M.Sc. Statistics

Course Title	:	**Probability Theory**	**Semester-1st for (PG)**
Course Code	:	**STA501C**	
Credit hrs.	:	**4**	

Course Objective: The main objective of this course is to introduce the notion of probability, random variable, expectation, Law of Large Numbers and the Central Limit Theorem with their applications based on which statistical theory and tools have been developed.

Course Outcomes: After successful completion of this course, student will be able to:
1. Recall concept of probability and related terminology.
2. Differentiate discrete and continuous random variables and their distributions.
3. Understand probability mass function, density function and distribution function.
4. Compute expectations of random variables and their generating functions
5. Learn the concepts of weak and strong laws of large numbers and central limit theorem.

Unit I: Random experiment, outcomes, sample space, events, axiomatic definition of probability measure, combination of events. Bonferroni and Boole inequalities. Independence of events. Sequences of events. Borel-Cantelli Lemma. Conditional probability, Bayes Theorem.

Unit II: Concept of a random variable and its probability distribution. Probability mass function and cumulative distribution function. Mixed distribution. Expectation of a random variable, properties of expectation, conditional expectation and its properties. Moments and variance. Properties of a cdf. Bivariate distributions and the joint probability distribution. Some Distributions and their Applications: Uniform (discrete and continuous), Bernoulli, Binomial, Poisson, Exponential, Normal.

Unit III Independence of random variables. Marginal and conditional distributions. Covariance and correlation coefficient. Moment generating function, probability generating function, cumulant generating function, characteristic function and their properties. Inversion, continuity and uniqueness theorems.

Unit IV: Markov, Tchebyshev, Holder and Jensen inequalities, Tchebychev and Khintchine weak laws of large numbers. Kolmogorov inequality (statement). Kolmogorov strong law of large numbers (statement). Central Limit Theorems

- Main References: • Introduction to Probability, by Dimitri P. Bertsekas and John N. Tsitsiklis. Athena Scientific.
- Probability – An Introduction, by Geoffrey Grimmett and Dominic Welsh, Oxford University Press.

References:
- Bhat, B.R. (1999): Modern Probability Theory, 2/e., New Age International, New Delhi.
- Rao B. L. S. Prakasa (2009): A First course in Probability and Statistics. World Scientific

- Meyer, P.A (1970). An Introduction to Probability and Its Applications. PHI
- John E Freund (2004): Mathematical Statistics with applications. 7/e, Upper saddle River, NJ: Prentice Hall. ISBN: 0131246461.
- Rohatgi V.K & A.K. MD. Ehsanes Saleh (2001): An Introduction to Probability Theory and Mathematical Statistics, 2nd. John Wiley and Sons.
- Wackerly D.D; Mendenhall III, William and Scheaffer, R.L.: Mathematical Statistics with applicable Duxbury, 2002.
- Hogg, R.V. and Craig, A.T. (1978): Introduction to Mathematical Statistics, 5/e, Pearsons Education.
- Dudewicz, E. J. and Mishra, S. N. (1988): Modern Mathematical Statistics, Wiley & Sons.
- Feller, W. (1968): Introduction to Probability and its Applications, Vol.1, Wiley Eastern.
- Gutt Allen, Probability (2010): A Graduate Course, Springer

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Course Title	:	Sampling Theory	*__Semester-1st__*
Course Code	:	STA502C	
Credit hrs.	:	4	

Objective: The main objective is to provide the knowledge of concept of sample and population in statistics and also the various sampling schemes. Estimation of population parameters and their respective standard errors.

Course Outcomes:
1. Upon successful completion of this course, the student will be able to:
2. Recall necessity of sampling techniques.
3. Understand various types of sampling schemes, their advantages, disadvantages, and estimation of population parameters.
4. Compare different sampling techniques.
5. Select appropriate sampling technique for different experimental scenario.
6. Conduct sample survey.

Unit I: Simple Random Sampling: Concept of sampling design, expected value and sampling variance of the sample mean, expected value of the sample mean square and estimation of the variance. Determination of sample size. Stratified random Sampling: Estimation of the population mean/total and its variance, choice of sample sizes in different strata, variance under different allocations. Comparison with unstratified sampling. Estimation of the gain in precision due to stratification, construction of strata.

Unit II: Ratio and Regression methods of Estimation: Variance of the estimates, estimation of variances, optimum property of ratio and regression estimator. Ratio and regression estimator in stratified random sampling. Some modifications of ratio and regression estimators. Comparison among regression, ratio and simple unbiased estimates. Unbiased ratio type estimates.

Unit III: Systematic Sampling: Sample mean and its variances. Comparison of systematic with simple random and stratified sampling in the general case and also in the case of linear trend. Cluster sampling with equal and unequal cluster sizes, relative efficiency with SRS and optimum cluster size.

