

Math Review Course: Syllabus

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Textbook:

- Sundaram, Rangarajan. *A First Course in Optimization Theory*, Cambridge University Press, 1996.

Supplementary Books:

- Rudin, Walter. *Principles of Mathematical Analysis*, Third Edition, McGraw-Hill, 1976.
- Bartle, Robert. *Elements of Mathematical Analysis*, John Wiley & Sons, 1976.
- Simon, Carl, and Lawrence Blume. *Mathematics for Economists*, W.W.Norton, 1994.

Course Outline:

1. Logic and Proofs
 - (a) Logical Notations and Their Properties
 - (b) Proofs (Simon and Blume A1.3)
2. Sets, Functions, and Numbers (Sundaram 1.1)
 - (a) Sets
 - (b) Functions
 - (c) Real Number
 - (d) n-Dimensional Euclidean Space
3. Sequences (Sundaram 1.2.1-1.2.6)
 - (a) Sequences and Limits

- (b) Subsequences and Limit Points
 - (c) Cauchy Sequences and Completeness
 - (d) Suprema, Infima, Maxima, and Minima
 - (e) Monotone Sequences in \mathbb{R}
 - (f) Lim Sup and Lim Inf
 - (g) Series
4. Basic Topology (Sundaram 1.2.7-1.2.10)
- (a) Open Sets and Closed Sets
 - (b) Compact Sets
 - (c) Connected Sets
 - (d) Convex Sets
5. Continuity (Sundaram 1.4.1 & Rudin Ch.4)
- (a) Continuous Functions
 - (b) Continuity and Compactness
 - (c) Continuity and Connectedness (Intermediate Value Theorem)
6. Differentiation (Sundaram 1.4.2-1.4.5 & Rudin Ch.5)
- (a) Differentiation of a Function from \mathbb{R} to \mathbb{R}
 - (b) Mean Value Theorems
 - (c) L'Hospital's Rule
 - (d) Higher Order Derivatives and Taylor's Theorem
 - (e) Differentiation of Functions from \mathbb{R}^n to \mathbb{R}^l
 - (f) Partial Derivatives and Differentiability
 - (g) Higher Order Derivatives of Functions from \mathbb{R}^n to \mathbb{R}
 - (h) Homogeneous Functions and the Euler Theorem (Simon and Blume Ch.20)
7. Integral (Rudin Ch.6)
- (a) Definitions and Existence
 - (b) Properties of Integral
 - (c) Integration and Differentiation: Fundamental Theorem of Calculus
8. Matrix Algebra (Sundaram 1.3)
- (a) Sum, Product, Transpose
 - (b) Some Important Classes of Matrices

- (c) Trace of a Matrix
 - (d) Partitioned Matrix
 - (e) Elementary Row Operations
 - (f) Inverse
 - (g) Determinant
 - (h) System of Linear Equations
9. Subspaces Attached to a Matrix (Simon and Blume Ch.27)
- (a) Vector Spaces and Subspaces
 - (b) Row and Column Spaces of a Matrix
 - (c) Nullspace and Affine Subspace
 - (d) Fundamental Theorem of Linear Algebra
10. Quadratic Forms (Sundaram 1.5)
- (a) Quadratic Forms and Definiteness
 - (b) Identifying Definiteness and Semidefiniteness