

Course title: Numerical methods for Statistics

Course code: Math 2061

Credit hours: 3

Contact hours: 3

Prerequisite: Calculus for statistics

Aims

The course intends to introduce students with finding numerical solutions to statistical problems for which analytical solution cannot easily be obtained. It also aims to help Students develop programming skills.

Course outline

Chapter 1: Basic concepts in error estimation

- 1.1 Sources of errors, Approximation of errors and Rounding off errors
- 1.2. Absolute and relative errors
- 1.3. Propagation of errors
- 1.4. Instability

Chapter 2: Nonlinear equations

- 2.1 Locating Roots
- 2.2 Bisection Method, Secant methods, Newton Raphson method, fixed point iteration Method and Reguli False Method
- 2.3 Conditions for convergence

Chapter 3: System of equations (Reading Assignment)

- 3.1 Direct methods for system of linear equations
 - 3.1.1 Gaussian's method, Gaussian's method with Partial Pivoting , Jordan's method, Matrix inversion using Jordan's method and LU decomposition method
- 3.2 Indirect methods for system of linear equations
 - 3.2.1 Gauss Jacobi method
 - 3.2.2 Gauss Seidel method
- 3.3 Solving systems of non-linear equations using Newton's method.

Chapter 4 Finite differences

4.1 Shift operators, Forward difference operators, and backward difference operators

4.2 Relations with operators

Chapter 5: Interpolation

5.1 Linear interpolation and quadratic interpolation

5.2 Newton interpolation formula (forward and backward)

5.3 Lagrange's interpolation formula

5.4 Newton's divided difference interpolation formula

Chapter 6: Applications of interpolation

6.1 Numerical Differentiation

6.2 Numerical Integration (Trapezoidal & Simpson's Rules)

Chapter 7: First order initial value problems

7.1 Definition of ODE and examples

7.2 Order of a differential equation, linear and nonlinear ODE

7.3 Nature of solutions of ODE: particular and general solutions

7.4 Initial value problem, Method of separable of variables, Homogeneous equations, exact equations, non-exact equations and integrating factors

Chapter 8: Numerical methods for initial value problems

Taylor's method of order n , Euler's method and Euler's modified method

Assessment methods: Quiz one (15%), Quiz two (15%), attendance (5%), assignment (15%) and final exam (50%)

Teaching materials: Textbook: Gerald C. F. and Wheatly P. O., Applied numerical analysis 5th ed, Edsion Wesley, Co, and Dennis G.Zill, A first course in Differential Equations

References: Richard L. Burden, Numerical Analysis, 1981, 2nd Ed, P.A. Strock, Introduction to numerical analysis and Volkov, Numerical methods 1986