Unit IV: Double Sampling: Double Sampling for Stratification including estimation of variance. Variance of ratio and regression estimates in double sampling. Double sampling for pps estimation. Sampling on successive occasions: Sampling on two occasions, estimation of current population mean. Two-stage sampling: (a) Equal first stage unit; estimation of population mean and its variance and estimates of variance. Comparison with one stage sampling (b) Unequal first stage unit; estimation of population mean. Expected values and variance of different estimates including the case of probability proportional to size

References:

- Sukhatme, P.V., Sukhatme, B.V., Sukhatme,S. and Asok, C. (1984): Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.
- Cochran, W. G: Sampling Techniques, 3rd edition, John Wiley and Sons.
- Mukhopadhyay, P. (2000): Theory and Methods of Survey Sampling, Prentice Hall of India, Private limited, New Delhi
- Des Raj & Chandak(1998): Sampling Theory, Narosa.
- Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
- Skate teal (1984): Sampling Theory of Surveys with Applications, Iowa State University Press, & IARS.
- S.C. Gupta and V.K. Kapoor (1984): Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
- Singh, D and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Design, New Age International Publisher.

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Course Title	:	Descriptive Statistics	**Semester-1st**
Course Code	:	STA503E	
Credit hrs.	:	3	

Objective: The main objective of this paper is to make students understand descriptive statistical methods for doing statistical analysis.

Course Outcomes:
1. Upon successful completion of this course, the student will be able to:
2. Understand and apply measures of central tendency and dispersion measures.
3. Understand graphical techniques for presentation of data.
4. Understand the concept and significance of index numbers, including various types such as price indices, quantity indices, and value indices.

Unit I: Statistics a conceptual frame work, Statistical enquiry, collection of data, classification and tabulation of data. Diagrammatic and Graphic presentation of data.

Measures of central tendency: Mean, median, mode, geometric mean and harmonic mean. Characteristics of a good average

Unit II: Measures of dispersion: range, mean deviation, quartile deviation, standard deviation, coefficient of variation. Moments. Measure of skewness- Karl-Pearson's and Bowley's methods. Measures of Kurtosis. Sheppard's corrections.

UNIT III: Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers, conversion of fixed based to chain based index numbers and vice-versa. Consumer price index numbers, Whole sale price Indix.

Text Books:

1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S : *Statistics: A Beginner's Text*, New Age International (P) Ltd**.**
2. Croxton F. E, Cowden D.J and Kelin S : *Applied General Statistic*, Prentice Hall of India.

References:

1. Spiegel, M.R.: *Theory & Problems of Statistics*, Schaum's Publishing Series
2. Gupta, S.C. and Kapoor, V.K.: *Fundamentals of applied Statistics*. Sultan Chand and sons.
3. S.P.Gupta: Statistical Methods. Sultan Chand and sons.
4. Verma A.P. Business *Mathematics & Statistics,* Asian Books Private Ltd
5. Anderson T.W and Sclove S.L: *An introduction to the Statistical Analysis of Data*, Houghton Miffin/Co.
6. Cooke, Cramer and Clarke : *Basic Statistical Computing*, Chapman and Hall.

7. Mood A.M. Graybill F.A and Boes D.C. : *Introduction to the Theory of Statistics*. Tata McGraw Hill Pub.
8. Ellance D N, Veena Elhance & Aggarwal B. M : *Fundamentals of Statistics* , Kitab Mahal.
9. Goon A.M., Gupta M.K. and Dasgupta B.: Fundamentals of Statistics, Vol. I& II. World Press, Kolkata.
10. Miller, I. and Miller, M.: John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
11. Rohatgi V. K. and Saleh, A.K. Md. E.: *An Introduction to Probability and Statistics*. 2nd Edn. (Reprint), John Wiley and Sons.
12. Gupta S.C.: Fundamentals of Statistics, 6th Edn., Himalaya Publishing House.

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Course Title	:	Linear Algebra	*Semester-1ˢᵗ*
Course Code	:	MTH501E	
Credit hrs.	:	3	

Objective: The main purpose is to provide mathematical foundation for statistics courses to enhance their knowledge in Linear algebra.

Course Outcomes:

1. Students will develop a thorough understanding of fundamental linear algebra topics such as vector spaces, matrices, determinants, eigenvalues, and eigenvectors, which are required for further studies in mathematics and related subjects.
2. Students will master key operations such as matrix multiplication, row reduction and discovering inverses as well as how to solve systems of linear equations which will help them improve their problem-solving and analytical skills.
3. Students will be able to apply linear algebra concepts to real-world issues in physics, engineering, computer science, economics, and other subjects, illustrating the subject's widespread relevance and usefulness.

Unit I: Introduction to systems of linear equations, Gauss-Jordan elimination, matrices and matrix operations, transpose and adjoint of a matrix, inverses, diagonal, triangular and symmetric matrices, determinants, cofactor expansion, row reduction.

