices, Algebraic and geometric multiplicity of a characteristic root, Generalized inverse, Properties of g-inverse, Moore-Penrose inverse and its computations.

UNIT IV

Quadratic forms, Congruent transformations, Congruence of symmetric matrices, Canonical reduction and orthogonal reduction of real quadratic forms, Nature of quadratic forms, Simultaneous reduction of quadratic forms, Similarity and spectral decomposition of real symmetric matrices.

Reference Books

1) Apostol T.M. (1996) Mathematical Analysis, Second edition, Narosa Publishing House, New Delhi.
2) Gilbert Strang (2014) Linear Algebra and its Applications, 15th Re-Printing edition, Cengage Learning.
3) Hoffman K. and Kunze R. (2014) Linear Algebra, Second edition, Phi Learning.
4) Malik S.C. and Arora S. (2014) Mathematical analysis, Fourth edition, New age international.
5) Rao A.R. and Bhimasankaram P. (2000) Linear Algebra, Second edition, Hindustan Book Agency.
6) Rao C.R. (2009) Linear Statistical Inference and its Applications, Second edition, Wiley Eastern.

PG1STAC04-SAMPLING THEORY

UNIT I

Census and sampling methods, probability sampling and non-probability sampling, simple random sampling with (SRSWR) and without replacement (SRSWOR), estimation of the population mean, total and proportions, properties of the estimators, variance and standard error of the estimators, confidence intervals, sample size determination. Stratified random sampling, estimation of the population mean, total and proportion, properties of estimators, optimum allocation, other types of allocation, Comparison of the precisions of estimators.

UNIT II

Systematic sampling: Linear and Circular, estimation of the mean and its variance. Comparison of systematic sampling with SRS and stratified sampling. Comparison with populations having a linear trend. Cluster sampling, single stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error. Multistage and multiphase sampling-Two-stage cluster sampling with equal and unequal cluster sizes, estimation of the population mean and its standard error. Comparison of cluster sampling with SRS and stratified sampling.

UNIT III

Unequal probability sampling, PPS sampling with and without replacement, Inclusion probabilities, cumulative total method, Lahiris method, Midzuno-Zen method, estimation of the population total and its estimated variance under PPS WR sampling, ordered and unordered estimators of the population total under PPS WOR, Horwitz–Thomson estimator and its estimated SE, Des-Raj's ordered estimator, Murthy's unordered estimator (properties of these estimators for $n = 2$ only).

UNIT IV

Inference in survey sampling -fixed population and super population approach. Ratio method of estimation, estimation of the population ratio, mean and total. Comparison with SRS estimation. Unbiased ratio type estimators- Hartly-Ross estimator, regression method of estimation, large sample comparison with mean per unit estimator and ratio estimators. Basic ideas of Quota sampling; Network sampling and Adaptive sampling.

Reference Books

1) Ardilly P., Tille' Y. (2006). Sampling Methods: Exercises and Solutions, Springer.
2) Cochran W. G. (1999) Sampling Techniques, 3rd edition, John Wiley and Sons.
3) George A. F. Seber, Mohammad M. Salehi (2013). Adaptive Sampling Designs Inference for Sparse and Clustered Populations, Springer.
4) Mukhopadyay P. (2009) Theory and Methods of Survey Sampling, 2nd edition, PHL, New Delhi.
5) Sampath S. C. (2001) Sampling Theory and Methods, Alpha Science International Ltd., India.
6) Sarinder Singh (2003) Advanced Sampling Theory with Applications, Springer-Sciences Business media B V
7) Singh D. and Choudhary F. S. (1986) Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd.

PG1STAC05-STATISTICAL COMPUTING USING R

Basics of R programming

Applications of topics covered in the following papers

1. PG1STAC02: DISTRIBUTION THEORY
2. PG1STAC03: ANALYTICAL TOOLS FOR STATISTICS
3. PG1STAC04: SAMPLING THEORY

Evaluation: Nine numerical questions, each having 16 marks, are to be asked. Three questions from each of the above papers must be asked. The student is expected to answer 5 questions. At least one question from each of the section must be answered. Use of packages R and MS-Excel is allowed for answering the questions in this paper. Examination of 3 hour duration must be conducted in the computer lab under the supervision of an external examiner appointed by the Controller of Examinations.

PG2STAC06-ADVANCED PROBABILITY THEORY

UNIT I

Characteristic functions**:** Definition and simple properties, Uniform continuity and non-negative definiteness, Bochner's Theorem (Statement only), Characteristic function and moments, Convex combinations of characteristic functions, Fourier Inversion theorem, Continuity theorem, Characteristic function of a vector random variable.

UNITII

Law of large numbers: Weak law of large numbers - Bernoulli, Chebychev, Poisson and Khinchine WLLN, Necessary and sufficient condition for weak law of large numbers. Strong law of large numbers, Kolmogrov strong law of large numbers for independent random variables - for i.i.d random variables.

