

University of Dhaka
Department of Statistics
Syllabus for 4-year B.S. (Honors) for affiliated colleges
Starting Sessions: 2017-2018

The year-wise distribution of credits is as follows:

First Year	:	32 credits
Second Year	:	36 credits
Third Year	:	32 credits
Fourth Year	:	34 credits
Total:		138 credits

List of Courses

FIRST YEAR

Paper Code	Paper Title	Credits
Stat H-101	Introduction to Statistics	4
Stat H-102	Introduction to Probability & Probability Distribution	4
Stat H-103	Linear Algebra	4
Stat H-104	Fundamentals of Mathematics	3
Stat H-105	Calculus	4
Stat H-106	Principles of Economics	3
Stat H-107	Lab I : Basic Statistics & Distribution Fitting	2
Stat H-108	Lab II: Linear Algebra	2
Stat H-109	Viva Voce	2
211501	History of the Emergence of Independent Bangladesh	4
	Total	32

Stat H-101: Introduction to Statistics

4 Credits

Definitions of statistics - its nature and characteristics, population and sample, descriptive and inferential statistics, scope and applications of statistics, abuse of statistics. Some key terms and mathematical notations.

Measurement scales and variable. Types and classification of variables. Classification of categorical variables. Data: types of data, sources of data. Data collection tools, questionnaire and schedule, construction of questionnaire, principles and other problems of data collection.

Data Classification: The smallest unit of data and its use, nominal class limits, actual class limits, number of classes, equal and unequal class intervals.

Data presentation in Tables: Construction of table: univariate table (categorical), cross-table. Frequency distribution table.

Graphical presentation of data: Details of different types of graphs and charts with their relative merits and demerits.

Characteristics of statistical data: Concept and measures of central tendency, Concept and measures of dispersion, Concept and measures of location, Quantiles, percentile rank and its use. Concept and measure of skewness and kurtosis. Moments, types of moments, general relations between moments and their uses. Detailed properties of these measures, interpretations of data with these measures.

Concept of explorative data analysis, stem-and-leaf plot, Box plots, outliers and 5-number summaries.

Correlation analysis: Bivariate data, scatter diagram, construction of bivariate frequency distribution table. The simple correlation, rank correlation, Kendall's Tau correlation, Properties of correlation, Correlation ratio and intraclass correlation.

The simple regression: Basic concept of regression, regression model, estimation of parameters (OLS method) in regression model, properties of estimators, interpreting the constants.

References

1. Larson, R. and Farber, B. (2003), *Elementary Statistics*, Prentice-Hall, Inc.
2. Mostafa, M.G., *Methods of Statistics*.
3. Newbold, P., Carlson, W.L. and Thorne, B. (2007), *Statistics for Business and Economics*, Fifth Edition, Prentice-Hall, Inc.
4. Islam, M.N. (2010), *An Introduction to Statistics and Probability*, Book World, Dhaka.
5. Jalil, M A and Ferdous, R. (1999), *Basic Statistics Methods and Applications*, Robi Publications.
6. Steel, R.G.D., Torrie, J.H. and Dickey, D.A. (1997), *Principles and Procedures of Statistics*, 3rd Ed.
7. Wesis, N. (2007) *Introduction to Statistics*, 7th edition, Addis Wiley.
8. Tukey, J. (1977) *Exploratory Data Analysis*, Wiley, N.Y.

Stat H-102: Introduction to Probability and Probability distribution

4 credits

Elements of set theory: Fundamentals of set, operations with set, laws of set.

Elements of probability: Experiment, random experiment, sample space, events, event space, union and intersection of events, different types of events.

Basic concepts of probability: Different approaches of defining probability – classical, axiomatic, empirical and subjective, laws and theorems of probability, conditional probability, Bayes' theorem and its uses and importance in statistics.

Random variable and its probability distribution: Discrete and continuous random variables, probability mass function, probability density function, distribution function, function of random variable and its distribution, joint distribution, marginal and conditional distributions, independence of random variables.

