1. A Simple Mathematical Model
   1. Mathematical model: formulation or equation that expresses the essential features of a physical system or process in mathematical terms
      1. Dependent variable: characteristic that reflects behavior or state of system
      2. Independent variable: dimensions, such as time and space, along which the system’s behavior is being determined
      3. Parameters: reflective of system’s properties or composition
      4. Forcing functions: external influences acting upon it
   2. Characteristics of a mathematical model
      1. Describes a natural process or system in mathematical terms
      2. Represents idealization and simplification of reality
         1. Ignores negligible details of natural process
         2. Focuses on essentials
      3. Yields reproducible results and, consequently, can be used for predictive purposes
   3. Differential equation: written in terms of the differential rate of change of the variable predicting
   4. Analytical/Closed-form Solution
      1. Satisfies original differential equation
      2. Must approximate in most cases
   5. Numerical methods
      1. Mathematical problem is reformulated so it can be solved by arithmetic operations
   6. Finite-difference approximation
   7. Euler’s method
2. Conservation Laws in Engineering and Science
   1. Conservation laws
      1. Change = increase - decrease
      2. Time-variable or transient computation predict changes with respect to time
      3. Steady state: no change, increase = decrease
3. Numerical Methods Covered in this Book
   1. Part Two
      1. Root finding
         1. Searching for zeros of function
      2. Optimization
         1. Determining value or values of independent variable that correspond to best or optimal value of function
   2. Part Three
      1. Linear algebraic equations
         1. Values to satisfy equations
         2. Curve fitting
   3. Part Four
      1. Regression
         1. Curve to represent trend of data
      2. Interpolation
         1. Intermediate values between error-free data points
   4. Part Five
      1. Numerical Integration
         1. Area under a curve
      2. Numerical Differentiation
         1. Slope or rate of change
   5. Part Six
      1. Ordinary differential equations
         1. Initial value and boundary value problems