UNIT III

Central limit theorem, Demoivre-Laplace central limit theorem, Lindberg-Levy central limit theorem, Liaponov's central limit theorem, Lindberg-Feller central limit theorem (Without proof), Domain of attraction, Infinitely divisible distributions and Stable distributions-definition and elementary properties.

UNIT IV

Signed measure, Hahn decomposition theorem, Jordan decomposition theorem, Statement and applications of Radon-Nikodym Theorem (without proof), Lebesgue decomposition theorem, Product space, Fubini's theorem, Conditional expectation and its properties, Martingales and its simple properties.

Reference Books

1) Ash R.B (1972) Real Analysis and Probability, Academic press.
2) Bhat B.R (1999) Modern Probability theory, Third Edition, Wiley Eastern Ltd, New Delhi.
3) Billingsley P (2012) Probability and Measure, Third Edition, Wiley Eastern Ltd.
4) Laha R.G and Rohatgi V.K (1979) Probability theory, Wiley.
5) Luckas E (1970) Characteristic functions, Second Edition, Hafner Publishing Company, NewYork.
6) Parthasarathy K.R (2005) Introduction to Probability and Measure, Hindustan Book Agency.

PG2STAC07-MULTIVARIATE DISTRIBUTIONS

UNIT I

Notions of bivariate distributions, Bivariate Normal- Marginals and conditionals, Gumbel's Bivariate Exponentials and basic properties. Multivariate distributions- Marginals and conditionals, Independence of random vectors, Multinomial distribution and its basic properties.

UNIT II

Multivariate Normal (Singular and non-singular), characteristic function, Marginals and conditionals–Properties, characterizations, Estimation of mean vector and dispersion matrix, Independence of sample mean vector and sample dispersion matrix.

UNIT III

Jacobian of matrix transformations, Y= AXB; Y= AXA`; X=TT`, Rectangular co-ordinate, Matrix variate Gamma and Beta distributions. Wishart distribution and its basic properties, characteristic function, Generalized variance and its distribution.

UNIT IV

Quadratic forms and their distributions (both scalar and vector forms), Independence of Quadratic forms, Cochran's Theorem, Simple, Partial and multiple correlation and their properties.

Reference Books

1) Anderson T.W. (1984) An introduction to multivariate statistical analysis, Second edition, John Wiley.
2) Giri N.(1984) Multivariate Statistical Inference, Academic publishers.
3) Kollo T and Rosen D.V. (2005): Advanced Multivariate Statistics with Matrices, Springer.
4) Kotz S, Balakrishnan N, and Johnson N.L. (2000) Continuous Multivariate Distributions, Volume 1, Models and Applications, Second Edition, John Wiley.
5) Mathai A.M. (1996) Jacobins of Matrix Transformations and functions of Matrix Argument, World Scientific Pub CoPvt.Ltd
6) Rao.C.R(2009) Linear statistical inference and its applications, Second Edition, Wiley Eastern.
7) Seber G.A.F. (1983) Multivariate Observations, John Wiley.

PG2STAC08-THEORY OF ESTIMATION

UNIT I

Criteria for estimators - unbiasedness, consistency, efficiency, sufficiency, minimal sufficiency, likelihood equivalence, Fisher-Neyman factorization theorem and completeness, bounded completeness, exponential families, ancillary statistics, Basu's theorem

UNIT II

UMVUE and their characterization, BLUE, Rao-Black well theorem, Lehmann-Scheffe theorem, Fisher information, Cramer-Rao inequality, Chapman-Robbins inequality, Bhattacharyya's bounds. Equivariance, Pitman estimator.

UNIT III

Methods of estimation: method of moments, method of maximum likelihood & their properties, Cramer- Huzurbazar theorem, Fisher's scoring method, method of minimum chi-square and method of modified minimum chi-square.

UNIT IV

Elements of decision theory, Statistical decision problem, Prior distributions and Loss functions, risk functions, Minimax estimators, Bayes Theorem, Bayes risk, Bayes principle, Bayes estimators, Admissible decision rules. Prior-Posterior analysis for normal, binomial and Poisson processes.

Reference Books

1) Berger J.O. (1993) Statistical Decision Theory and Bayesian Analysis, Third Edition, Springer.
2) Casella, G and Berger, R.L (2007) Statistical Inference, Second Edition, Cengage Learning.
3) Hogg R. V. and Craig A. T. (2013) Introduction to Mathematical Statistics, Pearson
4) Kale B. K. (2005) A First Course on Parametric Inference, Alpha Science International.
5) Lehmann E.L. (1983) Theory of point estimation – Wiley, New York.
6) Lindgren B.W (1976) Statistical Decision Theory (3rd Edition), Collier Macmillian, New York.
7) Rao C.R (2009) Linear Statistical Inference and its Applications, John Wiley, New York.
8) Rohatgi V.K. and Saleh A.K. (2015) An Introduction to Probability Theory and Mathematical Statistics, Wiley.

