

Affiliated Colleges Under Dhaka University
Subject: Statistics
Syllabus for Second Year B.S. (Honors)
Starting Sessions: 2017-2018 (DU Admission)

Second Year: Total Credits = 30

List of Courses

Paper Code	Paper Title	Credits
Stat H-201	Theory of Estimation	4
Stat H-202	Sampling Distribution and Order statistics	4
Stat H-203	Elementary Sample Survey	2
Stat H-204	Economic Statistics & Index Number	4
Stat H-205	Mathematical Methods	4
MAM-201	Calculus- II	2
MAM-202	Ordinary Differential Equation	2
Stat H-206	Lab III: Sample Survey & Estimation	2
Stat H-207	Lab IV: Economic Statistics & Index numbers	2
Stat H-208	Lab V: Numerical Mathematics	2
Stat H-209	Viva Voce	2
	Total	30

Detailed Syllabus for 2nd Year BS (honors)

Stat H-201: Theory of Estimation

4 Credits

Concept of statistical inference: Introduction to Estimation Theory, Problem of estimation, Types of Estimation

Methods of finding Point estimators: Method of moments, Method of Maximum likelihood, Method of Least Squares, Method of minimum distance and Bayes estimation method. Properties of estimators obtained using different methods.

Criteria of a good estimator: Unbiasedness, Mean Squared Error (MSE), Cramer Rao Inequality, Use of Cramer Rao inequality, Rao Blackwell theorem in finding UMVUE, MVB estimator, Efficient estimator, Consistency.

Sufficiency: Sufficiency, Factorization theorem, Application and examples. Families of distributions, exponential family etc., Minimal sufficiency and complete sufficiency, Ancillary statistic and its relation with complete sufficient statistic and UMVUE. Lehmann-Scheffe theorem, Basu's theorem and their applications.

M. J. Hossain
20/1/18

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M. Hossain
20/4/20

Interval estimation: Introduction, confidence interval and confidence limit, confidence coefficient.

Inverting a test statistics, Pivotal Quantities, Pivoting the CDF. Confidence interval for mean, Proportion, Difference of means, Difference of Proportions, variance, ratio of variance, correlation coefficient, regression coefficient etc. Approximate ML Intervals, Other large sample Intervals.

Text

Hogg, R.V. and Craig, A.T., (2005), *Introduction to Mathematical Statistics*, McMillan-Collierm, N.Y.

References

1. Mood, Graybill and Boes., (1974), *Introduction to the Theory of Statistics*, 3rd Ed., McGraw-Hill.
2. Casella., G., and Berger, R.L., (2002), *Statistical Inference*, 2nd Ed., Thomson
3. Rao, C.R., (2008), *Linear Statistical Inference and its Applications*, Wiley.
4. Kendall & Stuart., (1979), *The Advanced Theory of Statistics*, Vol. I & II. Charless Griffin co. ltd.
5. Ferguson., (1967) *Mathematical Statistics: A Decision Theoretic Approach*. Academic Press Inc,
6. Gramer., (1962), *Mathematical Methods in Statistics*. Princeton University Press.
7. Cox, D.R. & Hinkley, U., (1965), *The Theory of Statistics*, Methuem, London.
8. Lehmann., (1998), *Theory of Point Estimation.*, Springer

Stat H-202: Sampling Distributions and Order Statistics

4 Credits

Review: Discrete and continuous random variables, Probability mass function, Probability density function, Mathematical expectations.

Sampling distributions: Definition of sampling distribution, examples from discrete and continuous populations, difference from probability distribution.

Distribution of function of random variables and random vectors: Method of distribution functions, method of transformations, Method of moment generating functions, Distribution of sum, difference, product and quotient of random variables, functions of random vectors of discrete and continuous type, Central limit theorem with real life applications, probability integral transform, Law of large numbers and Chebyshev's inequality with real life problems.

Different methods of finding sampling distribution: Analytical method, inductive method, geometrical method, method of characteristics function.

Exact Sampling distributions: Distribution of sample mean and variance and their independence for normal population, chi-square, t and F distributions (central and non-central cases) with their uses in statistics. Sampling distribution of correlation and regression coefficients. Standard errors of statistics with their large sample approximations. Fisher's Z -transformation. Transformation of variables including square root, log, sin-inverse etc.

Order Statistics: Definition, The role of order statistics in practical applications, Distribution of functions of order statistics for both discrete and continuous cases, Joint distribution of order statistics (n^{th} order, two order, and single order), Distribution of Range and some other statistics.

Text

Mendenhall, Richard and Denis, Mathematical Statistics with applications, (2008), 7th edition, Duxbury press, Boston.

