

MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI – 12.

B.Sc., Statistics

under Choice Based Credit System
(with effect from the academic year 2020-2021)

Eligibility for Admission:

Candidates who have passed the higher secondary examination conducted by Government of Tamil Nadu with Statistics / Mathematics / Business Mathematics / Computer Science / Physics / Chemistry / Commerce as one of the courses or other equivalent examinations are eligible for admission to the first year of the B.Sc., (Statistics) degree program.

Duration of the Program:

The duration of the program is three academic years comprising of six semesters with two semesters in each academic year. Examinations will be conducted at the end of each semester for the respective courses.

Medium of Instructions and Examinations:

The medium of instructions and examinations for the courses of Part I and Part II shall be in the languages concerned. For the courses of Part III and Part IV, the medium of instructions and examinations shall be in English.

Examination

The regulations for examination, passing minimum in each course and classification of successful candidates and award of ranks are at par with the regulations for other undergraduate science programs of the University.

SCHEME OF EXAMINATION

Table: CS-03: Common Program Structure for other UG Degree Programme in Sciences – B.Sc., in Statistics

Sem. (1)	Pt. I/II/ III/ IV/ V (2)	Sub No. (3)	Course Status (4)	Course Title (5)	Contract Hrs./week (6)	L Hrs. / week (7)	T Hrs. / week (8)	P Hrs. / week (9)	C Credits (10)
III	I	16	Language	Tamil / Other Languages – III	6	6	0	0	4
	II	17	Language	English – III	6	6	0	0	4
	III	18	Core	Statistical Distributions	4	4	0	0	4
	III	19	Core	Probability Theory	4	4	0	0	4
	III	20	Major Practical - III	Statistics Practical - III	2	0	0	2	2
	III	21	Allied-III	Mathematics - II	3	3	0	0	3
	III	22	Skilled Based Core	Mathematical Computations using R	3	2	0	1	3
	III	23	Non-Major Elective	Elements of Statistics - I	2	2	0	0	2
	IV	24	Common	Yoga	2	1	0	1	2
Subtotal					32				28

IV	I	25	Language	Tamil / Other Languages - IV	6	6	0	0	4
	II	26	Language	English – IV	6	6	0	0	4
	III	27	Core	Demographic Methods	4	4	0	0	4
	III	28	Core	Time Series and Official Statistics	4	4	0	0	4
	III	29	Major Practical - IV	Statistics Practical - IV	2	0	0	2	2
	III	30	Allied- IV	Matrix Theory	3	3	0	0	3
	III	31	Skill Based Core	Numerical Methods	3	3	0	0	3
	IV	32	Non-Major Elective	Elements of Statistics - II	2	2	0	0	2
	IV	33	Common	Computers for Digital Era	2	2	0	0	2
	V	34	Extension Activity	NCC, NSS, YRC, YWF	0	0	0	0	1
Subtotal					32				29

Note 1:

- Statistics Practical – I : Based on the course “Descriptive Statistics”
- Statistics Practical – II : Based on the course “Sampling Techniques”
- Computer Practical : Based on the course “Programming with C”
- Statistics Practical – III : Based on the course “Statistical Distributions” and “Probability Theory”
- Statistics Practical – IV : Based on the course “Demographic Methods” and “Time Series and Official Statistics”
- Statistics Practical – V : Based on the course “Statistical Inference – I” and Elective – II (Actuarial Statistics / Biostatistics)
- Statistics Practical – VI : Based on the course “Statistical Quality Control”
- Statistics Practical – VII : Based on the course “Statistical Inference – II”
- Statistics Practical – VIII : Based on the course “Design of Experiments”
- Statistics Practical – IX : Based on the course “Operations Research”

Note 2:

- Elective – I: Econometrics
Stochastic Processes
- Elective – II: Actuarial Statistics
Biostatistics
- Elective - III: Discrete Mathematics
RDBMS with ORACLE)

SEMESTER – III

3.1 Tamil / Other Languages-III

3.2 English-III

3.3 STATISTICAL DISTRIBUTIONS (Core-III)

Unit - I

Distributions of functions of one-dimensional and two-dimensional random variables – Distribution function method, Transformations and Moment generating function method.