PG2STAC09-STOCHASTIC PROCESSES

UNIT I

Introduction to Stochastic Processes; classification of Stochastic Processes according to state space and time domain. Finite and countable state Markov Chain (MC), transition probability matrix, Chapman-Kolmogorov equation, first passage probabilities, generating functions, classification of states and of Markov chains. Basic limit theorems of MCs, mean ergodic theorem, stationary distributions, limiting probabilities, random walk and Gambler's ruin problem

UNIT II

Continuous time MC, Poisson processes and its properties. Pure birth process and Yule processes, Birth and Death process, Kolmogorov forward and backward differential equations, linear growth with immigration. Stationary solutions of queuing models – M/M/1, M/M/s, M/M/∞ and M/G/1.

UNIT III

Renewal process, concepts, examples, Poisson process viewed as renewal process. Renewal equation, stopping time, Walds equation. Elementary renewal theorem, central limit theorem for renewals, key renewal theorem (statement only), delayed renewal processes.

UNIT IV

Branching process, discrete time branching processes-examples. Generating function relations, mean and variance functions, extinction probabilities, criteria for extinction. Total population size and its generating function relations. A brief introduction to Brownian motion and Weiner process.

Reference Books

1) Basu A.K. (2003) Introduction to Stochastic Processes, Narosa, New-Delhi.
2) Bhat B.R. (2010) Stochastic Models: Analysis and Applications, First edition, New Age International.
3) Cinlar E. (2013) Introduction to Stochastic Processes, Dover Publications, NewYork.
4) Feller W. (1968) Introduction to Probability Theory and its Applications, Vols. I & II, John Wiley, New York.
5) Karlin S. and Taylor H.M. (1975) A First Course in Stochastic Processes, Second edition, Academic Press, New-York.
6) Medhi J. (2014) Stochastic Processes. Third Edition, New Age International.
7) Ross S.M. (2014) Introduction to Probability models, Eleventh edition, Academic Press.

PG2STAC10 -STATISTICAL COMPUTING USING MATLAB/R

Basics of MATLAB

Applications of topics covered in

1. PG2STAC07: MULTIVARIATE DISTRIBUTIONS
2. PG2STAC08: THEORY OF ESTIMATION
3. PG2STAC09: STOCHASTIC PROCESSES

Evaluation: 9 numerical questions each having 16 marks are to be asked. The student is expected to answer 5 questions. Three questions from each of the above papers must be asked. At least one question from each of the section must be answered. Use of packages R or MATLAB is allowed for answering the questions in this paper. Examination of 3 hour duration must be conducted in the computer lab under the supervision of an external examiner appointed by the Controller of Examinations.

PG3STAC11-TESTING OF STATISTICAL HYPOTHESES

UNIT I

Tests of hypotheses, Formulation of problem, Null and alternative hypotheses, Size of a test, Simple and composite hypotheses, Randomized and non-randomized tests, Power of a test, Most Powerful test, Neyman-Pearson lemma and its generalization, Monotone likelihood ratio property, UMP tests, Unbiased tests and UMPU tests, Unbiased critical regions and similar regions, Neyman structure, UMPU tests in exponential families of distributions.

UNIT II

Confidence interval estimation, Relationship between confidence interval estimation and testing of hypothesis, UMA and UMAU confidence intervals, Shortest confidence intervals, Construction of confidence intervals using pivots, Large sample confidence interval based on maximum likelihood estimator, Chebychev's inequality and central limit theorem, Credible regions.

UNIT III

Likelihood ratio tests and their properties, Testing mean and variance of a normal population, Testing equality of means and variances of two normal populations, Sequential probability ratio tests, Construction of sequential probability ratio tests, Wald's identity, OC and ASN functions, Properties of SPRT.

UNIT IV

Non-parametric inference: Goodness of fit tests- Chi square test and Kolmogorov-Smirnov test for one and two sample problems, Sign test, Wilcoxon signed-rank test, Wald-Wolfowitz run test, Median test, Man-Whitney U-test, Chi-Square tests for independence and homogeneity. One way layout-Kruskal Wallis test, Friedman test.

Reference Books

1) Casella, G and Berger, R.L (2007) Statistical Inference, Second Edition, Cengage Learning.
2) Gibbons, J.K. (1971) Non-Parametric Statistical Inference, McGraw Hill.
3) Kale, B.K. (2005) A First Course in Parametric Inference, Second Edition, Alpha Science International Ltd.
4) Lehmann, E.L. (1998) Testing Statistical Hypothesis, John Wiley.
5) Myles H, Wolfe D. A. (1973) Nonparametric Statistical methods, John Wiley and Sons.
6) Rohatgi V.K. and Saleh M. (2015) An introduction to probability and statistics, Third Edition, Wiley.
7) Srivastava M.K. and Srivastava N. (2009) Statistical Inference: Testing of Hypotheses, PHI.
8) Wald, A. (1947) Sequential Analysis, Doves.

PG3STAC12-DESIGN AND ANALYSIS OF EXPERIMENTS

UNIT I

Linear estimation: Gauss Markov set up, Estimability of parameters, Method of least squares, best linear unbiased Estimators, Gauss-Markov Theorem, Tests of linear hypotheses. Analysis of variance- one-way, two-way and three-way classification models.