Mathematical expectation: Concept, expectations of sums and products of random variables, conditional expectation and conditional variance, moments and moment generating functions, cumulants and cumulant generating functions, relation between moments and cumulants, probability generating functions, characteristic function.

Some basic distributions: Detailed study of binomial, Poisson, normal, uniform, geometric, negative binomial, hypergeometric, exponential, gamma, beta distributions.

References

1. Hoq, S. (1996), *Probability: An Introduction*.
2. Roy, M.K. (1996), *Fundamentals of Probability and Probability Distribution*.
3. Islam, M.N. (2010). *An Introduction to Statistics and Probability*, Book World, Dhaka.
4. Uspensky, J.V., *Introduction to Mathematical Probability*.
5. Cramer, H., *The Elements of Probability*, Wiley and Sons, N.Y.
6. Feller, W., *Introduction to Probability Theory and Its Applications*, Wiley and Sons, N.Y.
7. Ayres, F., *Set Theory*, Schaum Series, McGraw-Hill.
8. Patel, K., Kapadia, and Owen, D.B., *Handbook of Statistical Distributions*.
9. Parzen, E., *Modern Probability and its Application*, Wiley and Sons, N.Y.
10. Meyer, *Probability*, Addison-Wesley, Mass., U.S.A.
11. Rohatgi and Saleh, *An introduction to probability and statistics*.
12. Hogg and Tanis (2001): *Probability and Statistical inference*, 6th ed. Prentice Hall, N.Y.
13. Ross, S. (2008). *A First Course in Probability*, Pearson.

Stat H-103: Linear Algebra

4 credits

Vector and Vector Space: Definition of a vector, different types of vectors, geometrical interpretation, length and angle between two vectors, operation with vectors, vector set, linearly dependent and independent set of vectors, sweepout method, orthogonal set, normalization, Gram-Schmidt orthogonalisation process, subset and superset of vectors, related theorems. Spanning set of vectors, vector spaces and sub-spaces, their geometric interpretation, rank and basis of vector spaces and sub-spaces, orthogonal and orthonormal basis, related theorems.

Determinants: Matrix and vector, square matrix and determinants, ideas of minors and co-factors, product of determinants, properties of determinants, different types of determinants, solution of equations with the help of determinants, evaluation of $n \times n$ determinants.

Matrices and Special types of Matrices: Different types of matrices, definitions with examples, matrix operations, properties of such operations, rank and elementary transformation of matrices, diagonal reduction of a matrix, related theorems of ranks, trace of a matrix, its properties with proofs. Orthogonal matrices - definition with examples, their properties with proofs; idempotent and nilpotent matrices - definition with examples, their properties with proofs; patterned matrices - definition, examples, their properties, rank; Hadamard matrix - definition with example and properties.

Inverse of a matrix: Definition with examples, different methods of finding inverse of a matrix, properties of such inverses with proofs.

Rank of a Matrix: Elementary transformation. Related theorems of Ranks.

System of linear equations: Introduction, types of linear equations - homogeneous system, non-homogeneous system, consistent and inconsistent unique solution, different methods of solution of such equations: Gaussian elimination. Cramer's rule, sweep-out method, using matrix inverse, related theorems on system of linear equations.

Generalised inverses (g-inverses): Definition, methods of finding g-inverses, properties of g-inverses existence, uniqueness, other properties, kinds of g-inverses, application of g-inverses in the solution of system of equations.

Quadratic forms: Definition with examples, classification of quadratic forms, latent roots and latent vectors of matrices, canonical form of a quadratic form, rank, index and signature, eigen values, eigen vectors and quadratic forms.

Characteristics roots and vectors and theorems.

Differentiation involving vectors and matrices, linear transformation.