Unit - II

Discrete distributions: Bernoulli, Binomial, Poisson, Geometric and Negative binomial distributions – Hypergeometric distribution, and discrete Uniform distribution - Multinomial distribution. Moments – probability generating function, moment generating function, characteristic function and properties.

Unit - III

Continuous distributions: Uniform, Normal, Cauchy and Lognormal distributions - concepts, moments, moment generating function, characteristic function and properties.

Unit - IV

Exponential, Gamma, Beta (first and second kinds) concepts, moments, moment generating function, characteristic function and properties.

Unit - V

Sampling distributions: *Chi-square*, *t* and *F* distributions- concepts, moments, moment generating function, characteristic function and properties.

BOOKS FOR STUDY:

1. Goon, A. M., M.K. Gupta, and B. Dasgupta (2002) Fundamentals of Statistics, Vol. I, (Third Edition), World Press Ltd, Kolkata.
2. Alexander, M. Mood, Franklin A. Graybill and Duane C. Boes (2017). Introduction to the Theory of Statistics (Third Edition), Mc Graw Hill Education, New Delhi.

BOOKS FOR REFERENCE:

1. Bhuyan K.C. (2010), Probability Distribution Theory and Statistical Inference, New Central Book Agency (P) Ltd., New Delhi.
2. Gupta, S. C., and V. K. Kapoor (2020) Fundamentals of Mathematical Statistics, (Twelfth Edition). Sultan Chand & Sons, New Delhi.
3. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.

4. Rohatgi, V. K. and A. K. Md. E. Saleh (2009). An Introduction to Probability Theory and Mathematical Statistics (Second Edition). John Wiley & Sons, New York.

3.4 PROBABILITY THEORY (Core-IV)

Unit - I

Probability: sample space – Events - algebraic operations on events- definition of probability - independent events – conditional probability - addition and multiplication theorems of probability – Bayes Theorem.

Unit - II

Random variables: Discrete and continuous random variables – distribution function - properties – probability mass function and probability density function – discrete and continuous probability distributions.

Unit - III

Multiple random variables: Joint, marginal and conditional distribution functions - independence of random variables.

Unit - IV

Mathematical expectation: Expectation – properties – Cauchy - Schwartz inequality, conditional expectation and conditional variance – theorems on unconditional and conditional expectation. Moment generating function, characteristic function, probability generating function and their properties. Chebyshev's inequality.

Unit - V

Limit Theorems: convergence in probability, weak law of large numbers – Bernoulli's theorem, Khintchine's theorem (statements only) - Central limit theorem.

BOOKS FOR STUDY:

1. Goon, A. M., M.K. Gupta, and B. Dasgupta (2002) Fundamentals of Statistics, Vol. I, (Third Edition), World Press Ltd, Kolkata.
2. Alexander, M. Mood, Franklin A. Graybill and Duane C. Boes (2017). Introduction to the Theory of Statistics (Third Edition), Mc Graw Hill Education, New Delhi.

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1. Bhuyan K.C. (2010), Probability Distribution Theory and Statistical Inference, New Central Book Agency (P) Ltd., New Delhi.
2. Gupta, S. C., and V. K. Kapoor (2020) Fundamentals of Mathematical Statistics, (Twelfth Edition). Sultan Chand & Sons, New Delhi.
3. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
4. Rohatgi, V. K. and A. K. Md. E. Saleh (2009). An Introduction to Probability Theory and Mathematical Statistics (Second Edition). John Wiley & Sons, New York.
5. Lipschutz, S. (2008) Probability Theory (Second Edition), Schaum's Outline Series, McGraw Hill, New York.

3.5 STATISTICS PRACTICAL - III (Core)

Based on the Core courses 3.3. Statistical Distributions and 3.4 Probability Theory.