UNIT II

Planning of experiments: Basic principles of experimental design, Uniformity trails, Completely randomized design (CRD), Randomized block design (RBD), Latin square design (LSD) and Graeco-latin square designs, Analysis of covariance (ANACOVA), ANACOVA with one concomitant variable in CRD and RBD

UNIT III

Incomplete block design: Balanced incomplete block design (BIBD); Incidence Matrix, parametric relations; Intra-block analysis of BIBD, Basic ideas of partially balanced incomplete block design (PBIBD). Basics of Lattice designs.

UNIT IV

Factorial experiments, 2^n and 3^n factorial experiments, Analysis of 2^2, 2^3 and 3^2 factorial experiments, Confounding in factorial experiments, Basic ideas on fractional factorial designs, Split plot design.

Reference Books

1) Agarwal B.L (2010) Theory and Analysis of Experimental Designs, CBS Publishers & Distributers
2) Das M.N. and Giri N.C. (1994) Design and analysis of experiments, Wiley Eastern Ltd.
3) Dean A. and Voss D. (1999) Design and Analysis of Experiments, Springer Texts in Statistics
4) Dey A. (1986) Theory of Block Designs, Wiley Eastern, New Delhi.
5) Gomez K.A. and Gomez A.A. (1984) Statistical Procedures for Agricultural Research, Wiley.
6) Joshi D.D. (1987) Linear estimation and Design of Experiments, Wiley Eastern.
7) Montgomery C.D. (2012) Design and Analysis of Experiments, John Wiley, New York.

PG3STAC13-MULTIVARIATE ANALYSIS

UNIT I

Notion of likelihood ratio tests, Hotellings T^2 and Mahalnobis D^2 statistics-Their properties, interrelationships, Null distributions (one sample and two sample cases), Testing equality of mean vectors, Wilk's λ, Multivariate Fisher-Behrens problem, Profile Analysis.

UNIT II

Dimension Reduction methods: Principal component Analysis-Method of extraction-properties, Factor Analysis-Orthogonal Model-Estimation of loading, Canonical variates and canonical correlation, Hoteling's iterative procedure.

UNIT III

Classification problems: Discriminant Analysis-Baye's procedure, Classification into one of the two populations (Normal distribution only), Classification into several populations (Normal distribution only), Fishers linear discriminant function and its associated tests.

UNIT IV

Cluster Analysis: Similarity measures, Hierarchical and non-hierarchical methods, Multivariate General linear models-MANOVA (one way and two way), Tests-Independence of sets of variables, Equality of dispersion matrices, Sphericity test.

Reference Books

1) Anderson T. W. (2003) An Introduction to Multivariate Statistical Analysis, Third edition, John Wiley.
2) Johnson R.A. and Wichern D.W. (2007) Applied Multivariate Statistical Analysis. Sixth Edition, Pearson.
3) Seber G. F. (1983) Multivariate Observations, John Wiley.
4) Rencher, A. C. (1995) Methods of Multivariate Analysis. John Wiley.
5) Kshirasagar, A.M. (1972) Multivariate Analysis, Marcel-Dekker.
6) Bryan, F.J (2004) Multivariate Statistical Methods: A Primer, Third Edition, Chapman & Hall.
7) Everitt, B and Hothorn, T. (2011) An introduction to Applied Multivariate Analysis with R , Springer
8) Kachigan, S.K. (1991) Multivariate Statistical Analysis: A Conceptual Introduction, Hawthorne Academic
9) Morrison, D.F.(1990) Multivariate Statistical Methods, Second Edition, McGraw Hill Education.

PG3STAC14-STATISTICAL COMPUTING USING SPSS

Basics of SPSS

Applications of topics covered in the following papers

1. PG3STAC11 : TESTING OF HYPOTHESIS
2. PG3STAC12 : DESIGN OF EXPERIMENTS
3. PG3STAC13 : MULTIVARIATE STATISTICAL ANALYSIS

Evaluation: 9 numerical questions, each having 16 marks, are to be asked. The student is expected to answer 5 questions. Three questions from each of the above papers must be asked. At least one question from each of the section must be answered. Use of packages R MATLAB or SPSS is allowed for answering the questions in this paper. Examination of 3 hour duration must be conducted in the computer lab under the supervision of an external examiner appointed by the Controller of Examinations.

PG3STAE01-STATISTICAL QUALITY CONTROL

UNIT I

Meaning and Scope of Statistical process control , Control charts, Basic ideas, designing of control charts for the number of nonconformities and fraction non-conformities, mean charts, Median charts, R-charts, and S-charts, their uses, OC and ARL of control charts. Uses of runs and related patterns of points, Economic design of Shewarts control charts.

UNIT II

Acceptance sampling for attributes, Single sampling, Double sampling, Multiple and sequential sampling plans, Rectifying inspection, OC and ASN functions, Measuring the performance of these plans.

