The Bachelor of Science (B.Sc.) Honors program in Statistics fosters at specializing and training in statistical methodology in its theoretical, practical/applied, and in scientific research aspects of modern age particularly with computer intensiveness.

This program shall extend over a period of four academic years that is divided into four levels viz: Part I, Part II, Part III and Part IV. Each part denotes one academic year (July to June). The courses offered in this program are of theoretical and practical nature. The total units of courses is 34, totaling 3400 marks, of which 25½ units are theoretical courses, 6 units are practical courses, ½ unit for project report and 2 units of viva-voce.

<table>
<thead>
<tr>
<th>Part</th>
<th>Nature of course</th>
<th>Units</th>
<th>Credit Hours</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Theoretical</td>
<td>5 ½</td>
<td>22</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>1</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
<td>½</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>II</td>
<td>Theoretical</td>
<td>6</td>
<td>24</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>1</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
<td>½</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>III</td>
<td>Theoretical</td>
<td>6 ½</td>
<td>26</td>
<td>650</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
<td>½</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>IV</td>
<td>Theoretical</td>
<td>7½</td>
<td>30</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Practical</td>
<td>2</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Viva-voce</td>
<td>½</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Report</td>
<td>½</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>34 136</td>
<td>3400</td>
</tr>
</tbody>
</table>

The class attendance carries 10% of the total marks in all courses (theoretical and practical). The course-end examinations carry 70% marks both in theoretical and practical courses, while 20% of the total marks are allocated for tutorial examinations that spread through the whole academic year. The students shall have to submit a report carrying 50 marks at the end of the Part IV (fourth year). The topic of which shall be approved by the Chairperson of the Department on the recommendation of the research supervisor, which shall be submitted on or before the day that are fixed by the Part IV examination committee. At the end of all course examinations in each academic year students shall have to face an interview board for viva-voce that carries 50 marks.

The assessment of students in a particular course will be based on the marks obtained in the (i) class works in the form of class attendance and tutorials, and (ii) course-end examinations. The course-end examinations shall be held at the end of the First Year, Second Year, Third Year and Fourth Year, respectively.

The year-wise structure for the B.Sc. (Honors) program is given below:

**Part I**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT-101</td>
<td>Introductory Statistics</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>STAT-102</td>
<td>Elementary Probability</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT-103</td>
<td>Linear Algebra</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>STAT-104</td>
<td>Introduction to Computer Programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STAT-105</td>
<td>Numerical Analysis</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT-106</td>
<td>Algebra and Calculus with Analytical Geometry</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>STAT-107</td>
<td>Microeconomics and Economic Statistics</td>
<td>50</td>
<td>2</td>
</tr>
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<table>
<thead>
<tr>
<th>Practical Courses</th>
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<tbody>
<tr>
<td>STAT LAB -108</td>
</tr>
<tr>
<td>STAT LAB -109</td>
</tr>
<tr>
<td>Viva-Voce</td>
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<td>Total</td>
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</table>

**Part II**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>STAT-201</td>
<td>Probability Distribution</td>
<td>50</td>
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<tr>
<td>STAT-202</td>
<td>Sampling Distribution</td>
<td>100</td>
<td>4</td>
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<tr>
<td>STAT-203</td>
<td>Regression Analysis</td>
<td>100</td>
<td>4</td>
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<tr>
<td>STAT-204</td>
<td>Demography</td>
<td>50</td>
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<tr>
<td>STAT-205</td>
<td>Quality Control and Educational Statistics</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT-206</td>
<td>Macroeconomics and Economic Statistics</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT-207</td>
<td>Mathematical Analysis and Differential Equations</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>STAT-208</td>
<td>Data Processing and Statistical Simulation</td>
<td>100</td>
<td>4</td>
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</table>
### Part III

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Marks</th>
<th>Credit</th>
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<tbody>
<tr>
<td>STAT LAB - 209</td>
<td>Statistical Data Analysis III</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT LAB - 210</td>
<td>Statistical Data Analysis IV</td>
<td>50</td>
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<tr>
<td>Viva-Voce</td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
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### Part IV

<table>
<thead>
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<th>Course Code</th>
<th>Course Title</th>
<th>Marks</th>
<th>Credit</th>
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<tbody>
<tr>
<td>STAT LAB - 311</td>
<td>Statistical Data Analysis V</td>
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<td>4</td>
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<tr>
<td>STAT LAB - 312</td>
<td>Statistical Data Analysis VI</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>STAT LAB - 313</td>
<td>Statistical Data Analysis VII</td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td>Viva-Voce</td>
<td></td>
<td>50</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>900</td>
<td>36</td>
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</table>

**Grand Total**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1050</td>
<td>42</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td></td>
<td>3400</td>
<td>136</td>
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</tbody>
</table>
Part I

STAT-101: Introductory Statistics  
1 Unit/4 Credit  (at least 50 Class Hours)


Processing of Data: Variables and Attributes, Types of Variables, Population and Sample, Different Scales: Cardinal, Ordinal, Interval and Ratio, Source of Data, Classification and Tabulation of Data, Frequency Distribution, Graphical Representation of Data, Stem and Leaf Display, Dot Plot, Time Series Plot.

Measures of Central Tendency: Mean, Median, Mode, Geometric Mean, Harmonic Mean, Trimmed Mean, Quadratic Mean with their Properties, Quantiles, Application of Measures of Central Tendency.


Moments and Shape Characteristics of Distribution: Moments, Sheppard’s Corrections for Grouping Error, Skewness and Kurtosis, Box-Plot.

Simple Correlation and Regression: Bivariate Data, Scatter Diagram, Simple Correlation, Correlation Ratio, Rank Correlation, Simple Linear Regression Analysis.

Contingency Table: Association of Attributes, Coefficient of Association, Total Association, Partial Association, Manifold Classification, Coefficient of Contingency, Pearson’s Coefficient of Mean-Square Contingency.

Index Number: Basic Concepts, Problem of Index Number, Different Types of Indexes, Errors in Index Number, Different Formulae, Tests of Index Numbers, Cost of Living Index.


Text  

References  

STAT-102: Elementary Probability  
½ Unit/2 Credit  (at least 35 Class Hours)


Probability Distribution: Concepts of Bernoulli, Binomial, Poisson, Uniform and Normal.

Text  

References  
STAT-103: Linear Algebra

1 Unit/4 Credit (at least 50 Class Hours)

Vector: Introduction to Vector (Geometric), Norm of Vector, Vector Arithmetic, Dot Product, Projection, Cross Product, Lines and Planes In 3-Dimensional Space, Euclidean N-Space, Cauchy-Schwarz Inequality, Triangle Inequality, Linear Transformations from \( \mathbb{R}^n \) to \( \mathbb{R}^m \), Reflection Operators, Projection Operators, Rotation Operators, Compositions of Linear Transformations, Properties of Linear Transformations.

Vector Space: Vector Space, Axioms, Subspaces, Linear Combination, Span, Span Space, Spanned, Linearly Independent, Geometric Interpretation of Linear Independence and Dependence, Basis, Standard Basis, Dimension, Row Space, Column Space, Null Space.


Eigenvalues and Eigenvectors: Definition of Eigenvalues and Eigenvectors, Diagonalization, Orthogonal Diagonalization.

Characteristic Value Problem and Quadratic form: Characteristic Value Problem, Similarity, Characteristic Roots and Vectors of Matrix, Theorems of Characteristic Roots and Vectors: Cayley-Hermilton Theorem, Finding Square Root of Square Matrix, Spectral Decomposition, LU-Decomposition: Solving Linear System by Factorization, Classifications and Identification of Quadratic forms: Positive and Negative Definite, Positive and Negative Semidefinite and Indefinite Matrices, Diagonalization of Quadratic Forms, Reduction of Quadratic forms, Related Theorems, Derivatives of Quadratic form with Respect to Vector.