References

1. Hadley, G. (1993), *Linear Algebra*, Narosa, New Delhi.
2. Santinarayan, (1985), *A Text Book of Matrices*, 8th Ed., S. Chand and Co., New Delhi.
3. Anton, H. and Rorres, C. (2005): *Elementary Linear Algebra*, 4th edition, Wiley.
4. Rahman, A. (2006), *College Linear Algebra*.
5. Searle, S.R. (1982), *Matrix Algebra useful for Statistics*, Wiley, N.Y.
6. Graybill, A. (1982), *Matrices with Application in Statistics*, Wadsworth & Co. 2nd Ed., N.Y.
7. Searle, S.R., *Linear Models*, Wiley, N.Y.
8. Rao, C.R. and Mitra, *Generalised Inverses and Its Applications*.
9. Franklin, A.B., *Matrices with Applications in Statistics*, Wordsworth International Group.
10. Schaum Series (1981), *Linear Algebra*.
11. Aitken, A.C. (1982), *Determinant and Matrices*, Oliver and Boyd, London.

StatH-104: Fundamentals of Mathematics

3 Credits

Set Theory: Sets and subsets. Set operations. Family of sets. De Morgan's laws. Relations and functions: Cartesian product of sets. Relations. Equivalence relations. Functions. Images and inverse images of sets. Injective, subjective and bijective functions. Inverse functions, logic.

The Real number system: Field and order properties. Natural numbers, integers and rational numbers. Absolute value. Basic inequalities, (including inequalities involving means, powers; inequalities of Cauchy, Chebyshev, Weierstrass).

The complex number system: Geometrical representation Polar form. Field of complex numbers. De Moivre's theorem and its applications.

Elementary number theory: Divisibility. Fundamental theorem of arithmetic. Congruence's (basic property)

Summation of finite series: Arithmetic-geometric series. Method of difference. Successive differences.

Theory of equations: Synthetic division, Number of roots of polynomial equations. Relations between roots and coefficients. Multiplicity of roots. Symmetric functions of roots. De Cart's rule of signs. Transformation of equations.

Geometry: Graphical solutions of simultaneous, quadratic and cubic equations, graphs of logarithmic, exponential, conic functions, graphs of basic probability distribution etc. Convergence and divergence of a series. Different tests for convergence, Absolute convergence etc.

References

1. John Bird (2005): Basic Engineering Mathematics 4th ed. Elsevier, Amstendam.
2. Ayres, F(1995). Theory and Problems of modern Algebra, McGraw-hill.
3. S.Lipschutz, Set Theory, Schaum's Outline Series.
4. S. barnard& J.M. Child, Higher Algebra.
5. W.L. Ferrar, Algebra.
6. P.R. Halmos, Naïve Set Theory.
7. Durall& Robson, Differential Calculas.

Stat H-105: Calculus

4 Credits

Group A: Differential Calculus

Functions and their graphs (polynomial and Rational functions, logarithmic and exponential functions, trigonometric functions and their inverses, hyperbolic functions and their inverses, combination of such functions). Limits of Functions: definition. Basic limit theorems (without proofs). Limit at infinity and infinite limits. Continuous functions on closed and boundary intervals (no proofs required). Differentiation: Tangent lines and rates of change. Definition of derivative. One sided derivatives. Rules of differentiation (with applications). Linear approximations and differentials. Successive differentiation. Leibnitz theorem. Rolle's theorem. Lagrange's mean value theorems. Extrema of functions, problems involving maxima and minima.

Vector-valued functions of a single variable: Limits, derivatives and integrals of vector valued functions. Tangent lines to graphs of vector valued functions. Curvature of plane and space curves. Partial differentiation: Functions of several variables. Limits and continuity. Partial derivatives with constrained variables. Directional derivatives; gradient vectors and tangent planes.

Taylor's formula (in one and in several variables). Extrema of functions of several variables, Lagranges multiplier.

Examples of applications in Statistics.

Group B: Integral Calculus

Antiderivatives and indefinite integrals. Techniques of integration. Definite integration using antiderivatives.