References

1. Hogg, R.V. and Craig, A.T., (2013) An introduction to Mathematical Statistics, edi. 7th, McMillan-Collierm, N.Y.
2. Mood, Graybill and Boes., (2007), Introduction to the Theory of Statistics, 3rd Ed., McGraw-Hill.
3. Gupta, S.C. and Kapoor, V.K., (1970), Fundamentals of Mathematical Statistics. edi., 10th, Sultan Chand & sons, New Delhi.
4. Balakrishnan, N. & Cohen, A.C., (1993), Order Statistics and Inference: Estimation Methods, Academic Press, Boston.
5. Hoel, P.G., (1966), Introduction to Mathematical Statistics, 3rd eddi. John Wiley & Sons, N.Y.

Stat H-203: Elementary Sample Survey

2 Credits

Basic concept of sample survey, Relative advantages, disadvantages and suitability of complete and sample enumeration, Uses of sample survey, Role of sampling theory, Requirements of a good sample design.

Preliminaries in sample survey: Units, Population, Sampling units, Sampling frame, Basic principles of sample survey, various steps involved in a sample survey, Pilot survey.

Various methods of data collection, Questionnaire and schedule, Basic points to be considered while preparing a questionnaire, Open and closed questionnaire.

Random or Probability sample, method of drawing a random sample. Non-random or purposive sample, Sampling and non-sampling errors.

Basic concepts: Simple random sampling (SRS), systematic sampling, stratified sampling and cluster sampling. Drawing of samples based on those basic sample designs. Advantages and disadvantages of these sampling techniques with real life examples.

Population values and estimates in sample survey, Bias and its effect, Precision and Accuracy of estimates, Different types of errors associated with sampling and complete enumeration.

Text

Lohr, S.L., (2005), *Sampling Design and Analysis*, Addison-3rd, pub: Brooks/Cole, USA.

References:

1. Cochran, W.G., (1977), *Sampling Techniques*, 3rdeddi, John & Wiley sons.
2. Levy, P.S. and Lemeshow, S., (2008), *Sampling of Populations*, 4theddi, Wiley.
3. Kish, L., (1965), *Survey Sampling*, John & Wiley sons.
4. Singh, D and Chaudhury, F.S., (1987) *Theory and Analysis of Sample Survey design*. John & Wiley sons Inc.
5. Mendelhall, Ott, and Scaeffler., (2011), *Elementary Survey Sampling*, 7th Edition, Thomsom-Brooks/Cole, USA.
6. Sukhatme, P.V., (1954), *Sampling theory of Surveys with Application*, 2nd Ed. Asia Publishing House, London.
7. Yates, F., (1960), *Sampling Methods for Censuses and Surveys*. 3rdeddi, Hafner Publishing Company, N.Y.
8. Islam, M.N., (2008), *An Introduction to Sampling Methods*, Book World

Stat H-204: Economic Statistics & Index Number

4 Credits

Theory of Firms: Firms technology. Contrasts and similarities between firms and consume behavior analysis. Production function and its properties. Returns to scale. Productivity curves: total, average and marginal productivity curves along with their characteristics, Stages of production. Time horizons of decision making: short run, long run and very long run. Isoquants. Marginal rate of technical substitution(MRTS). Diminishing MRTS. Output elasticity of inputs. Isocost lines. Ridge lines. Firms optimization behavior: constrained output maximization, constrained cost minimization and profit maximization. Producer's equilibrium. The expansion path. Isoclines. Euler's theorem. Linearly homogeneous production function. Cobb-Douglas(CD) production function with properties and estimation. Constant elasticity of substitution(CES) production function.

Market mechanism: Market structure, perfect and imperfect competition, short- run and long-run equilibrium analysis in perfect competition.

Cost of Production: Costs of production-fixed and variable, total and marginal costs, Nature of cost. Cost function and curves: short run and long run. Diminishing return

and short run costs. Marginal average rule. Long run cost curve as an envelope of short run cost curves. Economics of scale of long run average cost. Statistical studies of long run average cost curves. Cost and profit functions with variable factor prices.

Pricing of the factors of production: Least-cost rule, Clark's theory, Marginal productivity theory of income distribution, Theories of wage, Rent, Interest and Profit.

Distribution of Income: Pareto and log-normal income distribution: properties, fitting, estimation of parameters, implications and limitations. Concentration curve: Lorenze curve and equation, Gini's concentration ratio. Engel's law and curve. Fitting of Engel's curve from family budget data.

National Income: Concept of National Income, Money and functions of money, Gross Domestic Product, Gross National Product, Net National Product, National Income, Personal Income, Disposable Income, Discretionary income, Difference between discretionary income and Disposable income, Measurements of national income and problems. Difficulties in the estimation of Gross National Product (GNP).