Text

References

STAT-104: Introduction to Computer and Computer Programming

1 Unit/4 Credit (at least 50 Class Hours)

Part A: Introduction to Computer


Processing Data: Presentation of Data by Computers, Bits and Bytes, Text Codes Data, Processing of Data by Computer, CPU-Control Unit, ALU and Registers, Factors Affecting the Processing Speed of Computer, Memory: Main and Auxiliary Memory, Storage Devices. RAM, ROM.

Input and Output Devices: Keyboard, Mouse, Monitor, Printer, Tape, Disk, CD, DVD, Pendrive, Scanner, Digital Cammera Etc.

Number System: Basic Concept, Binary, Octal, Decimal and Hexadecimal Number System, Conversion of Data Using Number System, ASCII.


DOS: Meaning of DOS, Difference Between PC-DOS and MS-DOS, DOS Prompt, Base Name and Extension, Command Line, Difference Between File and Directory (Root and Subdirectory), DOS Wild Character, Read Me and Executable Files, Different Internal and External Commands.

Dealing and Viewing Files, Multitasking, Managing and Scheduling Processes, Linux in Office, Networking with Linux, Installing Software for Linux, Printing Files.

**Networking:** Meaning of Networking, Data Communication and its Types, Basic Components of Data Communication System, Communication Link, Modulation and Demodulation, Router, Data Transmission and its Types, Network Topologies, Types of Network - LAN, WAN, MAN, etc., Some Commonly used Protocols, TCP/IP.

**Internet:** Basic Concept, Uses and Structure of Network, Server, Browser, how Internet Works, Factors Required to Run Internet, ISP, Features of Browser, Browser Launching, URL, Navigating Web, Search Engine, Satellite, Wi-Fi.

**E-Mail And Macro Virus:** Basic Idea of E-Mail, Concept of Macro Viruses, Affect of Virus in Computer, Categories of Viruses, Preventing Infections, Idea about Antivirus, Firewall, Cookes.

**Part B: Computer Programming Language C**

Fundamental of C, Component of C Program, Declare Variable and Assign Values, Function, C Keywords, Program Control Statements: if, else, for, Loop, Incremental, Decrement, Printf, Relation and Logical Operators, Input Characters, while Loop, Create Nested Loop, Break, Continue, Switch, Goto. Data Types, Variable and Expressions, Arrays and Strings, Pointers, Function Prototypes, Main (), Console I/U and File I/U.

**References**

**STAB-106: Algebra and Calculus with Analytical Geometry**

1 Unit/4 Credit (at least 50 Class Hours)

**Group A: Algebra**

**Boolean Algebra:** Concept, Basic Properties, Derived Properties, Boolean Functions, Boolean Multiplication, Boolean Addition.

**Real Number System:** Number System, Natural Numbers, Integers, Prime Numbers, Rational Numbers, Irrational Numbers, Real Numbers, Imaginary Numbers.

**Relations and Functions:** Graph of Relations and Functions, Distance Formula and the Circle.

**Logic and Language of Proof:** Tautologies, Mathematical Proof by Contradictions Method, Contra Positive Method, Iterative Method, Mathematical Induction.

**Group B: Analytical Geometry**

**Systems of Coordinates:** Concept of Cartesian Coordinates, Directed Line, Directed Distance, Undirected Distance, Slope of Line, Slope Formula, Parallel and Perpendicular Line, Three Dimensional Cartesian Coordinates, Concept of Polar Coordinates, Curve-Equation Relationship, Curve Sketching in Polar Coordinates, Symmetry of Curve with Line, Tangents to Polar Curves, Areas in Polar Coordinates, Arc Length in Polar Coordinates.

Circle: Equation of Circle, Related Theorems on Circle, Locus of Circle, Determining Coefficients, Translation of Circle.

Parabola: Definition, Equation of Parabola, Parabola as Reflector.

Ellipse: Definition, Equation of Ellipse, Reflection Property, Chord of an Ellipse, Tangent of an Ellipse, Normal to an Ellipse, Diameters, Algebraic Parameter for an Ellipse.

Hyperbola: Definition, Chord and Tangent, Equation of Hyperbola, Asymptote, Common Properties of Parabola, Ellipse, and Hyperbola; Parabola, Hyperbola, and Ellipse as Conic Sections.

Group C: Calculus

Relation, Functions, Domain, Range and Their Graphs for Real Numbers, Graphs of Functions Like Exponential and Logarithmic, Trigonometric etc., Inverse Function, Limits and Continuity, Intermediate form, Tangents and Normal. Sandwich Theorem.

Differentiability, Derivative Techniques, Shapes and Application for Different Differentiation, Asymptotes, Higher Derivatives, Chain Rule Implicit Differentiation, Leibnitz Theorem, Partial Derivatives; Euler’s Theorem, Intermediate forms, Tangents, Normal (Including Polar Coordinates), L-Hospital’s Rule, Rolle’s Theorem, Mean Value Theorem, Residue Theorem, Maxima and Minima, Extrema; Curve Sketching (Graphs): Algebraic Clues-Symmetry Criteria, Intercepts, First Derivative-Maxima, Asymptotes, Minima, Second Derivative-Concavity, Points of Inflection.

Integral Techniques, Method of Substitution, Integration by Parts, Application of Integration; Definite Integral as Limit of Sum, Interpretation as Area, Fundamental Theorem of Integral Calculus (for Continuous-Functions), Determination of Lengths and Area, Reduction Formulæ, Multiple Integrals Like Double Integral, Triple Integral, etc., Jacobian, Taylor’s Theorem, Maclaurian’s Theorem, Beta and Gamma Functions, Improper Integrals.

Texts


References


STAT-107: Microeconomics and Economic Statistics

½ Unit/2 Credit (at Least 35 Class Hours)

Introduction: Meaning of Economics, Distinguish between Microeconomics and Macroeconomics, Two Big Questions of Economics, Key Ideas that Defined Economic Way of Thinking, Production Possibility Frontier, Opportunity Cost.

Demand, Supply and Price: Determinants of Demand and Supply, Laws of Demand and Supply, Movements along and Shift of Demand and Supply Curves, Equilibrium Price and Quantity, Concept of Elasticity of Demand and Supply.


Possibilities, Preference and Choice: Consumption Possibilities, Preferences and Indifference Curves, Marginal Rate of Substitution, Diminishing Marginal Rate of Substitution, Degree of Substitutability, Best Affordable Choice, Predicting Consumer Choice: Substitution Effect and Income Effect.

Output and Cost: Concept of Short-Run and Long-Run, Average, Marginal and Total Product, Relationship Between AP and MP, Law of Diminishing Marginal Returns, Variable Cost, Fixed Cost and Total Cost, Returns to Scale, Relationship Between AC and MC.

Perfect Competition Market: Features of Perfect Competition Market, Marginal Analysis of a Firm, Short-Run and Long-Run Supply Curve of a Firm, Profit Outcomes in the Short-Run and Long-Run, Breakeven And Shutdown Point, Efficiency of Competition.


Text

References

STAT LAB-108: Statistical Data Analysis I

(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks)

(Related Course - STAT-101: Introductory Statistics)

Construction of Frequency Distributions Tables with Closed and Open Class Intervals, Graphical Representation, Statistical Averages and Percentiles, Variance, Standard Deviation, Standard Error, Mean Deviation from Mean and Median, Range, Quartile Deviation, Moments, Cumulants, Sheppard’s Corrections For Grouping Error, Coefficient of Measure of Skewness and Kurtosis, Box Plot and Steam and Leaf Plot, Fitting of Simple Regression Lines, Correlation Coefficient, Rank Correlation Coefficient, Contingency Table Analysis. Correlation Ratio.

