E600 Mathematics Fall Semester 2026

Content Overview

A compilation of the chapters' outlines to form a general content overview.

Chapter 0: Fundamentals

- Mathematical notation and the basics of formal logic
- Fundamental definitions of set theory
- Terminology and fundamentals of functions
- Basic definitions of convergence and continuity
- Archetypes of proofs

Chapter 1: Linear Algebra I

- The basic concept of the general, formal vector space concept
- The details of the widely used Euclidean Vector Space
- Mathematical distance functions and their properties
- Limits and continuity beyond univariate real-valued functions
- Key properties of general sets (open/closed, bounded, convex)

Chapter 2: Linear Algebra II

- The formal matrix concept and key definitions/types of matrices
- The matrix-based linear independence test
- Matrix inversion and its usefulness for solving equation systems

  → Elementary operations and the Gauss-Jordan algorithm
- Key concepts related to matrices: rank, determinant, eigenvalues, definiteness

Chapter 3: Analysis I

- A formal introduction to multi-dimensional functions
- Key function properties: invertability, convexity (and concavity)
- Multivariate differentiation (main focus)
  - Formal definition and derivation
  - Application
- Multivariate integration: concept and key theorems

Chapter 4: Analysis II

- The formal basics of mathematical optimization
- Unconstrained optimization and its justification
- Optimization with one equality constraint
- Generalization to more complex problems (multiple constraints, inequalities)
- Solution techniques

  → Simplification, Lagrange, Karush-Kuhn-Tucker

Chapter 5: Statistics

- Basics from probability theory: outcomes, event Spaces, probability spaces
- Random variables and their properties
- Stochastic and propabilistic convergence
- Weak Law of Large Numbers, Central Limit Theorem