3.6 MATHEMATICS -II (Allied-III)

Unit - I

Theory of Equations: Nature of roots, Formulation of equation whose roots are given. Relation between coefficients and roots - Transformation of equations - Reciprocal equations - Horner's method of solving equations.

Unit - II

Successive differentiation – Trigonometrical transformations - Leibnitz's Formulas, nth derivatives of standard functions - simple problems. Partial differentiation – Successive partial differentiation – Implicit functions – homogeneous functions – Euler's theorem.

Unit - III

Maxima and Minima for one variable – Applications – Concavity, Convexity and points of inflexion - Maxima and Minima for two variables – working rule.

Unit – IV

Linear differential equations of second order with constant coefficients - $(aD^2+bD+c)y = X$, various forms of $X : e^{ax}, \cos ax, \sin ax, x^m$. Methods of solving homogeneous linear differential equations of second order. Laplace transform and its inverse – solving ordinary differential equation with constant coefficients using Laplace transform.

Unit - V

Integration- Reverse process of differentiation – Methods of integration - Integrals of functions containing linear functions of x - Integrals of functions involving $a^2 \pm x^2$ - Integration of rational algebraic functions - $1/(ax^2+bx+c)$, $(px+q)/(ax^2+bx+c)$. Integration of irrational functions - $1/(ax^2+bx+c)^{1/2}$, $(px+q)/(ax^2+bx+c)^{1/2}$, $(px+q)\sqrt{(ax^2+bx+c)}$ - Integration by parts.

BOOKS FOR STUDY:

- 1.Narayanan,S., Hanumantha Rao and T.K. Manicavachagom Pillay (2008) Ancillary Mathematics, Volume I, S. Viswanathan Pvt. Ltd, Chennai.
- 2.Narayanan, S. and T.K. Manicavachagom Pillay (2008) Calculus Vol. II and III, S. Viswanathan Pvt. Ltd, Chennai.

BOOKS FOR REFERENCE:

1. P.Kandasamy, K.Thilagavathy (2003) Allied Mathematics Vol-I, II S.Chand & company Ltd., New Delhi-55.
2. P.Duraipandian and S.Udayabaskaran,(1997) Allied Mathematics, Vol. I & II. Muhil Publishers, Chennai
3. S.P.Rajagopalan and R.Sattanathan,(2005) Allied Mathematics .Vol. I & II. Vikas Publications, New Delhi.

3.7 MATHEMATICAL COMPUTATIONS USING R (Skill based Core)

UNIT-I

Introduction - History of R programming - R commands – Random numbers generation – Data Types – Objects – Basic data and Computations – Data input – Data frames – Graphics – Tables.

UNIT-II

Descriptive Statistics - Diagrammatic representation of data - measures of central Tendency - measures of dispersion - measures of skewness and kurtosis.

UNIT-III

Probability and probability distributions - problems on finding basic probabilities - some special discrete distributions – Bernoulli distribution - Binomial distribution – Poisson Distribution – Geometric Distribution.

UNIT-IV

Continuous distributions – Normal distribution – Uniform distribution – Gamma distribution – Exponential distribution - sketching graphs for various distributions.

UNIT-V

Correlation - inference procedure for correlation coefficient - bivariate correlation - multiple correlations - Linear regression and its inference procedure.

BOOKS FOR STUDY:

1. Normal Maltoff (2009) The art of R programming, William Pollock Publishers, San Fransisco.
2. Purohit S. G., Gore S. D. and Deshmukh S. K. (2010) Statistics using R, Narosa Publishing House Pvt. Ltd., New Delhi.
3. John Braun, W. and Duncan James Murdoch (2007) First Course in Statistical Programming with R, Cambridge University Press, UK.