Calculation of Indexes, Different Tests of Index Numbers, Construction of Cost of Living Index.


STAT LAB-109: Statistical Data Analysis II

(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group)

(Related Course - STAT-104: Introduction to Computer and Computer Programming)


Programming Language C: Solving Various Statistical Problems (Measures of Central Tendency, Measures of Dispersion, Correlation and Regression) Using C.

Group B (Marks: 20)

(Related Course – STAT-105: Algebra and Numerical Analysis)

Using SPSS, R or Programming Language C: Matrix Addition, Multiplication, Calculation of Determinant Value and Matrix Inversion, Newton’s Forward and Backward Interpolation Formulas, Lagrange’s Formula, Newton’s General Interpolation Formula.


Part II

STAT-201: Probability Distribution
½ Unit/2 Credit (at Least 35 Class Hours)

Basic Concept: Probability Space, Probability Calculus, Measure Theoretical Approach to Probability, Concept of Family of Exponential Distributions.

Univariate Discrete Distributions: Rectangular, Geometric, Hypergeometric, Negative Binomial, Multinomial, Logarithmic, Beta-Binomial, Generalized Negative Binomial, Negative Hypergeometric Distribution, Power Series Distribution, Edgeworth Series, Gram Charlie’s Series

Univariate Continuous Distributions: Uniform, Normal, Beta, Exponential, Gamma, Half Normal, Log Normal, Cauchy, Weibull, Inverted Gamma, Inverse Gaussian, Laplace, Gumbell, Maxwell, Erlang, Pareto and Other Exponential Family of Distribution, Rayleigh and Rician Distribution.

Special Distribution: Pearsonian Type Curves, Contagious, Truncated and Mixture Distribution of Normal, Poisson and Binomial.

Bivariate Distribution: Binomial, Poisson, Geometric, Normal, Gamma and Beta.

Texts

References

STAT-202: Sampling Distribution
1 Unit/4 Credit (at Least 50 Class Hours)


Sampling Distribution and Their Properties: Exact Sampling Distribution Related To Normal Population, Distribution of Sample Mean, Sample Variance, Sample Covariance; Distribution of Central And Non-Central Chi Square, Student T, and Variance Ratio F Statistics and Their Distributions, Distribution of Sample Correlation and Regression Coefficients, Joint Distribution of Sample Correlation Coefficient and Covariances, Fisher’s Z Distribution.

Law of Large Number: Theory of Large Samples, Convergence of Random Variable, Modes of Convergence, Law of Large Number (Strong Law and Weak Law), Central Limit Theorem, Standard Errors of Estimators in Large Samples (Mean, Variance, Standard Deviation, Correlation Coefficient and Regression Coefficient, Coefficient of Variation).


Texts

References
STAT-203: Regression Analysis

1 Unit/4 Credit  (at least 50 Class Hours)

Simple Linear Model: Linear Model, Regression Function, Simple Linear Regression, Least Square Estimators and their Properties, Precision of the Estimated Regression Model, Examining Regression Equation, Lack of Fit and Pure Error, Confidence Interval and Test of Hypothesis, Inverse Linear Regression.


Regression for Binary Data: Logistic Regression, Estimation and Interpretation of Coefficients.

Examination of Residuals: Overall Plot, Time Sequence Plot, Plot against Regression Equation, Plot Against Predictor Variables, Other Residual Plots, Statistics for Examination of Residuals, Correlations among Residuals, Outliers, Serial Correlation in Residuals, Examining Runs in Time Sequence Plot of Residuals, Durbin-Watson Test for a Certain Type of Serial Correlation, Detection of Influential Observations, Measures of Influences: Cook’s D, DFFITS AND DFBETAS, Leverage, Measures of Model Performances.

Selection of Best Regression Equation: All Possible Regression, Best Set of Regression, Backward Elimination Procedure, Stepwise Regression Procedure, Ridge Regression, Predictor Sum of Squares, Principal Component Regression, Latent Root Regression, Stage-Wise Regression Procedure, Robust Regression.


Polynomial Regression: Polynomial Model in One and Two or More Variables, Orthogonal Polynomials.

Texts

References

STAT-204: Demography

½ Unit/2 Credit  (at least 35 Class Hours)


Age and Sex Composition: Age and Sex Composition and their Importance.

Demographic Data: Sources of Demographic Data, Methods of Demographic Data Collection, Concept of De Facto and De Jure Population, Assessment of Quality of Demographic Data, Characteristics of Adequate Population Census, Vital Registration Method, Sample Surveys and their Advantages and Disadvantages.

Errors in Demographic Data: Sources of Type of Errors in Demographic Data and their Correlations, age Heaping, age Misstatement, Under Enumeration, Over Count etc., Application of Different Methods in Detecting Errors/Digital Preferences, Estimation Method of Under Count and Over Count.

Fertility and Fecundity: Detail Study of Fertility, Fecundity, Various Measures of Fertility, Important Determinants of Fertility, Estimation of Mean Age at Childbearing.

Standardization: Concept of Standardization in Demographic Measurements, Role of Standardization, Different Methods of Standardization with their Merits and Demerits, Stable Population and its Properties, Lotke’s and Derivation of Stable Population Model.

Mortality and Morbidity: Concept of Mortality and Morbidity, Important Determinants of Mortality, Various Measures of Mortality and Morbidity, Adjusted Measures of Morbidity, IMR and its Components (Neonatal and Post-Neonatal Infant Mortality), Life Table and its uses, Current and Cohort Life Table, Construction of Life Table.

Text

References

**STAT-205: Quality Control and Educational Statistics**

½ Unit/2 Credit (at Least 35 Class Hours)

**Basic Principles of Quality Control:** Meaning of Quality, Quality Improvement, Statistical Methods for Quality Control and Improvement.

**Methods and Philosophy of SPC:** Causes of Variation, Statistical Basis of the Control Chart: Basic Principles, Choice of Control Limits, Analysis of Patterns on Control Charts etc., Implementation and Application of SPC.

**Control Charts for Variables:** Control Charts: \( \bar{X}, R \) and \( S \), the Effect of Non Normality on \( \bar{X}, R \) Charts, OC Function, the average Run Length for the \( \bar{X} \) Chart, the Shewhart Control Chart for Individual Measurements, Applications of these Charts.

**Control Charts for Attributes:** Development of Different Control Charts: for Fraction Nonconforming, for Nonconformities, the OC Function and the ASN Curve for these Charts.

Choice between Attribute and Variable Control Charts, Guidelines for Implementing Control Charts.

**Process and Measurement System Capability Analysis:** Process Capability Analysis using Six-Pack, Using Histogram, a Probability Plot, Process Capability Ratios, using Control Charts, Design of Experiments etc.

Tolerance Limits: Parametric and Nonparametric Limits.

**Other Statistical Process Monitoring and Control Techniques:**

The Exponentially Weighted Moving average Control Chart, the Moving Average Control Charts.

**Acceptance Sampling:**

Types, Lot Formation, Guidelines of using Acceptance Sampling.

**Single Sampling Plan:** Designing of the Plan, the OC Curve, Rectifying Inspection etc.

**Double, Multiple and Sequential Sampling Plan:** Design of the Plans, the Oc Curve, the ASN Curve etc.

**The Dodge-Romig Sampling Plans:** The AOQL Plans, LTPD Plans, Estimation of Process Average etc.

**Other Acceptance Sampling Plans:** Acceptance sampling by Variables, Sequential Sampling by Variables, Chain Sampling etc.