Unit II: Euclidean n-space, linear transformations on n-spaces, vector spaces, subspaces, linear independence, basis and dimension, row space, column space, null space, rank and nullity. change of basis. Inner products, orthogonality, orthonormal bases, Gram-Schmidt process, orthogonal transformation.

Unit III: Eigenvalues and eigenvectors, Algebraic and geometric multiplicity of an eigenvalue. Cayley-Hamilton theorem. Diagonalization, orthogonal diagonalization. Real Quadratic forms, reduction and classification of quadratic forms

Textbooks: Linear Algebra by Jim Hefferon

- Elementary Linear Algebra by Howard Anton and Chris Rorres
- Linear Functions and Matrix Theory by Bill Jacob
- A Textbook on Matrices by Hari Krishen
- Linear Algebra – Schaum's Outline Series
- Linear Algebra and its Applications by David C. Lay, Springer
- Linear Algebra and its Applications by Gilbert Strang Thomson Learnin

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Course Title	:	Computer Fundamentals	*Semester-1ˢᵗ*
Course Code	:	CSC501F	
Credit hrs.	:	3 (2+1)	

Course Objective: The course provides basic knowledge of computer fundamentals and fundamentals of problem solving techniques.

Unit-I:
Computer Components, Characteristics and Classification of Computers, Hardware and Software, Peripheral devices, System Software, Application Software, Utility program, Compiler, interpreter, Assemblers. Evolution of programming languages.

Unit-II:
Linux Introduction: History, Difference between Linux and Windows, GNU, Usage, Various Linux Distributions, Installation of Linux, Architecture of Linux, Basic Commands in Linux, Introduction to Vi Editor, Understanding Files and Directories, Software Installation in Linuxs.
.
Unit-III:
Structure of C Program, Identifiers, Keywords, Data Types, Constant and Variables, Operators: Precedence and Associativity, Expressions, Statements, Input and Output functions, Storage Classes.

Unit-IV:
Control Structures: Branching and Looping, One Dimensional Array, Multidimensional Array and their Applications, Library and User Defined Functions

R**eference books:**

- Computer Fundamentals and Programming in C – Pradip Dey & Manas Ghosh, Second Edition, 2013, OXFORD University Press.
- Programming in ANSI C - E. Balaguruswami, Sixth Edition, TMH
- Programming in C – Byron Gottfried, Third Edition, 2010, TMH
- Richard Petersen, "*Linux:The Complete Reference*", 6ᵗʰ Edition , Tata McGraw – Hill,2007.
- Mark G. Sobell. "*Priactical Guide to Fedora and Red Hat Enterprise Linux"*, 6ᵗʰ Edition, Prentice Hall, 2011

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Course Title	: Communication Skills	***Semester-1st***
Course Code	: ENG501F	
Credit hrs.	: 3	

Course Objective: The aim of this course is to introduce the students an overview of prerequisites to business and organizational communication.

Unit-I - English Language Skills

Introduction to phonetic sounds and transcription of words. Enriching vocabulary, word formation: prefixes and suffixes, Homophones, Antonyms, Synonyms, Idioms and phrases, one word substitution. Tenses, Reported speech, Concord, Articles.

UNIT II- Technical Writing

Characteristics of technical writing. Difference between technical writing and general writing. Essentials of strong writing skills. Report writing: structure, style and drafting of different types of reports. Proposal writing, Writing Research papers, avoiding plagiarism

Unit III – Business Correspondence

Ramification of business letters, analyzing audience, purpose, layout & form and types. CV/Resume writing and cover letter.

Textbooks:
- Battacharaya, Indrajit. An Approach to Communication Skills. New Delhi: Dhanpat Rai and Co, 2002.
- Chaturvedi, P.D and Mukesh Chaturvedi. Business Communication, Delhi: Pearson Education, 2006.
- Kumar, Sanjay and Pushp Lata. Communication Skills. India: OUP, 2011.
- Mohan, Krishna and Meera Bannerji. Developing Communication Skill, Delhi: Macmillian, 1990
- O'Connor, J.D. Better English Pronunciation. London: Cambridge University Press, 1985.
- Raman, Meenakshi and Sangeeta Sharma. Technical Communication: Principles and Practice. India: OUP, 2011.
- Roach, Peter. English Phonetics and Phonology. London: Cambridge University Press, 2000.
- Taylor, Shirley. Communication for Business. New Delhi: Pearson Education, 1988.

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Course Title	**:**	**Practical**	**Semester-1st**
Course Code	**:**	**STA500C**	
Credit hrs.	**:**	**2**	

Objective:
The main objective is to enhance the practical knowledge of the students in the courses sampling theory and probability theory.

Course Outcome:
1. Learning to perform statistical computation using any statistical software (Sampling Theory and Probability Theory).

Practical's based on STA501C and STA502C