BOOKS FOR REFERENCE

1. Ugarte, M. D., A. F. Militino, A. T. Arnholt (2008) Probability and Statistics with R, CRC Press, Taylor & Francis Group, London.
2. Peter Dalgaard (2008) Introductory Statistics with R, Springer India Private Limited, New Delhi.
3. Michael J. Crawley (2007) The R Book, John Wiley and Sons, New York.

3.8 ELEMENTS OF STATISTICS – I (Non-Major Elective)

UNIT I

Nature and scope of Statistics - characteristics and limitation of Statistics - statistical investigation - preparation of questionnaire - Population and Sample - collection of data - primary and secondary data.

UNIT II

Processing and presentation of data - Classification of data - tabulation of data - Formation of frequency tables - Diagrammatic presentation of statistical data - bar diagrams - pie diagrams and pictograms - simple problems - Graphical presentation of statistical data - Histogram, frequency curves - simple problems.

UNIT III

Measures of Central tendency: Arithmetic Mean, Median, Mode. Measures of Dispersion: Range, Inter-Quartile Range, Standard Deviation and Coefficient of Variation.

UNIT IV

Simple Correlation- Scatter diagram - Properties of coefficient of correlation- Kendall's coefficient of correlation -Partial and Multiple correlation coefficients. Regression -regression coefficients and their properties-regression equations- Simple problems.

UNIT V

Concept of Skewness and Kurtosis - Karl Pearson's and Bowley's coefficients of Skewness- moments- coefficients of Skewness and Kurtosis - simple problems.

BOOKS FOR STUDY:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017): Fundamentals of Statistics, Volume-I, World Press Ltd, Calcutta.
2. Gupta, S. C., and V. K. Kapoor (2020) Fundamentals of Mathematical Statistics, (Twelfth Edition). Sultan Chand & Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
2. Spiegel, M.R., Schiller, J. and Srinivasan, R.A. (2012): Probability and Statistics, Schaum's Outline Series (Fourth Edition). McGraw- Hill Publishing Company, New Delhi.

3.9 YOGA - (Common - Part-IV)

SEMESTER – IV

4.1 Tamil / Other Languages-IV

4.2 English - IV

4.3 DEMOGRAPHIC METHODS

Unit - I

Demography Data: Demography – definition-sources of demographic data - population census -demographic surveys - Registration method: vital registration - population register and other administrative records, registration of population in India.

Unit - II

Fertility: Fertility measurements – crude birth rates - general, specific and total fertility rates -gross and net reproduction rates and their interpretation.

Unit - III

Mortality: Mortality measurements: crude death rate - specific death rate - standardized death rate - infant mortality rate – maternal mortality rate – case fertility rate - comparative mortality index.

Unit – IV

Life Table and Migration: Description and construction of various columns of a life table and their relationships - uses of life table – migration-factors effecting migration - gross and net migration rates.

Unit - V

Population Growth: Population projection – population estimates and projection – arithmetic, geometric and exponential growth rates - logistic curve and its suitability for graduating population data - Basic ideas of stationary and stable population.

BOOKS FOR STUDY:

1. Gupta, S.C. and V.K. Kapoor (2015) Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
2. Parimal Mukopadhyay (1999). Applied Statistics. Books and Allied Private Limited, Kolkata.
- 3.V.C.Sinha E.Zacharia (2012) Elements of Demography, Allied Publishers, New Delhi.

BOOKS FOR REFERENCE:

1. Agarwala, S.N. (1991) Indian Population Problems, Tata Mc Graw Hill Publishing House, New Delhi.
2. Mishra, D.E. (1982) An introduction to the Study of Population, South India Publishers, Madras.

3. Hansraj, D.R. (1981) Fundamentals of Demography, Surjeet publications, New Delhi
4. Asha A. Bhende and Tara Karitkar (1994) Principles of Population Studies, Himalaya Publishing House Pvt Ltd., Mumbai.
5. Suddhendu Biswas and G. L. Sriwatav (2006), Stochastic Processes in Demography and Applications, New Central Book Agency, London.