**Statistical Quality Control and Six-Sigma:** Six \( \sigma \), Process Control and its Applications; Six \( \sigma \) Quality Assurance, Quality Management System; Quality Management Tools used in Six \( \sigma \), Six Steps to Six \( \sigma \) Control, Methods of Six \( \sigma \) Process: DMAIC (Dh-May-Ick), DMADV (Dh-Mad-Vcc); Some Common Tools, Techniques and Unit of Measurements to Achieve Six \( \sigma \) : Cause and Effect Diagram Also Known as a Fishbone Diagram, Cp/Cpk (Process Capability), DFSS-Design for Six Sigma, DMAIC - Define, Measure, Analyze, Improve, Control, Control Charts, DPMO - Defects Per Million Opportunities, DOE - Design of Experiments, PDCA – Plan Do Check Act, R and R Repeatability and Reproducibility, Tolerance Design, SPC - Statistical Process Control etc.

**The Educational Statistics:** Importance of Studying Educational Statistics, Different Scores, Scaling Individual Test Items: \( \sigma \) Scaling and \( z \) Scaling, \( T \) Scores and its Computation, Reliability and Validity of the Test Scores, Methods of Determining Reliability and Validity of a Test Score, Comparisons of Reliability and Validity, Intelligent Quotient.

**Official Statistics:**

Official Statistics of Bangladesh Especially Related to Sectors of Economy and Population; Statistical Data Sources: Official and Other Sources, Critical Evaluation of Sources and their Limitations: Constraints in BBS in Respect of Governance, Data Collection and Dissemination; Problems Associated with Administrative Data, Major Obstacles/Weakness in using Administrative Data for Statistical Purpose, Recent Innovative Measures for Improvement Official Statistics.

Publications of Different Sources of Official Data: Bangladesh Bank, Ministry of Finance, Bangladesh Bureau of Statistics etc.

Publications of the Subsequent Sources: Board of Investment (BOI) of Bangladesh, Climate Change Cell, Export Promotion Bureau, Bangladesh Export Statistics.

Publications of Other Data Sources: Asian Development Bank (ADB), the International Food Policy Research Institute (IFPRI), the International Labour Organization (ILO), the International Monetary Fund (IMF), and the World Bank.

**Text**


**References**

STAT-206: Macroeconomics and Economic Statistics

½ Unit/2 Credit  (at Least 35 Class Hours)


Poverty, Inequality, and Development: Measuring Inequality and Poverty - Size Distribution, Lorenz Curves, Gini Coefficient, Poverty Gap, Foster-Greer-Thorbecke Index, Human Poverty Index, Dualistic Development, Growth and Inequality, Growth and Poverty, Economic Characteristics of Poverty Groups, Ahiwalia-Chenery Welfare Index.

Text

References

STAT-207: Mathematical Analysis and Differential Equations

1 Unit/4 Credit  (at Least 50 Class Hours)


Text

References


STAT-208: Statistical Simulation and Data Processing

1 Unit/4 Credit (at Least 50 Class Hours)

Simulation

Overview: Meaning, Motivational Example, Simulation Process, Verification, Validation, Synchronous and Asynchronous Discrete Event Simulation, Continuous Event Simulation, Hybrid Event Simulation, Monte Carlo: Hit or Miss Monte Carlo Method, Sample- Mean Monte Carlo Method.

Variance Reduction Technique: Stratified Sampling, Conditional Monte Carlo, Jackknifing, Antithetic Variates.

Generating Uniform Random Variable: Classes of Generators – Random Devices, Tables, Midsquare Method, Fibonacci and Additive Congruential Generators, Linear Congruential Generators, Linear Recursion Mod 2 Generator, Combinations of Generators, Choosing Good Generator Based on Theoretical Considerations, Serial Correlation, Cycle of Length, Spectral Test.

Empirical Testing Of Uniform Random Number Generators: Chi-Square Test, Kolmogorov-Smirnov Test, Gap Test, Run Test, Poker Test, Test of Autocorrelation, Maximum Test.

Generating Non-Uniform Random Variables: Alias Method, Inverse Transformation Method, Acceptance-Rejection Method, Polar Method, Method of Generating Random Numbers from Normal, Exponential, Gamma, Beta, \( \chi^2 \), \( t \), \( F \), Cauchy, Binomial, Poisson, Geometric, Negative Binomial Distributions.


SPSS

Overview: Meaning of SPSS, Concepts of Commands, Syntax Diagram, Running Commands in Inter-Relative and Batch Mode, Sub-Commands, Keywords, Values in Command Specifications, String Values in Command Specifications, Delimiters Command Order.


Running SPSS using Production Facility.

SAS

Input Statement: List Directed and Column Input, Pointers and Formats, Reading Structured and Unstructured Data Format List.

External File: Reading and Writing Raw and System Files, Reading and Writing Data from Program and ASCII Data from External File, File Options, Writing Data to External File, Creating and Reading Permanent SAS Data Set, Working with Large Data Sets Problems.

Importing and Exporting Data: Reading Data from Different Formatted Data Files, Converting Different Database Formatted Files to SAS System Files.

Arrays Used in SAS: Use of Array for Missing Values to Create New Variables, Transformation of Data Set, Temporary Arrays, Multidimensional Arrays.

Data Manipulation: Data Set Subsetting, Concatenating, Merging and Updating Subsetting, Combining Different Data from Multiple Files, Table Look Up, Updating Master File from Update File.


Use of SAS Program (Codes) and Functions for Descriptive Statistics, Correlation and Regression, Questionnaire Design and Analysis, Analysis of Variance, Multiple Regression.

Texts


References

STAT LAB-209: Statistical Data Analysis III
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group) ½ Unit/2 Credit (at Least 35 Class Hours)

Group A (Marks: 30)
(Related Course - STAT-203: Regression Analysis)

Fitting of Simple Regression, Correlation Coefficient, Determination of Intra-Class and Inter-Class, Fitting of Multiple Regression Model, Partial Regression Model, Multiple and Partial Correlation Coefficients, Test of Significance of Simple, Multiple, Partial Correlation and Regression Coefficient, Tests of Influential and Outlier Observations by Different Methods, Fitting of Ridge Regression. Fitting of Polynomial Regression and Orthogonal Polynomial Model, Durbin Watson Test for Serial Correlation.

Group B (Marks: 20)
(Related Course - STAT-204: Demography)

Calculation of Rates and Ratios, Standardization of Rates, Meyer’s Index, Whipple’s Index, United Nations Index, Estimation of Under and Over Count, Intrinsic Rates, Mean and Median Age at Marriage, Growth Rates, Migration, Child Mortality, Adult Mortality, Coale’s Indices, Construction of Nuptiality Tables, Life Tables.

STAT LAB-210: Statistical Data Analysis IV
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group) ½ Unit/2 Credit (at Least 35 Class Hours)

Group A (Marks: 10)
(Related Course - STAT-205: Quality Control and Educational Statistics)

Different Types of Control Charts, Determination of Sampling Plan in Different Situations, OC Curve for Different Sampling Plans, Average Sample Number and Average Outgoing Quality Level for Different Sampling Plans, Fitting of Curve for Different Sampling Plans. Calculation of Different Scores and their Standardization, Calculation of IQ.