UNIT III

Sampling inspection plans. Classification and general properties, Sampling plans by variables: estimation of lot defective and determination of plan parameters in known and unknown variance cases, single specification case. Continuous sampling plans – CSP- 1 and its modifications. Derivation of AOQL for CSP-1.

UNIT IV

Process capability studies, (C_p, C_{pk}, C_{pkm}). Control charts with memory - CUSUM charts, EWMA-mean charts, OC and ARL for control charts, Taguchi philosophy of Quality, Total Quality Management ISO standardization.

Reference Books

1) Montgomery, D.C. (2012). Introduction to Statistical Quality Control, Seventh edition, Wiley.
2) Mittag, H.J. and Rinne, H. (1993) Statistical Methods for Quality Assurance, Chapman & Hall, Chapters 1, 3 and 4.
3) Rabbit, J T and Bergle, P.A. The ISO 9000 book, Second Edition, Quality resources, Chapter-I
4) Schilling, E.G. (1982) Acceptance Sampling in Quality Control, Marcel Dekker.
5) Duncan, A.J. (1986) Quality control and Industrial Statistics.
6) Grant E.L. and Leaven Worth, R.S. (1980) Statistical Quality Control, McGraw Hill.

PG3STAE02-SURVIVAL ANALYSIS

UNIT I

Basic Quantities and Models - Survival function, Hazard function, Mean residual life function and Median life, Common Parametric Models for Survival Data; Censoring and Truncation - Right Censoring, Left or Interval Censoring, Truncation, Likelihood Construction for Censored and Truncated Data

UNIT II

Nonparametric Estimation of a Survivor Function and Quantiles, The Product-Limit Estimator, Nelson-Aalen Estimator, Interval Estimation of Survival Probabilities or Quantiles, Asymptotic Properties of Estimators, Descriptive and Diagnostic Plots, Plots Involving Survivor or Cumulative Hazard Functions, Classic Probability Plots, Estimation of Hazard or Density Functions, Methods for Truncated and Interval Censored Data, Left-Truncated Data, Right-Truncated Data, Interval-Censored Data.

UNIT III

Semiparametric Proportional Hazards Regression with Fixed Covariates - Coding Covariates, Partial Likelihoods for Distinct-Event Time Data, Partial Likelihoods when Ties are present, Local Tests, Discretizing a Continuous Covariate, Model Building using the Proportional Hazards Model, Estimation for the Survival Function; Introduction to Time-Dependent Covariates; Regression Diagnostics :- Cox-Snell Residuals for assessing the fit of a Cox Model, Graphical Checks of the Proportional Hazards Assumption, Deviance Residuals, Checking the Influence of Individual Observations

UNIT IV

Inference for Parametric Regression Models - Exponential, Gamma and Weibull Distributions, Nonparametric procedure for comparison of survival function, Competing risk models – Basic Characteristics and Model Specification

Reference Books

1) Klein J.P. and Moeschberger M.L. (2003) Survival Analysis - Techniques for censored and truncated data, Second Edition, Springer-Verlag , New York,
2) Lawless J.F (2003) Statistical Models and Methods for Lifetime Data, Second Editon, John Wiley & Sons
3) Kalbfleisch J.D and Prentice, R.L. (2002) The Statistical Analysis of Failure Time Data, Second Edition, John Wiley & Sons Inc.
4) Hosmer Jr. D.W and Lemeshow S (1999) Applied Survival Analysis - Regression Modelling of Time to event Data, John Wiley & Sons. Inc. 3. Nelson. W (1982) Applied Life Data Analysis.
5) Miller, R.G. (1981) Survival Analysis, John Wiley.

PG3STAE03- CATEGORICAL DATA ANALYSIS

UNIT I

Categorical variables, Introduction to Binary data, The linear probability models, The logit model, The Probit model, the latent variable approach, the odds ratio, Relarive risks, Sensitivity and specificity, MNemar's test, Binomial response models, log-log models, Likelihood ration Chi-squared statistic, Log-rate models, Time Hazard models, Semi-parametric rate models.

UNIT II

Logistic Regression Analysis: Logit Models with Categorical Predictors Logistic Regression models, regression diagnostics, Predictions, Interpreting parameters in logistic Regression. Inference for logistic Regression, Multiple logistic regression.

UNIT III

Poisson regression: interpretations, regression diagnostics, Predictions**,** negative binomial regression**,** Proportional hazards regression.

UNIT IV

Principles of Bayesian statistics, Inference using simulations - Standard distributions, Understanding Markov Chain Monte Carlo, The Gibbs sampler and the WinBUGS [Necessary topics from Chapter 1-5 of Ioannis Ntzoufras (2009)]

Reference Books

1) Agresti, A. (1990) Categorical Data Analysis. New York: John Wiley
2) Carlin, B.P. and Louis, T.A. (2000) Bayes and Emperical Bayes Methods for Data Analysis, Second Edition
3) Congdon P. (2006) Bayesian Statistical Modelling, Second Edition, John Wiley & Sons, Ltd. ISBN: 0-470-01875-5
4) Ntzoufras I. (2009) Bayesian Modeling using WinBUGS John Wiley & Sons Inc.
5) Powers D.A. (1999) Statistical methods for Categorical data analysis. Academic press Inc.
6) Shewhart, W.A. and Wilks, S.S. (2013) Case Studies in Bayesian Statistical Modelling and Analysis. Wiely.

