

# ***Mathematica*<sup>®</sup> for Rogawski's Calculus**

Abdul Hassen, Gary Itzkowitz, Hieu D. Nguyen, Jay Schiffman

W. H. Freeman and Company  
New York

© Copyright 2007

---

# Table of Contents

Chapter 1	Introduction
1.1	Getting Started
1.1.1	First-Time Users of <i>Mathematica 6</i>
1.1.2	Entering and Evaluating Input Commands
1.1.3	Help Menu
1.2	<i>Mathematica's</i> Conventions for Inputting Commands
1.2.1	Naming
1.2.2	Parentheses, Brackets, and Braces
1.2.3	Lists
1.2.4	Equal Signs
1.2.5	Referring to Previous Results
1.2.6	Commenting
1.3	Basic Calculator Operations
1.4	Functions
1.5	Palettes
1.6	Solving Equations
Chapter 2	Graphs, Limits, and Continuity of Functions
2.1	Plotting Graphs
2.1.1	Basic Plot
2.1.2	Plot Options
2.2	Limits
2.2.1	Evaluating Limits
2.2.2	Limits Involving Trigonometric Functions
2.2.3	Limits Involving Infinity
2.3	Continuity
Chapter 3.	Differentiation
3.1	The Derivative
3.1.1	Slope of Tangent

- 3.1.2 Derivative as a Function
- 3.2 Higher-Order Derivatives
- 3.3 Chain Rule and Implicit Differentiation
- 3.4 Derivatives of Inverse, Exponential and Logarithmic Functions
  - 3.4.1 Inverse of a Function
  - 3.4.2 Exponential and Logarithmic Functions
- Chapter 4 Applications of the Derivative
  - 4.1 Related Rates
  - 4.2 Extrema
  - 4.3 Optimization
    - 4.3.1 Traffic Flow
    - 4.3.2 Minimum Cost
    - 4.3.3 Packaging (Minimum Surface Area)
    - 4.3.4 Maximum Revenue
  - 4.4 Newton's Method
    - 4.4.1 Programming Newton's Method
    - 4.4.2 Divergence
    - 4.4.3 Slow Convergence
- Chapter 5 Integration
  - 5.1 Antiderivatives (Indefinite Integral)
  - 5.2 Riemann Sums and the Definite Integral
    - 5.2.1 Riemann Sums Using Left Endpoints
    - 5.2.2 Riemann Sums Using Right Endpoints
    - 5.2.3 Riemann Sums Using Midpoints
  - 5.3 The Fundamental Theorem of Calculus
  - 5.4 Integrals Involving Trigonometric, Exponential, and Logarithmic Functions
- Chapter 6 Applications of the Integral
  - 6.1 Area Between Curves
  - 6.2 Average Value
  - 6.3 Volumes of Solids of Revolution

- 6.3.1 The Method of Discs
- 6.3.2 The Method of Washers
- 6.3.3 The Method of Cylindrical Shells

Chapter 7 Techniques of Integration

- 7.1 Numerical Integration
  - 7.1.1 Trapezoidal Rule
  - 7.1.2 Simpson's Rule
  - 7.1.3 Midpoint Rule
- 7.2 Techniques of Integration
  - 7.2.1 Substitution
  - 7.2.2 Trigonometric Substitution
  - 7.2.3 Method of Partial Fractions
- 7.3 Improper Integrals
- 7.4 Hyperbolic Functions
  - 7.4.1 Hyperbolic Functions
  - 7.4.2 Identities Involving Hyperbolic Functions
  - 7.4.3 Derivatives of Hyperbolic Functions
  - 7.4.4 Inverse Hyperbolic Functions

Chapter 8 Further Applications of Integration

- 8.1 Arc Length and Surface Area
  - 8.1.1 Arc Length
  - 8.1.2 Surface Area
- 8.2 Center of Mass

Chapter 9 Introduction to Differential Equations

- 9.1 Solving Differential Equations
- 9.2 Applications
  - 9.2.1 Growth and Decay
  - 9.2.2 Annuity
  - 9.2.3 Logistics Equation
  - 9.2.4 Newton's Law of Cooling

9.3 Numerical Methods Using Slope Fields

9.3.1 Euler's Method

9.3.2 Vector Fields

Chapter 10 Infinite Series

10.1 Sequences

10.2 Infinite Series

10.2.1 Finite Sums

10.2.2 Partial Sums and Convergence

10.3 Tests for Convergence

10.3.1 Comparison and Limit Comparison Tests

10.3.2 The Integral Test

10.3.3 Absolute and Conditional Convergence

10.3.4 Ratio Test

10.3.5 Root Test

10.4 Power Series

10.4.1 Taylor Polynomials

10.4.2 Convergence of Power Series

10.4.3 Taylor Series

Chapter 11 Parametric Equations, Polar Coordinates, and Conic Sections

11.1 Parametric Equations

11.1.1 Plotting Parametric Equations

11.1.2 Parametric Derivatives

11.1.3 Arc Length

11.2 Polar Curves

11.3 Conic Sections

Chapter 12 Vector Geometry

12.1 Vectors

12.2 Matrices and the Cross Product

12.3 Planes in 3-Space

12.4 A Survey of Quadric Surfaces

	12.4.1	Ellipsoids
	12.4.2	Hyperboloids
	12.4.3	Paraboloids
	12.4.4	Quadratic Cylinders
	12.5	Cylindrical and Spherical Coordinates
	12.5.1	Cylindrical Coordinates
	12.5.2	Spherical Coordinates
Chapter 13		Calculus of Vector-Valued Functions
	13.1	Vector-Valued Functions
	13.2	Calculus of Vector-Valued Functions
	13.3	Arc Length
	13.4	Curvature
	13.5	Motion in Space
Chapter 14		Differentiation in Several Variables
	14.1	Functions of Two or More Variables
	14.1.1	Graphs of Functions of Two Variables
	14.1.2	ParametricPlot3D and ContourPlot3D
	14.2	Limits and Continuity
	14.2.1	Limits
	14.2.2	Continuity
	14.3	Partial Derivatives
	14.4	Tangent Planes
	14.5	Gradient and Directional Derivatives
	14.6	Chain Rule
	14.7	Optimization
	14.8	Lagrange Multipliers
Chapter 15		Multiple Integration
	15.1	Double Integration Over a Rectangle
	15.1.1	Double Integrals and Riemann Sums
	15.1.2	Double Integrals and Iterated Integrals in <i>Mathematica</i>

- 15.2 Double Integrals Over More General Regions
- 15.3 Triple Integrals
- 15.4 Integration in Polar, Cylindrical and Spherical Coordinates
- 15.5 Change of Variables

Chapter 16 Line and Surface Integrals

- 16.1 Vector Fields
- 16.2 Line Integrals
- 16.3 Conservative Vector Fields
- 16.4 Parametrized Surfaces and Surface Integrals
- 16.5 Surface Integrals of Vector Fields
- 16.6 Fundamental Theorems of Vector Analysis
  - 16.6.1 Green's Theorem
  - 16.6.2 Stokes' Theorem
  - 16.6.3 Divergence Theorem

Appendices

- A. Traditional Notation versus *Mathematica* Notation
- B. Useful Programming and Editing Commands
- C. Formatting Cells in a Notebook
- D. Saving and Printing a Notebook

References