Group B (Marks: 40)
(Related Course - STAT-208: Data Processing and Statistical Simulation)


Problem Solving Though SPSS and SAS: Solving Different Statistical Problems by SPSS and SAS (Measures of Central Tendency, Measures of Dispersion, Correlation and Regression), Graphical Presentation of Statistical Data by SPSS, Analysis of Data by SPSS, Writing and Running Syntax in SPSS and SAS to Solve Different Statistical Problems.
Part III

STAT-301: Statistical Inference I
1 Unit/4 Credit (at Least 50 Class Hours)

Group A: Parametric Inference


Interval Estimation: Fundamental Notions of Confidence Interval Estimation, Different Methods of Interval Estimation, Properties and Construction of Confidence Interval by Different Methods. Confidence Interval for Mean and Variance, Length of Confidence Interval, Shortest Length Confidence Interval, Simultaneous Confidence Interval for Mean and Variance.

Test of Hypothesis
Fundamental Notions of Hypothesis Testing, Basic Concepts and Ideas of Test of Significance in Small and Large Samples, Type I and Type II Error, Level of Significance, P-Vale, Power of the Test, Neyman-Pearson Lemma, Composite Hypothesis, Simple Likelihood Ratio Test.

Tests Based on Z, t, F and χ² Statistics, Fisher’s Exact Test, Analysis and Test Based on r×c Contingency Table.

Group B: Non-Parametric Inference


Test Based on Runs: Distribution Theory of Runs, Test Based on Total Number of Runs, Test Based on Length of Longest Run, Runs up and Down, Randomness Test Based on Ranks.

Test of Goodness of Fit: Distribution Theory of Kolmogorov-Smirnov (K-S) One-Sample Test Statistic and Test Based on K-S Test, Comparison of Chi-Square Test and Kolmogorov-Smirnov, Test for Goodness of Fit, Lilliefors’ Test for Normality.

Rank-Order Statistics: Definition, Correlation between Variate Values and Ranks, Treatment of Ties in Rank Tests.

One-Sample and Paired-Sample Techniques: Sign Test, Wilcoxon Signed-Rank Test and their Distributional Properties, Power and Confidence Interval Procedure, Binominal and Quantile Test.

General Two Sample Problem: Wald-Wolfowitz Runs Test, Kolmogorov-Smirnov Two-Sample Test, Median Test and Control Median Test, Mann-Whitney U Test and their Distribution Under Null Hypothesis, Confidence Interval Procedures.

Linear Rank Statistics: Definition, Distributional Properties of Linear Rank Statistics

Linear Rank Test for Location Problem: Wilcoxon Rank-Sum Test, Terry-Hoeffding Test, Van Der Waerden Test and their Distributions under Null Hypothesis.

Linear Rank Test for Scale Problem: Mood Test, Freund-Ansari-Bradley-David-Barton Test, Seigel-Tukey Test, Klotz-Normal Score Test, Sukhatme Test and Their Distributions under Null Hypothesis, Moments under Null Hypothesis.

Tests of Equality of k Independent Samples: Extension of Median Test, Kruskal-Wallis One-Way Anova Test, Distributional Properties of Each Test, Test against Ordered Alternatives, Comparisons with Control.

Asymptotic Relative Efficiency (ARE): Concept of Pitman Efficiency, Theoretical Bases for Calculating ARE, Examples of Calculation of Efficacy and ARE.

Tolerance Limits for Distributions, Coverage, Confidence Interval Estimates of Population Quintiles.

Texts

References
STAT-302 Analysis of Variance  
½ Unit/2 Credit  (at Least 35 Class Hours)

Basic Concept of Experimental Design and Non-Experimental Design, Basic Concept of Analysis of Variance, Linear Models, Analysis of Variance in One-Way, Two-Way and Three-Way Classification with Equal Number of Observations Per Cell, Analysis of Variance with Fixed Effects, Mixed Effects and Random Effects Model.


Nested Design, the Two-Stage Nested Designs, Statistical Analysis Variance Components, Analysis of Three-Stage Nested Design.

Covariance Analysis, Covariance Analysis with One Concomitant Variable, Analysis of Covariance in One-Way and Two-Way Classified Data with One Concomitant Variable.

Texts

References

STAT-303 Sampling Techniques I  
½ Unit/2 Credit  (at Least 35 Class Hours)


Probability Sampling: Simple Random Sampling with Replacement and Without Replacement, Stratified Sampling, Systematic Sampling, Relative Precision and Comparative Analysis, Cluster Sampling with Equal Size, Relative Precision of Different Sampling Scheme.

Estimation using Auxiliary Variables: Ratio, Regression and their Differences, Method of Estimation and their Comparative Analysis.

Non Probability Sampling: Convenience Sampling, Accidental Sampling, Purposive Sampling, Judgment Sampling, Quota Sampling, Snowballs Sampling, Area Sampling.


Texts

References

STAT-304: Operations Research  
½ Unit/2 Credit  (At Least 35 Class Hours)


Game Theory: Introduction, Properties Assumptions of Two Persons Zero Sum Game, Maximum Minimum Principle, Pure and Mixed Strategy Games, Two Person Zero Sum and its Relation with Linear Programming and Non-Zero Sum Games, Solution of Game by Graphical Methods, Simplex Method, Approximate Solution of Game by Brown’s Algorithm.

Network Models: Scope and Definition of Network Models, Minimal Spanning Tree Algorithm, Shortest-Root Problem, Maximal Flow Model, CPM and PERT.

Inventory Models: Deterministic and Probabilistic Inventory Models, Role of Demand in the Inventory Models, Static and Dynamic, Economic-Order-Quality (EOQ), Single Period Models, Multi Period Models.

Text

References

**STAT-305: Research Methodology**

½ Unit/2 Credit (at least 35 Class Hours)

**Basic Concepts of Research Methodology:** Meaning of Research, Objectives, Research Method and Methodology, Concepts of Theory, Proposition, Concept and Hypothesis.


**Sampling Design:** Types of Data, Review of Probability and Non Probability Sampling, Technique to Collect Data.

**Attitude Measurement:** Components of Attitude, Elements of Measuring Attitude, Attitude as a Hypothetical Construct, Techniques for Measuring Attitude, Scaling Techniques of Attitude; Comparative Scales and Non-Comparative Scales. *Attitude Rating Scale*: Simple Attitude Scale, Category Scale, Summated Ratings Methods - The Likert Scale, Semantic Differential Scale, Numerical Scale, Constant Sum Scale, Stapel, Continuous Rating/Graphic Rating Scale, Behavioral Differential, Paired Comparison Scaling.

**Measurement and Scaling Concept:** Concept of Measurement, Purpose of Scaling, Types of Scales, Criteria for Good Measurement: Reliability, Validity and Sensitivity, Difference between Reliability and Validity, Tests for Reliability, Different Measures of Validity.

**Data Management and Analysis:** Stages of Data Preparation Process, Preliminary Plan of Data Analysis, Questionnaire Checking, Editing, Coding, Re-Coding, Data Cleaning, Statistically Adjusting Data, all Statistical Techniques, Including Modeling and Inference.

**Report Preparation and Presentation:** Literature Review, Report Writing, Oral Presentation, Research Follow-Up, Reference Writing.

**Texts**

**References**

**STAT-306: Economometrics**

1 Unit/4 Credit (at least 50 Class Hours)

**Basic Concept of Economometrics:** Meaning, Methodology of Economometrics, Types of Econometrics, Nature and Source of Data for Econometric Analysis, Role of Computer in Econometric Analysis, Meaning of Population Regression Function (PRF) and Sample Regression Function (SRF), Stochastic Specification of PRF, Different Functional form of PRF and Transformation of PRF to Linear form.