PG4STAC15-TIME SERIES ANALYSIS

UNIT I

Time series, Components of time series, Additive and multiplicative models, Estimation and elimination of trend and seasonality, Moving average, Simple Exponential Smoothing, Holt's exponential smoothing, Holt-Winter's exponential smoothing, Forecasting based on smoothing.

UNIT II

Time series as a discrete parameter stochastic process, Auto-covariance and auto-correlation functions and their properties, Stationary processes, Wold representation of linear stationary processes, Detailed study of the linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models.

UNIT III

Estimation of ARMA models: Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes. Choice of AR and MA periods, Forecasting using ARIMA models, Residual analysis and diagnostic checking.

UNIT IV

Spectral density of a stationary time series and its elementary properties, Periodogram, Spectral density of an ARMA process. Seasonal ARIMA models (Basic concepts only), ARCH and GARCH models (Basic concepts only).

Reference Books

1) Abraham B. and Ledolter J.C. (2005) Statistical Methods for Forecasting, Second edition Wiley.
2) Box G.E.P, Jenkins G.M. and Reinsel G.C. (2008) Time Series Analysis: Forecasting and Control, Fourth Edition, Wiley.
3) Brockwell P.J and Davis R.A. (2002) Introduction to Time Series and Forecasting Second edition, Springer-Verlag.
4) Cryer, J. D. and Chan, K. (2008). Time Series Analysis with Applications in R, Second Edition, Springer-Verlag.
5) Shumway, R. H. and Stoffer, D. S. (2011) Time Series Analysis and Its Applications with R Examples, Third Edition, Springer-Verlag.

PG4STAC16-ECONOMETRIC METHODS

UNIT I

Simple linear regression models, Multiple linear regression models, estimation of the model parameters, tests concerning the parameters, confidence intervals, prediction, use of Dummy variables in regression, polynomial regression models, step-wise regression.

UNIT II

Multicollinearity- consequences, Detection, Farrar-Glauber test, remedial measures. Heteroscedasticity- consequences, Detection, tests, remedial measures Aitken's generalized least square method. Auto-correlation-tests for auto correlation, consequences, and estimation procedures, Errors in variables-consequences, detection, remedial measures, Stochastic regressors. Diagnostics, outlier, Influential observations, Leverage, Non parametric regression basics.

UNIT III

Demand and supply functions, Cobweb model, elasticity of demand, equilibrium of market, indifference curves, Cost Function, Utility, Firms, Marginal analysis of firms, production functions- elasticity of production, homogeneous functions, Cobb-Douglas Production function, constraint maximization of Profit, Revenue, output, input- output analysis-Open and closed system.

UNIT IV

Simultaneous equation models, instrumental variables, recursive models, distributed- lag models identification problems, rank and order condition, methods of estimation- indirect least squares, least variance ratio and two-stage least squares, FIML- methods.

References Books

1) AllenR.G.D. (2008) Mathematical Analysis For Economists, Aldine Transaction
2) Apte P.G. (1990) Text book of Econometrics, Tata Me Graw Hill.
3) Damodar N Gujrati, Sangeeth (2007) Basic Econometrics 5th Ed., McGraw Hill Education Private Ltd.
4) Jeffrey M. Wooldridge (2012) Introductory Econometrics: A Modern Approach 5th Edition, South-Western College Pub.
5) Johnston J. (1984) Econometric Methods (Third edition), McGraw Hill, New York.
6) Koutsoyiannis A. (2008) Modern Microeconomics, Second Edition, Macmillan Press Ltd
7) Kutner M. H, Nachtsheim C.J, Neter J and Li W. (2005), Applied Linear Statistical Model, Fifth edition. McGraw Hill
8) Montgomery D.C., Peck E.A. and Vining G.G. (2007) Introduction to Linear Regression Analysis, John Wiley, India.
9) Theil H. (1982) Introduction to the Theory and Practice of Econometrics, John Wiley.

PG4STAC17-OPERATIONS RESEARCH

UNIT I

Linear programming: convex sets and associated theorems, Simplex method, Artificial variables technique-Big M method, Two phase method; Dual simplex method. Concept of duality and sensitivity analysis, Transportation problems, Assignment problems. Integer Programming Problem (Basic concepts only).

UNIT II

Non-linear programming problem (NLPP): General non-linear programming problem, Dynamic and Quadratic programming, Constrained optimization with equality constraints - necessary conditions for a generalized NLPP, sufficient conditions for a general NLPP with one constraint, sufficient conditions for a general problem with m ($< n$) constraints, Constrained optimization with inequality constraints, Kuhn-Tucker conditions for general NLPP with m ($< n$) constraints.

