Detailed Syllabus for Semester II

BSTAT 201 Application of Probability in Real Life

Course Outcome:

After completion of the course the students will be able to

1. Understand different probability models in different real-life situations,
2. Build different probability models applicable for different types of data set,
3. Learn about important probability distributions,
4. Make use of moments and moment generating functions,
5. Use data generated from different probability distributions.

UNIT I

Two dimensional random variables: Discrete and Continuous type, Joint, Marginal and Conditional p.m.f, p.d.f., and c.d.f., Independence of Variables, Bivariate transformations with illustrations. Wald's Equation. Applications of Bivariate random vector in real situation.

UNIT II

Mathematical Expectation and Generating Functions: Expectation of single and Bivariate random variables and its properties. Moments and Cumulants, Moment Generating Function, Cumulant Generating Function and Characteristic Function. Uniqueness and Inversion theorems (without proof) along with applications. Conditional Expectations.

UNIT III

Standard probability distributions: Binomial, Poisson, Geometric, Negative binomial, Hypergeometric, Uniform, Exponential, Normal, Cauchy, Beta and Gamma along with their properties and limiting/approximation cases.

References:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

BSTAT 291 Probability Laboratory

Course Outcome

After completion of the course the students will be able to,

1. Model a data set based on appropriate probability distribution,
2. Apply probability to carry out decision analysis for real life data,
3. Understand the applicability of normality assumption across different data sets.

PRACTICAL/LAB. WORK: List of Practical (At least 10 Practicals)

1. Fitting of binomial distributions for n and p = q = 1⁄2.
2. Fitting of binomial distributions for given n and p.
3. Fitting of binomial distributions after computing mean and variance.
4. Fitting of Poisson distributions for given value of lambda.
5. Fitting of Poisson distributions after computing mean.
6. Fitting of negative binomial.
7. Fitting of suitable distribution.
8. Application problems based on binomial distribution.
9. Application problems based on Poisson distribution.
10. Application problems based on negative binomial distribution.
11. Problems based on area property of normal distribution.
12. To find the ordinate for a given area for normal distribution.
13. Application based problems using normal distribution.
14. Fitting of normal distribution when parameters are given.
15. Fitting of normal distribution when parameters are not given.
16. Gambler's ruin problem, Drunkard Step problem

BSTAT 202- Mathematical Analysis

Course Outcome:

After completion of the course the students will be able to,

1. To describe the fundamental properties of the real numbers that underpin the formal development of real analysis,
2. To demonstrate an understanding of the theory of sequences and series, continuity, differentiation and integration,
3. To apply and analyze rigorous mathematical arguments,
4. To apply procedures like interpolation, Numerical integration and solution of Differential equation in different application areas,
5. To Analyze and evaluate the accuracy of common numerical methods.

UNIT-I

Real Analysis: Representation of real numbers as points on the line and the set of real numbers as complete ordered field. Bounded and unbounded sets, Neighborhoods and limit points, Supremum and infimum, Derived sets, Open and closed sets, Sequences and their convergence, Limits of some special sequences such as and Cauchy's general principle of convergence, Cauchy's first theorem on limits, Monotonic sequences, Limit superior and limit inferior of a bounded sequence.

UNIT-II

Infinite series, Series with positive terms and their convergence, Comparison test, D'Alembert's ratio test, Cauchy's nth root test, Raabe's test, Gauss test, Cauchy's condensation test and Integral test (Statements and Examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence.

UNIT-III

Numerical Analysis: Approximations and Errors, Factorial notation, Operators: Shift, Forward, Backward, Central differences, Divided difference. Interpolation: Newton's forward, backward and divided differences interpolation, Lagrange's interpolation. Gauss and Stirling interpolation formulae

UNIT-IV

Numerical integration. Trapezoidal rule, Simpson's $1/3^{rd}$ rule, $3/8^{th}$ rule, Weddle's rule with corresponding error terms, Solution of differential equations of first order: Euler's and Modified Euler's method, Runge- Kutta Method (4^{th} order).

References:

1. Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International Limited, New Delhi, 1994.
2. Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi, 1987.
3. Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd., New Delhi, 1995.
4. Apostol T.M.: Mathematical Analysis, Second Edition, Narosa Publishing House, NewDelhi, 1987.
5. Shanti Narayan: A course of Mathematical Analysis, 12th revised Edition, S. Chand & Co. (Pvt.) Ltd., New Delhi, 1987.
6. Bartle, R. G. and Sherbert, D. R., Introduction to Real Analysis (3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore, 2002.

