

Working Analysis

PART I

Chapter 1 Foundations

- 1.1 Ordered Fields
- 1.2 Completeness
- 1.3 Using inequalities
- 1.4 Induction
- 1.5 Sets and functions

Chapter 2 Sequences of real numbers

- 2.1 Limits of sequences
- 2.2 Criteria for convergence
- 2.3 Cauchy sequences

Chapter 3 Continuity

- 3.1 Limits of functions
- 3.2 Continuous functions
- 3.3 Further properties of continuous functions
- 3.4 Golden-section search
- 3.5 The intermediate value theorem

Chapter 4 The derivative

- 4.1 The derivative and approximation
- 4.2 The mean value theorem
- 4.3 The Cauchy mean value theorem and l'Hôpital's rule
- 4.4 The second derivative test

Chapter 5 Higher derivatives and polynomial approximation

- 5.1 Taylor polynomials
- 5.2 Numerical differentiation
- 5.3 Polynomial interpolation
- 5.4 Convex functions

Chapter 6 Solving equations in one dimension

- 6.1 Fixed point problems
- 6.2 Computation with functional iteration
- 6.3 Newton's method

Chapter 7 Integration

- 7.1 The definition of the integral
- 7.2 Properties of the integral
- 7.3 The fundamental theorem of calculus and further properties of the integral
- 7.4 Numerical methods of integration
- 7.5 Improper integrals

Chapter 8 Series

- 8.1 Infinite series
- 8.2 Sequences and series of functions
- 8.3 Power series and analytic functions

Appendix I

- I.1 The exponential and logarithm functions
- I.2 The trigonometric functions

Part II

Chapter 9 Convergence and continuity in \mathbb{R}^n

- 9.1 Norms
- 9.2 A little topology
- 9.3 Continuous functions of several variables

Chapter 10 The derivative in \mathbb{R}^n

- 10.1 The derivative and approximation in \mathbb{R}^n
- 10.2 Linear transformations and matrix norms
- 10.3 Vector-valued mappings

Chapter 11 Solving systems of equations

- 11.1 Linear systems
- 11.2 The contraction mapping theorem
- 11.3 Newton's method
- 11.4 The inverse function theorem
- 11.5 The implicit function theorem
- 11.6 An application in mechanics

Chapter 12 Quadratic approximation and optimization

- 12.1 Higher derivatives and quadratic approximation
- 12.2 Convex functions
- 12.3 Potentials and dynamical systems
- 12.4 The method of steepest descent
- 12.5 Conjugate gradient methods
- 12.6 Some optimization problems

Chapter 13 Constrained optimization

- 13.1 Lagrange multipliers
- 13.2 Dependence on parameters and second order conditions
- 13.3 Constrained optimization with inequalities
- 13.4 Applications in economics

Chapter 14 Integration in \mathbb{R}^n

- 14.1 Integration over generalized rectangles
- 14.2 Integration over Jordan domains
- 14.3 Numerical methods
- 14.4 Change of variable in multiple integrals
- 14.5 Applications of the change of variable theorem
- 14.6 Improper integrals in several variables
- 14.7 Applications in probability

Chapter 15 Applications of integration to differential equations

- 15.1 Interchanging limits and integrals
- 15.2 Approximation by smooth functions
- 15.3 Diffusion
- 15.4 Fluid flow

Appendix II

- A matrix factorization