Index Numbers: Definition and necessity of index numbers, problems in the construction of index numbers, Different types of index numbers: Simple and weighted indices, construction and problems. Test of index numbers. Cost of living index. Constructions of Different types of cost of living index, Chain indices and the construction of chain indices, Base shifting, Splicing and Deflating of index numbers.

Text

Samuelson.,(2009), P.A., *Economics. 19th edition*, McGraw-Hill.

References

1. Varian, H.R., (2010), *Intermediate Microeconomics 8th edition* .W.W. Norton & Company,
2. Gupta and Kapoor., (2007), *Applied Statistics. 4th edition*, Sultan Chand & Sons,
3. Davis., (1972), *Economic Statistics. 2nd edition*, Principia Press,
4. Parashar, S. and Singh., (2002), *Econometrics and Mathematical Economics*.
5. Varinn, H.R., (1992), *Microeconomic Theory, 3rd edition*, Norton, W. W. & Company, Inc.
6. Henderson and Quandt.,(1958), *Microeconomic Theory.3rd edition*. McGraw-Hill.
7. Wonnacott and Wonnacott., (1970), *Econometrics, 5th edition*, Wiley
8. Dominick Salvatore.,(1992), *Theory and Problems of Microeconomic Theory*. McGraw-Hill.
9. Croxton and Cowden.,(1952) *Practical Business Statistics, 2ndedi*. Prentice-Hall, Inc.;

Stat H-205: Mathematical Methods

4 Credits

Group A: Numerical Mathematics

Differences of a polynomial, finite difference operators, interpolation and extrapolation by different formulae, inverse interpolation, numerical differentiation, numerical integration by different formulae, the accuracy of quadrature formula, numerical solution of equations by various methods, double interpolation.

Group B: Advanced Calculus

Beta and gamma function and their properties; incomplete beta and gamma function; Jacobian of transformation and their uses in statistics. Lagrange's multipliers and their uses in statistics. Fourier series: periodic function; Dirichlet conditions; odd and even functions.

Laplace transform: introduction; definition of integral transformation; definition of Laplace transform; Laplace transform of some elementary functions; sufficient conditions for the existence of Laplace transform; some important properties of Laplace transform, Laplace transforms of some special functions. Inverse Laplace transform: definition, some important properties of the inverse Laplace transform; definition of the convolution; convolution theorem; application of Laplace transform.

Text

Agarwal, D., (2014), *Advanced Integral Calculus*. 19thedi, Krishna Prakashan Media

Reference:

1. Mallick, S.A. and Uddin, M. A. (2007), *Numerical mathematics*.
2. Burden, R.J and Faires, J. D. (2010): *Numerical Analysis*, 9th ed. Brooks Cole.
3. Spiegel, M.R. (1965): *Schaum's outlines of Laplace Transform*, McGraw-Hill.
4. Wrede, R and Spiegel M.R. (2010): *Schaum's outlines of Advanced Calculus*, 3rd ed. McGraw-Hill.
5. Rahman, M.A. (2001), *A College Mathematical Methods*, second edition. Nahar Book Depot.

MAM-201: Calculus-II

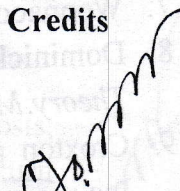
2 Credits

(Contents of Syllabus will be taken from Mathematics Department)

MAM-202: Ordinary Differential Equation

2 Credits

(Contents of Syllabus will be taken from Mathematics Syllabus)



Stat H-206: Lab III: Sample Survey & Estimation

2 Credits

Sample Survey: Drafting questionnaire. Construction of direct interview schedules (semi structured).

Drawing random sample: Practical problems of drawing sample by the methods of SRS, Systematic sampling, Stratified sampling and Cluster sampling.

Estimation: Numerical problems on method of moments, maximum likelihood, Least squares, Minimum chi-square for various distributions, Construction of confidence intervals.

Stat H-207: Lab IV: Economic Statistics & Index Numbers

2 Credits

Economic Statistics: Fitting of demand curve and interpretation, fitting of the Cobb-Douglas production function, fitting income distribution: Pareto and log-normal. Finding of Gini's ratio. Fitting of Lorenze and Engel's function.

Index Numbers: Construction of different types of index numbers, Test of index numbers. Cost of living index. Constructions of different types of cost of living index, construction of chain indices, Base shifting, Splicing and Deflating of index numbers.