Detail Study of Problem of Estimation and Inference in Multiple Linear Regression Models, Examination of Linear Regression Results for Fitted Line and Residuals to Detect Assumption Violations, Likelihood Ratio, Wald, Lagrange Multiplier and Other Suitable Tests for Testing Regression Parameters, Verification of BLUE Properties of Linear Regression by Monte Carlo Experiments.

**Multicollinearity:** Nature of Multicollinearity, Theoretical Multicollinearity, Estimation in Presence of Multicollinearity, Theoretical and Practical Consequences of Multicollinearity, Detection of Multicollinearity, Remedy and Measures of Multicollinearity.


Monte-Carlo Experiment: Consequence of Autocorrelation.


Model Selection: Learner’s and Hendry’s Approach to Model Selection, Non-Nested Hypothesis Test by (I) Discrimination Approach (ii) Discerning Approach And (iii) Other Criteria Such as Hocking’s $Q_p$ Measures, Mallow’s $C_p$ Measure, Amemiya’s $PC$ Measure and Akaike’s $AIC$ Measure, Schwarz Criterion, Hannan Quinn and Shibata Criterion.

Detail Study of Linear Probability, Logistic, Probit and Tobit Models to Study Regression on Dummy Dependent Variables.

Dynamic Econometric Model: Autoregression, Distributed Lagged Variables, Lag Model, Meaning of Dynamic Distribution Lag and Autoregressive Models, Role and Reasons for Lags in Econometric Model.


Input-Output Analysis, Internal Efficiency, Inter Industry Relation, Application of Social Accounting Matrix in Planning and Development.

Texts

References

STAT-307: Time Series Analysis
1 Unit/4 Credit (at least 50 Class Hours)


Stationary Processes


Multivariate Time Series: Second-Order Properties, Mean And Covariance Function, Multivariate ARMA (MARMA) Models, Best Linear Predictors, Modeling and Forecasting With MAR or VAR Process.

VAR Models, Unit Root Models, Error-Correction Model, Cointegration Analysis.

Text

References

STAT-308: Actuarial Statistics

½ Unit/2 Credit (at least 35 Class Hours)

Basic Concept: Definition of Actuarial Science, its Relationship with Life Insurance, Important uses of Actuarial Statistics Especially in Context of Bangladesh.

Interest: Theory of Rates of Interest and Discount Including Theoretical Continuous Case of Forces of Interest and Discount.

Amortization and Sinking Funds, and Bonds: Amortization and Amortization Schedule, Sinking Funds Yield Rates, Annuities and Sinking Funds Including Continuous Case, Practical and Theoretical Applications Primarily to Mortgages and Bonds, Yield Rates.

Annuities: Meaning, Perpetuities, Continuous and Varying Annuities.

Life Annuity and Insurance: Economics of Insurance, Utility Theory, Application of Probability to Problems of Life and Death, Determination of Single Premium for Insurances and Annuities in both Discrete and Continuous Case.

Theory and Practice of Pension Plan Funding, Assumptions, Basic Actuarial Functions, Population Theory Applied to Private Pensions.

Survival Distributions, Life Tables, Life Insurance, Life Annuities, Net Premium, Premium Series, Multiple Life Functions, Multiple Decrement Models, Valuation Theory for Pension Plans, Expense Function and Dividends.

Exposure Formula: Assumed and using Implications, Techniques of Calculating Exposures from Individual Records Including Consideration Involving Selection of Studies, Various Observation Periods and Various Methods of Tabulating Deaths, Techniques of Calculating Exposures from Valuation Schedules Including General Concepts of Fiscal Year, use of Interim Schedules and Variations in Observations Period or Method of Grouping Deaths and Practical Aspects of Construction of Actuarial Tables.

Text

References

STAT-309: Environmental Statistics

½ Unit/2 Credit (at least 35 Class Hours)


Health Environment: Sources of Health Risk in Air, Water, Food, and Wastes, Climate Change and Environmental Health, Arsenic Instigation in Drinking Water.


Environmental Pollutants: Environmental Pollutants, Impacts of Pollutants on Environment, Sources of Environmental Pollutants, Decomposition of Pollutants, Types of Environmental Pollution.

Diffusion and Dispersion of Pollutants: Concept of Diffusion and Dispersion of Pollutants, Distribution of Pollutants with Respect to Space and Time by Wedge Machine, Plume Model.


Texts

References

STAT-310: Data Processing with Statistical Software
½ Unit/2 Credit (at Least 35 Class Hours)

STATA: Introduction to STATA, Different Windows of STATA, Converting Data by Stat Transfer, Importing and Exporting Data, Data Entry, Data Cleaning, Data Management: Imputing, Editing Data, Generating and Changing Variables, Saving and Reusing Data, Data Reorganization, Data Merging and Appending; Basic STATA Commands, Creating do File, STATA Commands for Different Probability Distributions, Vector and Matrix Operations: Transpose, Addition, Subtraction, Multiplication and Inversion, Solution of Simultaneous Equations.

Minitab: Introduction to Minitab, Accessing Minitab, Minitab Worksheet, Menu and Session Commands, Entering Data from Keyboard, Doing Arithmetic, Interoperability in Minitab, Transferring Data from MS Excel to Minitab, Exporting Analysis Data From Minitab to Word and PPT, Exporting Data from Session Window to Word and PPT, Generate Different Charts in Minitab, Descriptive Measures, Basic Probability Calculation, Finding Probabilities by Different Probability Distributions, Confidence Interval Estimation, Parametric and Non-Parametric Test of Hypothesis, Correlation and Regression, Design of Experiments and Analysis of Variance, Solving Different Statistical Problems by Minitab.

R: History of R, R versus STATA, Downloading and Installing R, Simple R Session with some Basic Commands, Case-Sensitivity, Recall and Correction of Previous Commands, Assignments and Expressions, Simple Manipulations of Numbers, Getting Help on R, Data Objects and Data Structure, Importing Data, Data Manipulation, Graphics, Obtaining Densities, Cumulative Probabilities, Quantiles and Random Samples from Different Probability Distributions, Writing Functions, Conditional Execution with If Statement, Repetitive Execution with for, Repeat and while Statements.

Applications of STATA, Minitab and R: Basic Statistical Techniques, Graphs, Correlation and Regression, Estimation of Parameters of Multiple Regression Model, Inference in Multiple Regression, Partial Correlation, Multiple Correlation and Related Tests, Model Selection, Fitting Polynomial Regression, Examination of Residuals, Outliers, Influential Points, Logistic Regression.

Texts

References

STAT LAB-311: Statistical Data Analysis V
1 Unit/4 Credit (at Least 50 Class Hours)

(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group)

Group A (Marks: 40)

( Related Course - STAT-301: Statistical Inference I)

Drawing Sample from Parent Population: Binomial, Poisson, Geometric, Hypergeometric, Normal, Cauchy, Gamma, Beta, Incomplete Gamma and Beta.

Estimation of Location and Scale Parameter of the Sample Drawn from the above Distributions, Maximum Likelihood Estimator, Method of Moments Estimator, Method of Least Squares Estimators.

Determination of Confidence Interval for Mean, Difference of Means, Proportion, Difference of Proportions, Correlation Coefficient, Regression Coefficient, Fitting of Different Distributions, Different Tests for Mean, Difference of Means, Equality of Several Means, Proportion, Difference of Proportion, Equality Of Several Proportions, Variances, Equality of Two and Several Variances, Equality of Several Correlation Coefficients, Regression Coefficients Based on Normal, t, \( \chi^2 \) and F. Power Curves of Different Tests.
Test of Randomness (One-Sample, Two-Sample); Wilcoxon Signed-Rank Test, Mann-Whitney U-Test, Median Tests (Two or More Samples), Kolmogorov-Smirnov Tests, Different Location and Scale Problem Tests, Kruskal-Wallis Test, Different Tests of Measures of Association.