4.4 TIME SERIES and OFFICIAL STATISTICS (Core-II)

Unit-I (Time Series)

Time Series – components of time series – additive and multiplicative models - Resolving components of a time series-measuring trend: Graphic, semi-averages, moving average and least squares methods.

Unit -II (Time Series)

Seasonal variation- measuring seasonal variation: method of simple averages, ratio-to- trend method, ratio-to-moving average method and link relative method- Cyclical and Random fluctuations- variate difference method.

Unit -III (Index Numbers)

Index numbers and their definitions - construction and uses of fixed and chain based index numbers - simple and weighted index numbers - Laspeyre's, Paasche's, Fisher's, and Marshall - Edgeworth index numbers – optimum tests for index numbers - Cost of living index numbers.

Unit -IV (Psychological Statistics)

Percentile curve and percentile ranks-their uses – combination and comparison of examination scores - Norms and scaling procedures-T and C scaling of tests - Reliability of measurements - method of measuring reliability – Internal consistency and reliability – item validity – special correlation methods.

Unit -V (Official Statistics)

Present official statistics system in India – Ministry of statistics – NSSO, CSO and their functions - Registration of vital events – National Income Statistics – Agricultural Statistics – Industrial Statistics in India – Trade Statistics in India – Labour Statistics in India – Financial Statistics in India.

BOOKS FOR STUDY:

- 1.. Gupta, S.C. and V.K. Kapoor (2007) Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
2. Parimal Mukopadhyay (1999) Applied Statistics. Books and Allied Private Limited, Kolkata.
3. Guilford, J. P. (1986) Fundamental Statistics in Psychology and Education, McGraw-Hill Book Company, New Delhi.
4. Srivastava, S. C. and S. Srivastava (2003) Fundamentals of Statistics, Anmol Publications Pvt. Ltd., New Delhi

BOOKS FOR REFERENCE:

1. Anderson, T. W. (2011). The Statistical Analysis of Time Series. John Wiley & Sons.
2. Box, G. E. P. and Jenkins, G.M. and Reinsel, G.C.(2013). Time Series Analysis – Forecasting and Control (Fourth Edition). Holden- Day, San Francisco.
3. Brockwell, P. J. and Davis, R. A. (2002). Introduction to Time Series and Forecasting. Taylor& Francis.
4. Chatfield, C. (1978). The Analysis of Time Series - Theory and Practice (Third Edition). Chapman and Hall, London.
5. Guide to Official Statistics (CSO) 1999.

4.5 STATISTICS PRACTICAL - IV (Core)

Based on the Core courses 4.3 Demographic Methods and 4.4. Time Series and Official Statistics

4.6 MATRIX THEORY (Allied-IV)

Unit - I

Matrix Algebra: Introduction – Operations on Matrices – Determinant of a Matrix – Adjoint and Inverse of a Matrix – Singular and Non-singular Matrices. Transpose of a matrix - Symmetric and Skew-symmetric Matrices – Conjugate of a Matrix – Hermitian and Skew – Hermitian matrices.

Unit - II

Rank of a matrix: Elementary transformations, Elementary matrices, Row and Column ranks – rank of a matrix. Invariance of rank through elementary transformations, Reduction to Normal form, Rank of sum and product of matrices, Equivalent matrices.

Unit - III

Characteristic Roots and Vectors: Matrix polynomials, Characteristic roots and Characteristic vectors, Cayley- Hamilton theorem, Minimal equation of a matrix.

Unit – IV

Orthogonal and Unitary matrices. Matrices and System of Linear Equations: Use of inverse of a matrix to find the solution of a system of linear equations - conditions for consistency of equations.

Unit - V

Quadratic Forms: Quadratic Form – Matrix of a quadratic form – rank, signature and classification of quadratic forms – Sylvester’s law of Inertia.

BOOKS FOR STUDY:

1. Vasishtha,A.R.(2014) Matrices, Krishna Prakashan, Meerut.
2. Shanthi Narayan. and Mittal,P.K. (2000) A Text Book of Matrices, S.Chand& Co, New Delhi.