Definite integral as a limit of a sum. The fundamental theorem of calculus. Integration by reduction. Application of integration: Plane areas. Solids of revolution. Volumes by cylindrical shells. Volumes by cross-sections. Arc length and surface of revolution. Multiple integrals: Double and triple integrals; and iterated integrals. Area as a double integral. Double integrals in polar form. Volume as a triple integral. Triple integral in cylindrical and spherical polar coordinates.

General multiple integrals. Change of variables in multiple integrals. Jacobians. Examples of applications in statistics.

References

1. Stewart, J (2006): Calculus: early transcendental (Stewart's calculus series)
2. Rdwanls,J(1994) Differential Calculus, Macmillan,London.5th edition, Wiley.
3. H. Anton et al, Calculus with Analytic Geometry.
4. E.W. Swokowski, Calculus with Analytic Geometry.
5. L. Bers&P.Karal, Caqlculus.

6. S. Lang, A first Course in Calculus.
7. S. Lang, Calculus of several variables.

Stat H-106: Principles of Economics

3 Credits

Basic Concepts: definition and scope of economics, basic economic problem: scarcity and choice, opportunity cost, the question of what to produce, how to produce and how to distribute output, production possibility frontier, economic systems – definition and examples of command economy, market economy and mixed economy; microeconomics and macroeconomics; normative economics and positive economics.

Demand and supply: definition, factors influencing them, demand and supply schedules & curves, law of demand, market demand and market supply, law of supply, movements along and shifts in demand curve, shifts in supply curve, market equilibrium, application of demand and supply.

Elasticity: elasticity of demand and supply - concepts, definitions and problems associated with calculations, price elasticity, income elasticity and cross elasticity of demand, factors influencing them, types of demand curves depending on elasticity of demand, computation of elasticity from demand function and family budget data.

Consumer behaviour and utility: basic concepts, ordinal and cardinal measurements of utility, total utility and marginal utility, law of diminishing marginal utility, utility maximization, determination of demand function from utility function and budget constraint. Substitution and income effects and the law of demand. Slutsky equation, diamond-water paradox.

The indifference curve analysis: Concepts, consumer's indifference curve: properties, rate of commodity substitution. Consumer's equilibrium, effects of income and price change on equilibrium.

Overview of Macro Economics: Objective and instruments of macroeconomics. National income accounting, GDP, problem of double counting net domestic product, gross national product, from GDP to disposable income. Net economic welfare (NEW).

Growth and Development: Economic development and economic growth, Measurement of economic development, obstacles to economic development.

Money: Definition and functions of money, Importance of money in modern economy- Different concepts of money (M1, M2, M3). Value of money.

Concept: Inflation. Causes and effects of inflation and deflation.

Concept: Perfect Competition, monopoly, pure monopoly, oligopoly, duopoly, return to scale, short run, long run.

Text

Samuelson, P.A. and Nordhaus, W.D., *Economics*, 16th Ed., McGraw-Hill Inc.

References

1. Dr. H. L. Ahuja, *Principles of Economics*, 18th Edition.
2. Lipsey, R.G. and Crystal, K.A., *An Introduction to Positive Economics*, Oxford University Press.
3. Colander, C., *Microeconomics*, 3rd Ed.
4. Ferguson, C.E. and Gould, J.P., *Microeconomic Theory*.
2. Samuelson, P.A., *Economics*, 10th Ed., McGraw-Hill Inc.
3. Varian, H.R., *Intermediate Microeconomics: A Modern Approach*, 3rd Ed., W.W. Norton & Company.

Stat H-107: Lab I: Introduction to statistics and Distribution fitting

2 Credits

Introduction to Statistics

Condensation and tabulation of data. Formation of frequency distribution from both qualitative and quantitative data. Construction of bivariate table. Graphical representation of data. Measures of location and dispersion, Calculation of moments, Measures of skewness and kurtosis. Simple correlation coefficient and fitting of regression lines. Computation of rank correlation coefficient. Computation Ratio and Intraclass correlation.