UNIT III

Inventory models:-Deterministic inventory models -general inventory model, Static economic-order quantity (EOQ) models -classic EOQ model, EOQ with price breaks, multi-item EOQ with storage limitation, Probabilistic inventory models:-Continuous review models "probabilitized" EOQ model, probabilistic EOQ model.

UNIT IV

Theory of Games, Two person zero sum games, fundamental theorem of matrix games, Rectangular games as a Linear programming problem, Dominance property, Graphical Method of solution 2xn and mx2 games.

Reference Books

1) KantiSwarup, Gupta, P.K. and Man Mohan (2001) Operations Research, Ninth edition, Sultan Chand & Sons.
2) Taha H.A. (2007) Operations Research -An introduction, Eighth edition, Prentice-Hall of India Ltd.
3) Sharma J.K. (2013) Operations Research: Theory and Applications, Fifth edition,Laxmi Publications-New Delhi.
4) Gass S.I. (1985) Linear Programming -methods and applications, Fifth edition, McGraw Hill, USA,
5) Ravindran A, Philips D.T and Soleberg J.J. (1997) Operation Research-Principles and Practice, John Wiley & Sons.
6) Sinha, S.M. (2006) Mathematical programming theory and methods, Elsevier, a division of Reed Elsevier India Pvt. Ltd., New Delhi.
7) Paneerselvam, R. (2008) Operations Research, Second edition, Prentice Hall of India Pvt. Ltd., New Delhi.

PG4STAC18-STATISTICAL COMPUTING USING SAS

Basics of SAS Programming

Applications of topics covered in the following papers

1. PG4STAC15: TIME SERIES ANALYSIS
2. PG4TA4C16: ECONOMETRIC METHODS
3. PG4TA4C17: OPERATIONS RESEARCH

Evaluation: 9 numerical questions each having 16 marks are to be asked. The student is expected to answer 5 questions. Three questions from each of the above papers must be asked. At least one question from each of the section must be answered. Use of packages R, SPSS, MATLAB/SAS is allowed for answering the questions in this paper. Examination of 3 hour duration must be conducted in the computer lab under the supervision of an external examiner appointed by the Controller of Examinations.

PG4STAE04: POPULATION DYNAMICS

UNIT I

Sources of mortality data-mortality measures-ratios and proportions, crude mortality rates, specific rates- standardization of mortality rates, direct and indirect methods, gradation of mortality data, fitting Gompertz and Makeham curves.

UNIT II

Life tables-complete life table-relation between life table functions, abridged life table-relation between abridged life table functions, construction of life tables, Greville's formula, Reed and Merrell's formula- sampling distribution of life table functions, multivariate pgf –estimation of survival probability by method of MLE.

UNIT III

Fertility models, fertility indices-relation between CBR,GFR,TFR and NRR stochastic models on fertility and human reproductive process, Dandekar's modified binomial and Poisson models, Brass, Singh models-models for waiting time distributions, Sheps and Perrin model.

UNIT IV

Population growth indices, logistic model, fitting logistic, other growth models, Lotka's stable population, analysis, quasi stable population, effect of declining mortality and fertility on age structure, population projections, component method-Leslie matrix technique, properties of time independent Leslie matrix-models under random environment

Reference Books

1) Biswas S (1988) Stochastics processes in Demography and applications, Wiley Eastern.
2) Biswas S (2007) Applied Stochastic Processes-A Biostatistical and Population Oriented Approach, Second Edition, New Central Book Agency.
3) Keyfitz N (1977) Applied Mathematical Demography A Wiley Interscience publication.
4) Pollard J.H (1975) Mathematical Models for the growth of Human population, Cambridge University Press.
5) Ramkumar R (1986) Technical Demography, Wiley Eastern.
6) Srinivasan K (1970) Basic Demographic Techniques and Applications.

PG4STAE05-RELIABILITY MODELING AND ANALYSIS

UNIT I

Reliability function, hazard rate and mean residual life function, one-one correspondence of these functions, Study of life time models viz, exponential, Weibull, Lognormal, Pareto, Gamma, Makeham, Reliegh distributions. Reliability concepts in the discrete time. Extension to higher dimensions (Basic concepts only).

UNIT II

Series and parallel systems, k out of n systems and its reliability, coherent systems, reliability of coherent systems, cuts and paths, bounds on system reliability.

UNIT III

Notions of ageing; increasing failure rate (IFR), increasing failure rate average (IFRA), new better than used (NBU), decreasing mean residual life (DMRL) and new better than used in expectation (NBUE), classes and their duals; loss of memory property of the exponential distribution, closures of these classes under formation of coherent systems, convolutions and mixtures.

UNIT IV

Reliability estimation using MLE - Exponential, Weibull and Gamma distributions based on censored and non-censored samples, Kaplan-Meier estimator of the reliability function, Stress-strength models- reliability and its estimation.