7. Jain,M. K., Iyengar, S. R. K. and Jain, R. K., Numerical methods for scientific and engineering computation, New age International Publisher, India, 2003.
8. Sastry, S.S. (2000): Introductory Methods of Numerical Analysis, 3rd edition, Prentice Hall of India Pvt. Ltd., New Delhi
9. Gupta, A. and Bose, S.C., Introduction to Numerical Analysis, Academic Publishers, 2009.

BSTAT 203 Introduction to Computer Programming using Python

Course Outcome:
After completion of the course the students will be able to

1. Understand the principles of Python and acquire skills in programming in python.
2. Interpret the fundamental Python syntax and semantics and be fluent in the use of control flow statements.
3. Implement Python programs with conditionals and loops.
4. Represent compound data using Python lists, tuples, dictionaries, Files and modules.
5. Implement the python programming features in practical applications.

Unit I
Basic concepts: Fundamentals of Python
Getting Started: Running Code in the Interactive Shell, Input, Processing and Output, Editing, Saving and Running a Script, Working of Python.

Variables, Expressions and Statements: Values and Data Types, Variables, Keywords, String Literals, Escape Sequences, Operators and Operands, Expressions and Statements, Interactive mode and Script mode, Order of Operations, Comments.

Python Operators and Operands: Arithmetic, Relational Operators and Comparison Operators -- Python Assignment Operators Short hand Assignment Operators -- Logical Operators or Bitwise Operators Membership Operators -- Identity Operators Operator precedence -- Evaluating Expressions

Unit II
String Handling: String operations and indices Basic String Operations -- String Functions, Methods -- Delete a string -- String Multiplication and concatenation -- Python Keywords, Identifiers and Literals -- String Formatting Operator -- Structuring with indentation in Python -- Built-in String Methods-- Accessing Values in Strings -- Various String Operators -- Python String replace() Method -- Changing upper and lower case strings -- Using "join" function for the string -- Reversing String -- Split Strings

Unit III
Control Structures: Boolean Expressions - Selection Control - If Statement- Indentation in Python- Multi-Way Selection – If-Elif statements--Iterative Control- For loop- While Statement- Infinite loops—Break and Continue Statements--Definite vs Indefinite Loops- Boolean Flags and Indefinite Loops.

References:

1. Mark Lutz, "*Learning Python Powerful Object-Oriented Programming*", O'reilly Media 2018, 5th Edition.
2. Timothy A. Budd, "*Exploring Python*", Tata MCGraw Hill Education Private Limited, 1st Edition, 2011.
3. Kenneth A. Lambert, The Fundamentals of Python: First Programs, Cengage Learning, 2011.

BSTAT 204 Environmental Science

Course Outcome:
After completion of the course the students will be able to

1. Understand and evaluate the global scale of environmental problems,
2. Reflect critically on their roles, responsibilities, and identities as citizens, consumers and environmental actors in a complex, interconnected world,
3. Use critical thinking, problem-solving, and the methodological approaches of the social sciences, natural sciences, and humanities in environmental problem solving.

Unit I

Introduction to environmental studies & ecosystems: Multidisciplinary nature of environmental studies: Scope and importance; what is an ecosystem? The structure and function of ecosystem, Energy flow in an ecosystem, food chains, food webs and ecological succession, forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems.

Unit II

Natural resources & its management and conservation: Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources and growing energy needs.

Unit III

Environmental pollution & management: Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution, Solid waste management: Control measures of urban and industrial waste. Climate change, global warming, Environment Laws: Environment Protection. Act, Air (Prevention & Control of Pollution) Act, Water (Prevention and control of pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Unit IV

Environment & social issues: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental ethics: environmental conservation; environmental communication and public awareness.

References:

1. Carson, R. Silent Spring. Houghton Mifflin Harcourt, 2002.
2. Gadgil, M., & Guha, R. This Fissured Land: An Ecological History of India. Univ. of California Press, 1993.
3. Gleeson, B. and Low, N. (eds.). Global Ethics and Environment, London, Routledge, 1999.
4. Gleick, P. H. Water in Crisis. Pacific Institute for Studies in Dev., Environment Security. Stockholm Env. Institute, Oxford Univ. Press, 1993.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.