Stat H-208: Lab V: Numerical Mathematics

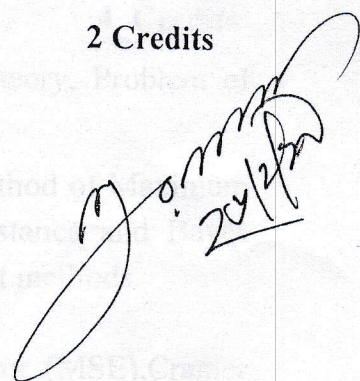
2 Credits

Numerical Mathematics: Numerical Mathematics: Use of interpolation formulae for equal and unequal intervals, Inverse interpolation, Numerical integration & solution of equation.

Stat H-209: Viva voce

2 Credits

The End



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(For the Students other than Statistics)
Starting Sessions: 2017-2018 (DU Admission)

List of Courses

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Stat NM-201	Mathematical Statistics	2
Stat NM-202	Principles of Statistics	2
Stat NM-203	Lab (Principles of Statistics)	2

Detailed Syllabus

Stat NM-201: Mathematical Statistics

2 Credits

Functions of random variables and random vectors: Methods of distribution functions, methods of transformations, Method of moment generating functions, Probability integral transform.

Distribution of sum, Difference, Product and Quotient of random variables, Functions of random vectors of continuous and discrete type, Central limit theorem, other limit laws and their applications, Conditional expectations, Chebyshev's inequality, Probability generating function, characteristic function. Inversion theorem, Sampling from the normal distribution, Role of normal distribution in statistics, Distribution of sample mean and variance and their independence. Detailed study of X^2 , F and t distribution. Sampling Distribution of correlation and regression coefficients and their uses.

Standard errors of statistics and their large sample approximations. Transformation of variables including square root, log, sin-inverse etc.

Texts

1. Mood, Grabill & Boes, *Introduction to the Theory of Statistics*, 3rd ed. McGraw-Hill
2. Hogg, R.V. & Craig, A.T. *An introduction to mathematical statistics*, McMillan-Collier, N.Y
3. Gupta, S.C and Kapoor, V.K. *Fundamentals of Mathematical Statistics*.
4. Balakrishnan, N & Cohen, A.C. *Order Statistics and Inference; Estimation Methods*, Academic Press, Boston.

References

1. Hoel, P.G. *Introduction to mathematical statistics*, Wiley, N.Y
2. Rao, C.R. *Linear Statistical inference & its Applications*, Wiley.
3. Mardia, K.V. *Families of Bivariate Distributions*, Charles & Griffin & Co. Ltd.
4. Anderson & Bancroft, *Statistical Theory in Research*, Megraw Hill, N.Y.
5. Steel and Torrie, *Principle and Procedures of Statistics*.
6. Ferguson, *Mathematical methods of statistics*.
7. Cramer, *Mathematical methods of statistics*.

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Stat NM-202: Principles of Statistics**2 Credits**

Test of Hypothesis: Hypothesis, simple and composite hypotheses, null and alternative hypotheses, concept of test of significance, procedures of a test, error in testing of hypotheses, level of significance, one tailed and two-tailed tests, p-value. Tests based on usual normal X^2 , t and F statistics.

Testing the significance of a single mean, single variance, single proportion; difference of two means and proportions, ratio of two variances and their confidence intervals. Tests and confidence intervals concerning simple correlation coefficient and regression coefficient for single and double sample, paired t-test. Testing the homogeneity of several population mean, variance and proportions. Statement about p-values for these tests. Association of attributes, Association & disassociation, Measure of association, Attribute, contingency tables, General test of independence in an $r \times c$ contingency table. Fisher's exact test for a 2×2 contingency table, Test of goodness of fit.

Analysis of Variance (ANOVA): One-way, two-way, classification, etc.

Tests

1. Mendenhall, *Mathematical Statistics*
2. Mostafa M.G. *Methods of Statistics*

References

1. Snedcor-*Statistical Methods*.
2. Anderson, R.L. & Bancorft, T.A. *Statistical Theory in Research*, Mcgraw-Hill
3. Weatherbum, C.E.A. *First course in Mathematical Statistics*, Camb U.P.
4. Steel & Torie, *Principles and Procedures of Statistics*.
5. Goulden- *Methods of Statistics*.
6. Kendall & Stuart, *Advanced Theory of Statistics*, Vol. I & II.
7. Ashraf Ali, *Theory of Statistics*, Vol. 2

Stat NM-203: Lab (Principles of Statistics)**2 Credits**

Drawing normal, Chi-square, F and t curve. Finding probabilities against coordinates from normal, Chi-square, F and t and vice-versa. Setting null and alternative hypothesis in practical situation. Determining the power function, level of significance and power of test and p-value. Testing a population mean, variance and proportion. Testing homogeneity of several population means, variances and proportions. Testing the difference between two populations: mean and proportion testing two population variances. Testing correlation and regression coefficients, Paired t-test. Test of independence. Test of goodness of fit, ANOVA techniques.

The End