Reference Books

1) Barlow R.E. and Proschan F. (1965) Mathematical Theory of Reliability, Wiley, New York.
2) Sinha S. K. (1986) Reliability and Life Testing, Wiley Eastern.
3) Barlow R.E. and Proschan F. (1985) Statistical Theory of Reliability and Life Testing, Holt Rinehart and Winston, New York.
4) Rao S.S. (1992) Reliability-based design, McGraw Hill, New York.
5) Lai C.D and Xie M. (2006) Stochastic ageing and dependence in reliability, Springer.

PG4STAE06-ACTUARIAL STATISTICS

UNIT I

Actuarial Science Introduction, Insurance Companies as Business Organizations, meaning of loss, peril, hazard and proximate cause in insurance, Costs and benefits of insurance to society Concept of Risk; Future Lifetime Distribution and Life Tables – Future Lifetime Random Variable, Curate Future Lifetime, Assumptions for Fractional Ages, Select and Ultimate Life Tables.

UNIT II

Actuarial Present Values or Benefit in Life Insurance Products – Compound Interest and Discount Factor, Benefit Payable at the Moment of Death, Benefit Payable at the End of Year of Death, Relation between A and $\bar{A}$.

UNIT III

Annuities – Annuities Certain, Continuous Life Annuities, Discrete Life Annuities, Life Annuities with monthly Payments; Premiums – Loss at Issue Random Variable, Fully Continuous Premiums, Fully Discrete Premiums, True monthly Payment Premiums, Gross Premiums.

UNIT IV

Fully continuous Reserves, Fully Discrete Reserves: Multiple Life Contracts-Joint Life Status, Last Survivor Status.

Reference Books

1) Deshmukh, S.R. (2009) Actuarial Statistics – An Introduction using R, University Press (India) Pvt Ltd., Hyderabad,
2) Daykin, C.D, Pentikainen,T. et al, Practical Risk Theory of Acturies, Chapman and Hill .
3) Promislow, S.D (2006) Fundamentals of Actuarial Mathematics, John Wiley. Chapters 2-11 &14
4) Neill, A (1977) Life Contingencies, Heinemann , London.
5) King,G. Institute of Actuaries Text Book. Part 11, Second Edition, Charles and Edwin Layton, London.
6) Donald D.W.A.(1970) Compound Interest and Annuities, Heinemann, London.
7) Jordan, C.W.Jr.(1967) Life Contigencies, Second Edition, Chicago Society of Actuaries.
8) Spurgeen, E.T. Life Contigencies, 3rd Edition, Cambridge University Press.
9) Benjamin, B. and Pollard, J.H.(1980) Analysis of Mortality and other Actuarial Statistics, Second Edition, Heinemann, London.
10) Freeman,H.(1960) Finite Differences for Actuarial Students, Cambridge University Press.
11) Biandt-Johnson, R.C.and Johnson ,N.L(1980) Survival Models and Data Analysis, John Wiley

PG4STAE07-OFFICIAL STATISTICS

UNIT I

The Statistical system in India: The Central and State Government organizations, the functions of the Central Statistical Organization (CSO), the National Sample Survey Organization (NSSO). National Income statistics: Income, expenditure and production approaches-Applications in various sectors in India.

UNIT II

Economic statistics:- Index number - its definition, price relatives and quantity or volume relatives, link and chain relatives, consumer price index; Demand analysis - static laws of demand and supply, price elasticity of demand, Measurement of income inequality: Gini's coefficient, Lorenz curves, Application of Pareto and Lognormal as income distributions. Economic development, growth in per capita income and indices of development; Human Development Index, Estimation of national income - product approach, income approach and expenditure approach.

UNIT III

Educational and Psychological statistics:- Scaling individual test items, scaling of scores on a test, different types of scores and scaling, scaling of ranking and rating in terms of normal curve, Reliability of test scores, Rulon and Kuder Richardson methods, Reliability of a test, validity, comparison between reliability and validity, Intelligence coefficient.

UNIT IV

Demographic methods:- Sources of demographic data - census, register, adhoc survey, hospital records, demographic profiles of Indian census; Measurement of mortality and life tables - crude, death rates, infant mortality rates, death date by cause, standardized death rate; Complete life tables – its main features, mortality rate and probability of dying, use of survival tables; Measurement of fertility - crude birth rate, general fertility rate, total fertility rate, gross reproduction rate, net reproduction rate; Population projection.

Reference Books

1) Biswas S. (2007) Applied Stochastic Processes-A Biostatistical and Population Oriented Approach, Second Edition, New Central Book Agency
2) Cox P.R. (1957) Demography, Cambridge University Press
3) Croxton F. E. and Crowder D. J. (1967) Applied General statistics, Prentice - Hall India.
4) Guide to current Indian Official Statistics CSO, Govt. of India, New Delhi
5) Guide to official Statistics (CSO) -1990
6) Kendall, M.G. and Stuart, A. (1966). The Advanced Theory of Statistics, Charles Griffin
7) Keyfitz, N. (1977) Applied Mathematical Demography - Springer Verlag
8) Mukhopadhyay, P. (2011) Applied Statistics, Books and Allied (P) Ltd.
9) Sen, A. (1997) : Poverty and inequality
10) Statistical System in Indian (CSO) 1995