BOOKS FOR REFERENCE:

- 1 Gentle, J.E. (2007) Matrix Algebra Theory, Computations, and Applications in Statistics, Springer, New York.
2. Richard Bronson. (2011) Matrix Operations, Schaum's Outline Series, McGraw Hill, New York.
3. Searle, S. R. (2006) Matrix Algebra useful for Statistics, Wiley Interscience, New York.

4.7 NUMERICAL METHODS (Skill Based Core)**Unit - I**

Solving algebraic equations: Bisection method, False position method, Newton - Raphson method. Simple problems and applications.

Unit - II

Gauss Elimination method, Gauss – Jordan, Gauss –Jacobi and Gauss- Seidel methods. Solving system of linear equations using Cramer's rule and inverse of matrix. Simple problems and applications.

Unit - III

Operators and differences: Operators – E , Δ , δ and ∇ - their relationship and their role in difference tables.

Interpolation: Solving problems for equidistant cases using Newton's forward and backward difference formulae. Lagrange's formula and Newton's divided difference formula for unequal intervals. Simple problems and applications.

Unit - IV

Numerical differentiation – Newton's forward and backward formulae – maxima and minima using numerical methods.

Unit - V

Numerical Integration: Quadrature rule- trapezoidal rule - Simpson's one - third rule and three-eighth rule – Gregory Formula, Newton – Cote's formula.

BOOKS FOR STUDY:

1. Sastry, S. S. (2012). Introductory Methods of Numerical Analysis (Fifth Edition). Prentice Hall of India, New Delhi.
2. Jain, M. K., S. R. K. Iyengar and R.K. Jain (2019). Numerical Methods for Scientific and Engineering Computation (Seventh Edition). New Age International (P) Ltd., New Delhi.

BOOKS FOR REFERENCE:

1. Atkinson, K. (2003). Elementary Numerical Analysis (Third Edition). John Wiley & Sons, New York.
2. Gerald, C. F. and P. O. Wheatley (2004) Applied Numerical Analysis (Seventh Edition). Pearson, New York.
3. James B. Scarborough, (2010). Numerical Mathematical Analysis (Sixth Edition). Oxford & IBH Publishing Co., New Delhi.

4.8 ELEMENTS OF STATISTICS – II (Non-Major Elective)

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 distribution

UNIT II

Random experiment - sample space - events - mathematical and empirical definitions of Probability - conditional probability – Bayes’ theorem - Random variable - Distribution function – moment generating function and their properties-simple problems.

UNIT III

Tests of significance - hypotheses - two types of errors - power function - critical region - level of significance. Chi-square test for goodness of fit. Chi-square test for independence of attributes.

UNIT IV

Small and Large sample tests: Test of significance of population mean when population variance is (i) known and (ii) unknown – Test of significance of equality of means of two normal populations when population variances are (i) known and (ii) common, but unknown.

UNIT V

Analysis of Variance: One-way classification – Two-way classification - Kruskal-Wallis test, Friedman’s test.

BOOKS FOR STUDY:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2017): Fundamentals of Statistics, Volume-I, World Press Ltd, Kolkata.
2. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2019): Fundamentals of Statistics, Volume-II (Fourth Edition), The World Press Pvt., Ltd, Kolkata.
3. Gupta, S.C. and V.K. Kapoor. (2020): Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

BOOKS FOR REFERENCE:

1. Robert, V. Hogg, Joseph W. McKean and Allen T. Craig (2013) Introduction to Mathematical Statistics (Seventh Edition), Pearson Education, New York.
2. Spiegel, M.R., Schiller, J. and Srinivasan, R.A. (2012): Probability and Statistics, Schaum's Outline Series (Fourth Edition). McGraw- Hill Publishing Company, New Delhi.

4.9 Computers for Digital Era - (Common - Part-IV)**4.10 NCC, NSS, YRC, YWF - (Extension Activity - Common - Part-V)**