**Group B (Marks: 30)**

(Related Course - STAT-302: Analysis of Variance)

Analysis of Variance in One-Way, Two-Way and Three-Way Classifications with Equal Number of Observations Per Cell Using Fixed Effect Model and Random Effect Model, Covariance Analysis in CRD, RBD And LSD with One Concomitant Variable, Analysis of Data in Nested Classification.

**Group C (Marks: 30)**

(Related Course - STAT-303: Sampling Techniques I)


**STAT LAB-312: Statistical Data Analysis VI**

½ Unit/2 Credit (at Least 35 Class Hours)

(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group)

**Group A (Marks: 20)**

(Related Course - STAT-304: Operations Research)

Solution of Linear Programming Problem by Geometric and Simplex Method, Transportation Problem, Game Problem: two Person Zero Sum Games, Optimization of Cost and Profits, Real Life Problem Related to Network Model and Inventory Model.

**Group B (Marks: 30)**

(Related Course - STAT-306: Econometrics)


**STAT LAB-313: Statistical Data Analysis VII**

½ Unit/2 Credit (at Least 35 - 40 Class Hours)

(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group)

**Group A (Marks: 30)**

(Related Course - STAT-307: Time Series Analysis)


**Group B (Marks: 20)**

(Related Course - STAT-309: Data Processing with Statistical Software)

Data Management, Univariate and Bivariate Tables, Descriptive Statistics, Graphs with Appropriate Title and Other Parameters, Performing Different Statistical Tests, Correlation, Simple and Multiple Regression, Polynomial Regression, Logistic Regression, Regression Post Estimation, Examination of Residuals, Outliers, Influential Points, Matrix and Vector Operations, PDF, CDF, Quantiles and Random Number Generations, Writing Functions, Looping.
Part IV

STAT-401: Statistical Inference II

1 Unit/4 Credit (at least 50 Class Hours)

Group A: Estimation


Group B: Test of Hypothesis


Prior and Posterior Odds, Bayes Factor for Simple vs Simple Hypothesis, Bayes Factor for Composite vs Composite Hypothesis.

Sequential Analysis, SPRT, Efficiency of SPRT, Fundamental Identity of Sequential Analysis, O.C. Function of Sequential Plan, ASN Function.

Bayesian Test of Hypothesis, Test of Influential Variables in Predictive Approach, Bayesian Approach to Contingency Tables. Concepts of Decision Theory.

Themes


References


STAT-402: Multivariate Analysis

1 Unit/4 Credit (at least 50 Class Hours)


Multivariate Analysis of Variance: MANOVA and Profile Analysis.

Multivariate Multiple Regression: Meaning, Functional form and Underlying Assumptions. Likelihood Ratio Test for Regression Parameters, Predicting Multivariate Multiple Regression, Confidence Ellipse and Prediction Ellipse from Bivariate Responses.

Principal Components: Introduction to the Principal Components Analysis, ML Estimator of the Principal Components and their Variances, Sampling Properties of the Sample Principal Components, Statistical Inference.

Cluster Analysis: Meaning and Objectives of Clustering, Different Similarity Measures, Euclidean Distance, Statistical Distance, Minkowski, Canberra, Hierarchical Clustering Method, Non-Hierarchical Method.

Discriminant Analysis: Meaning and Goals of Discriminations and Classification, Fisher's Linear Discriminant Function, Classification Into One of Two and Into One of More than Two Multivariate Populations, Quadratic Discriminators, Test of a Discriminant Function.

Canonical Correlation and Canonical Variables: Concepts of Canonical Variables and Canonical Correlation, Estimation of Canonical Correlation and Varieties, Large Sample Statistical Inference of Canonical Correlation.

Text

References

STAT-403: Design of Experiments
Covariance Analysis with Two Concomitant Variables.

Analysis of Variance in One-Way, Two-Way and Three-Way Classification with Unequal Number of Observations Per Cell, Test for Additivity, Multiple Comparison Test, Covariance Analysis with Two Concomitant Variables.


Factorial Experiment up to $p^r$ Series, Asymmetrical Factorial Experiments, Confounding, Partial Confounding, Total Confounding, Balanced Confounding, Fractional Replications, Multiple Comparison Tests, Split-Plot Design, Incomplete Block Design, Balanced Incomplete Block and Partially Balanced Incomplete Block Design with Their Construction, Lattice Design, Youden Square Design.

Text

References

STAT-404: Sampling Technique II
½ Unit/2 Credit (at Least 35 Class Hours)


Double Sampling: Description of the Technique, Double Sampling in Ration, Product and Regression Method of Estimation, Sample Size Determination. Double Sample for Stratification, Two-Phase PPS Sampling.


Sub Sampling: Reasons for Sub Sampling, Sub Sampling with Units of Equals Size, Tow Stage Sampling, Means and Variances in Two-Stage Sampling, Three-Stage Sampling, Sub Sampling with Units of Unequal Sizes, Units Selected with Equal Probabilities-Unbiased Estimator, Units Selected with Equal Probabilities-Ratio To Size Estimate, Estimation Using SRSWOR at both the Stages, Estimation using PPSWWR And SRSWOR.


Inverse Sampling: Inverse Sampling with Equal and Unequal Probability.


Texts
References


STAT-405: Data Mining

Overview: Meaning of Data Mining and Knowledge Discovery, Basics, Data Mining Tasks, Classification, Regression, Time Series Analysis, Prediction, Clustering, Summarization, Association, Rules, Sequence Discovery, Development of Data Mining, Data Mining Issues and Mining Metrics, Social Implications of Data Mining.


Data Mining Techniques: Statistical Perspective on Data Mining: Point Estimation, Models Based on Summarization, Bayes Theorem, Hypothesis Testing, Regression And Correlation. Similarity Measures, Decision Tree, Genetic Algorithms.


Classification: Issues in Classification, Statistical-Based Algorithms, Regression, Bayesian Classification, Distance-Based Algorithms, K-Nearest Neighbors, Decision Tree-Based Algorithms, ID3, C4.5, C5.0, CART, Neural Network-Based Algorithms, Propagation, NN, Supervised Learning, Radial Basis Function Network, Perceptrons, Rule-Based Algorithms, Generating Rules from DT, Generating Rules from Neural Net.


Texts

References

STAT-406: Epidemiology and Biostatistics

Epidemiology

Basic Concepts: Definition, Scope of Epidemiology, uses of Epidemiology.

Causation in Epidemiology: Concept of Cause, Establishing Cause of Disease.

Types of Epidemiologic Studies: Cross Sectional, Cohort, Case-Control, Retrospective and Prospective, Clinical Trials, Community Intervention and Cluster Randomized Trials.

Measures of Disease Frequency: Incidence and Prevalence Rates, Relation between Incidence and Prevalence, Case Fatality Rate, Risk Ratio, Rate Ratio, Risk Difference, Rate Difference, Mortality Measures, Standardized Mortality Ratio.

Measures of Association between Disease and Risk Factor: Relative Risk, Attributable Risk, Odds Ratio.

Epidemiology and Prevention: Scope of Prevention, Levels of Prevention: Primordial, Primary, Secondary and Tertiary.
Screening, Properties of Screening Test: Sensitivity, Specificity, Negative and Positive Predictive Values.

Biostatistics

Scope of Biostatistics: Probability Density Function, Survivor Function, Hazard Function, their Inter Relationships; Censoring and Truncation; Type I, Type II and Random Censoring; Likelihood Functions under Different Types of Censoring, Survival Distributions: Exponential, Weibull, Extreme Value, Gamma, Lognormal.


