

M.Sc. Statistics

Course Title : Probability Theory
Course Code : STA501C
Credit hrs. : 4

Semester-Ist

Course Objective: The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.

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.

Other 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.

M.Sc. Statistics

Course Title : Sampling Theory
Course Code : STA502C
Credit hrs. : 4

Semester-1st

Course Objective: The aim of the course is to give students in-depth knowledge of sampling theory and its practical usage in various applied fields. The course covers the most commonly used sampling designs: simple random sampling, stratified sampling, cluster sampling, multistage sampling and systematic sampling, and to some limited extent non-random sampling designs. The course provides useful knowledge about planning and assessing different types of surveys designs.

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.
- Singh, D and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Design, New Age International Publisher.

M.Sc. Statistics

Course Title	: Descriptive Statistics	<i>Semester-1st</i>
Course Code	: STA503E	
Credit hrs.	: 3	

Course Objective: The students will get overview of basic statistical concept and measurements. The students will be able to manage quantitative and quantitative data materials and also will be able to calculate the descriptive statistics from real data sets, its presentation and interpretation.

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 Index.

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 Mifflin/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.

M.Sc. Statistics

Course Title : Linear Algebra
Course Code : MTH501E
Credit hrs. : 3

Semester-1st

Course Objective: Introduce students the use of computational techniques and algebraic skills essential for the study of systems of linear equations, matrix algebra, vector spaces, eigenvalues and eigenvectors, vectors and basic vector operations and solving computational problems of linear algebra.

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 Learning

M.Sc. Statistics

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

Semester-Ist

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 Linux.

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

Reference 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

M.Sc. Statistics

Course Title : Communication Skills
Course Code : ENG501F
Credit hrs. : 3

Semester-Ist

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.

M.Sc. Statistics

Course Title : Practical
Course Code : STA500C
Credit hrs. : 2

Semester-Ist

Course Objective: The aim of this course is to introduce the students the practical usage of probability theory, sampling theory and descriptive statistics.

1. Generation of random sample from Binomial, Poisson, Uniform, Exponential and Normal distributions. Stem and Leaf plots and Box plots for these random samples.
2. Fitting of real datasets through Uniform (discrete), Bernoulli, Binomial and Poisson.
3. Fitting of real datasets through Uniform (continuous), Exponential and Normal.
4. CLT for binomial and Poisson distribution. (Generate samples, compute their means and draw histogram along with normal curve; normal probability plot).
5. Compute cdf $F(x) = p(X \leq x)$ for random sample of observations drawn from theoretical distributions.
6. Enumerating all possible samples with and without replacement method through software packages (Ordered and unordered) and testing unbiasedness of mean.
7. Obtain sampling distribution of sample mean and sample variance.
8. Variance under SRSWOR in comparison to variance under SRSWR based on random generated data.
9. Unbiasedness of sample variance under SRSWOR and SRSWR.
10. Draw histogram for equal/unequal width class interval, Stem and Leaf plot, Box plot frequency polygon, pie chart, bar graphs, line charts, Ogive.
11. Construct frequency table using recode (having equal and unequal interval) and visual binning.
12. Compute descriptive statistics for raw data and grouped data and interpret by computing coefficient of variation, skewness and kurtosis.