Exploratory data analysis: Stem and leaf plot, Box plot.

Distribution fitting

Fitting of Binomial distribution, Poisson distribution and Normal distribution.

Stat H-108: Lab II: Linear Algebra

2 Credits

Vector: Rank Basis, Dimension & Orthogonal vectors by the Gram-Schmidt Orthogonalization process, Orthonormal vectors, Linear dependence and independence of vectors etc.

Linear Algebra: Rank of a Matrix, Transpose, Determinant, Inversion, Trace, Solutions of Simultaneous Equations, Quadratic Form, Latent Roots and Latent Vectors of the matrix.

Stat H-109 Viva voce

2 Credits

Affiliated Colleges under Dhaka University
Syllabus for First Year BS (Honors)
Subject: Statistics (Non-Major)
Session: 2017-2018

Paper Code	Stat. NM- 101	Marks: 50	Credits: 02	Class Hours: 30
Paper Title:	Introduction to Statistics			

Descriptive Statistics: Statistics- Definition, scope and uses. Variable and its type, Qualitative and Quantitative data, Data Classification, and frequency distribution, Graphical representation of data, Measure of location, Measures of Dispersion, Moments types of moments, general relations between moments and their uses, Shape characteristics, Mathematical relationship among different measures of location, dispersion, Skewness and kurtosis. Different measures of Skewness and Kurtosis.

Concept of explorative data analysis, stem-and –leaf plot, Box plots, outliers and 5-number summaries.

Relationship between Variables: Bivariate Data, Scatter diagram, Simple correlation, Rank correlation. Simple regression and methods of least squares and estimation of parameters.

Books Recommended:

1. Yule and Kendall : Introduction to Theory of Statistics.
2. Islam, M. Nurul. : An Introduction to Statistics and Probability.
3. Jalil A. and Ferdous R. : Basic Statistics.
4. Mostafa M.G. : Methods of Statistics.
5. David E.N. : Probability Theory for Statistical Methods.
6. Weatherburn C.F. : A First Paper in Mathematical statistics.
7. Mosteller, Roure and Thomas : Probability with Statistical Applications.
8. Ali A. : Theory of Statistics Vol. I

Paper Code	Stat. NM- 102	Marks: 50	Credits: 02	Class Hours: 30
Paper Title:	Introduction to Probability			

Meaning of probability, Classical and empirical definitions of Probability, Axiomatic approach to probability, Event, Sample space and simple problems of probability, Addition rule, Conditional probability, Multiplication rule and Bayes' theorem, The concept of a random variables, Discrete and continuous random variables, Probability function and probability density function, Joint probability function. Marginal and conditional distributions, Statistical independence, Expected value and related theorems, Moment generating function.

Common probability distributions, Binomial, Poisson and Normal.

Books Recommended:

14. Hoq, S. (1996), *Probability: An Introduction*.
15. Roy, M.K. (1996), *Fundamentals of Probability and Probability Distribution*.
16. Islam, M.N. (2010). *An Introduction to Statistics and Probability*, Book World, Dhaka.
17. Uspensky, J.V., *Introduction to Mathematical Probability*.
18. Cramer, H., *The Elements of Probability*, Wiley and Sons, N.Y.
19. Feller, W., *Introduction to Probability Theory and Its Applications*, Wiley and Sons, N.Y.
20. Ayres, F., *Set Theory*, Schaum Series, McGraw-Hill.
21. Pattel, K., Kapadia, and Owen, D.B., *Handbook of Statistical Distributions*.

Paper Code	Stat. NM 103 (Lab)	Marks: 50	Credits: 02	Class Hours: 30
Paper Title:	Statistics Practical-I			

Condensation and tabulation of data, Graphical representation of data, Frequency table, Measures of location, Dispersion, Moments, Skewness and Kurtosis, measures of correlation coefficient, Rank correlation, Fitting of simple regression lines, Fitting of Binomial, Normal and Poisson distributions.