Inference Procedures for Exponential Distributions: One Parameter Exponential Distribution with Type I and Type II Censored Data, Comparison of Exponential Distributions, Two Parameter Exponential Distribution with Type I and Type II Censored Data.

Inference Procedures for Extreme Value Distributions: Inference Procedures for Weibull and Extreme Value Distributions with Type I and Type II Censored Data.

Exponential Regression Model: Method of Estimation, Tests of Hypothesis.

References


Texts


STAT-407: Advanced Demography

Demographic Transition Theory, Population Policies, Programs in Bangladesh, Changes Option in HPSP, Population Projection, Application and use of Different Demographic Projections with Special Reference to Bangladesh.

Urbanization and Migration, Economic and Social Consequences of Rapid Urbanization and Migration with Respect to Bangladesh.

Birth Averted by FP Program, Bongaarts Model and Proximate Determinants, Targeting and Projection by Bongaarts Model, Estimation of Adult Mortality by Indirect Means (Such as Orphan Hood, Widowhood Methods), Gompertz Model, Reduced Gompertz Model, Estimation of Fertility and Mortality from Two Censuses, Age Distribution, Estimation of Mortality from Census Based Method, Census Coverage and Estimation, Completeness of Coverage of Census and Vital Registration Data.

Population Momentum, Population aging and Health and its Implication.

Important Demographic Surveys.

Texts


References

7. Demographic Reports, BBS, NIPORT.

STAT-408: Stochastic Process

½ Unit/2 Credit (at Least 35 Class Hours)


Renewal Theory: Distribution of $N(t)$, Limit Theorem and their Applications, Renewal Reward Processes.


Text

References

STAT-409: Bioinformatics

½ Unit/2 Credit (at Least 35 Class Hours)

Introduction: Basic Cell Architecture, the Structure, Content and Scale of Deoxyribonucleic Acid (DNA), History of the Human Genome, Genes and Proteins, Current Knowledge and the ‘Central Dogma’, why Proteins are Important? Gene and Cell Regulation, when Cell Regulation Goes Wrong? So, what is Bioinformatics?

Introduction and Bioinformatics Resources: Knowledge of Various Databases and Bioinformatics Tools Available at These Resources, the Major Content of the Databases, Nucleic Acid Sequence Databases (Genbank, EMBL, DDBJ), Protein Sequence Databases (SWISS-PROT, Trembl, PIR, PDB), Genome Databases (NCBI, EBI, TIGR, SANGER), Other Databases of Patterns/Motifs/System Biology (Gene and Protein Network Database and Resources)

Sequence Analysis: Various File Formats for Bio-Molecular Sequences: Genbank, Fasta, Gcg, Msf, Nbrf-Pir Etc., Basic Concepts of Sequence Similarity, Identity and Homology, Definitions of Homologues, Orthologues, Paralogues. Basic Concept of a Scoring Matrix, PAM and BLOSUM Series. Sequence-Based Database Searches: what are Sequence-Based Database Searches, BLAST and FASTA Algorithms, Various Versions of Basic BLAST and FASTA.

Pairwise and Multiple Sequence Alignments: Basic Concepts of Sequence Alignment, Needleman and Wunch, Smith and Waterman Algorithms for Pairwise Alignments, Progressive and Hierarchical Algorithms for MSA. Use of Pairwise Alignments and Multiple Sequence Alignment for Analysis of Nucleic Acid and Protein Sequences and Interpretation of Results.


Texts
References

STAT-410: Categorical Data Analysis

1 Unit/4 Credit (at least 50 Class Hours)

Introduction-Distributions and Inference for Categorical Data: Categorical Response Data, Distributions for Categorical Data, Statistical Inference for Categorical Data, Statistical Inference for Binomial and Multinomial Parameters, Bayesian Inference for Binomial and Multinomial Parameters.


Text

Reference

STAT LAB-411: Statistical Data Analysis VIII

½ Unit/2 Credit (at least 35 Class Hours)
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks for Each Group)

Group A (Marks: 30)
(Related Course - STAT-401: Bayesian and Classical Inference)

Drawing Samples from Bivariate Normal, Multivariate Normal, Gamma, Beta and Other Distributions.

Estimation of Population Parameters of Different Distributions by Different Methods, Inference about Mean Vector and Variance-Covariance Matrix of Multivariate Population, Comparison of Several Multivariate Means.

Estimation of Confidence Interval for Mean and Variance.

Test of Simple Hypothesis for Mean and Variance, Drawing Power Curve, Test of Multiple Regression Coefficients, Test of Multiple Correlation Coefficients, Test of Mean Vector, Bayesian Contingency Table Analysis.
Group B (Marks: 20)
(Related Course - STAT-403: Design of Experiments)

STAT LAB-412: Statistical Data Analysis IX
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks For Each Group) ½ Unit/2 Credit  (at least 35 Class Hours)

Group A (Marks: 30)
(Related Course - STAT-402: Multivariate Analysis)
Determining Euclidean and Statistical Distances, Constructing Contour, Assessing Multivariate Normality and Box-Cox Transformation of Multivariate Data, Construction of Confidence Region For Different Testing Problems, Analysis of Covariance Structure, Analysis Of Data By MANOVA, Multivariate Regression Analysis, Principal Components, Factor Analysis, Canonical Analysis, Logistic Analysis, Classification And Grouping Techniques Of Data By Discrimination And Classification, Cluster Analysis of Categorical Data By Different Measures.

Group B (Marks: 20)
(Related Course - STAT-410: Categorical Data Analysis)

STAT LAB-413: Statistical Data Analysis X
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks For Each Group) ½ Unit/2 Credit  (At Least 35 Class Hours)

Group A (Marks: 20)
(Related Course - STAT-404: Sampling Technique II)
Drawing Probability Samples, Sampling with and without Replacement, Estimation of Population Characteristics and Variance of Estimators for Cluster Sampling, Double Sampling and Two Stage Sampling Methods, Allocation of Sample Sizes for Optimum Cost and Variance Function for Different Sampling Procedures, Drawing of Stratified Two-Stage Sampling and Estimation of Parameters, Related Precision of Different Sampling Scheme.

Group B (Marks: 30)
(Related Course - STAT-408: Applied Probability and Stochastic Process)


STAT LAB-414: Statistical Data Analysis XI
(Tutorial: 20% Marks, Attendance: 10% Marks, Final: 70% Marks For Each Group) ½ Unit/2 Credit  (At Least 35 Class Hours)

Group A (Marks: 30)
(Related Course - STAT-405: Data Mining)
Determination of Partition of Set of Data by Sum of Squares of Errors, Clustering Criteria, Hierarchical Clustering by Nearest Neighbor, Further Neighbor, K-Means Method or Algorithm, Determination of Minimum Distance Decision Boundary, Performing K-NN Classification Using Euclidean and Statistical Matrix, Application of Different Rules of Data Mining, Classification by Regression Tree, Decision Tree, Bayesian Approach, Neural Network.

Group B (Marks: 20)
(Related Course - STAT-406: Epidemiology and Biostatistics)
Plotting Procedures: Plots Involving Estimated Survivor and Hazard Functions, Probability Plots.

Estimation of Relative Risk: Cross Product Ratio, Prevalence Rate, Incidence Rate.

Three-Dimensional Contingency Tables: Fitting of Log Linear Models, Goodness of Fit Test.

Family of Exponential Distribution: Estimation of Parameters of Exponential, Weibull and Extreme Value Distribution for Censored Data, Fitting of Exponential Regression Model, Solution of Problems Regarding Epidemiology.