Preparing for the Master’s Comprehensive Exam

Problems on the Master’s Comprehensive Exam are drawn from the topics listed below. Graduate students intending to take the Master’s Comprehensive Exam may prepare for the exam by reviewing these topics. Typical textbook sources are listed for each core course.

Math 547 Linear Algebra II


Topics:
- Chapter 1, all sections
- Chapter 3, all sections
- Chapter 4, all sections
- Chapter 6, sections 1–7
- Chapter 7, sections 1–3

Math 570 Numerical Analysis I


Topic: Solutions of Nonlinear Equations
- Bisection method
- Secant method
- Newton’s method
- Fixed Point Iteration method
- Rates of Convergence

Topic: Interpolation and Approximating Functions
- Taylor polynomials
- Lagrange polynomials
- Divided differences
- Splines – quadratic and cubic
- Least squares and orthogonal polynomials
- Error analysis

Topic: Differentiation and Integration
- Approximations to derivatives
- Secant method
- Newton’s method
- Quadrature formulae using Taylor or Lagrange polynomials
- Error terms for each approximation

Topic: Solutions of Linear Systems
Gaussian elimination with pivoting
Jacobi iterative method
Gauss-Seidel iterative method
Order of computational complexity for each method

**Topic: Matrix Algebra**

LU factorization
QR decomposition
Singular value decomposition
Power method for eigenvalues

**Math 517 Real Analysis I**


**Topic: Set Theory and Preliminaries**

Least Upper Bound Property
Cardinality (countable and uncountable, Schoeder-Bernstein Theorem)

**Topic: Sequences**

$\epsilon$-$N$ definition of convergence
Cauchy criterion and Cauchy sequences
Monotone Convergence Theorem
Pinching Theorem
Bolzano-Weierstraß

**Topic: Series**

Definition of convergence
Cauchy Criterion for convergence
Elementary tests (divergence, comparison, alternating series)

**Topic: Topology**

Open sets
Three characterizations of closed sets
Connected Sets
Compact Sets
Heine-Borel Theorem
Effects of set operations on open, closed and compact sets

**Topic: Continuity**

The three Characterizations of continuity
Continuous images of connected and compact sets
Uniform continuity

Topic: Derivatives and Integrals

Limit definition of derivatives
Mean Value Theorem
Riemann Integrable
Integrability of continuous functions

Topic: Sequences and Series of Functions

Pointwise versus uniform convergence
Continuity/differentiability/integrability of convergent sequences/series

Math/Stat 555 Theory of Statistics I

Textbook: *Introduction to Mathematical Statistics* by Hogg, McKean and Craig.

Topics:

Chapter 1, all sections
Chapter 2, all sections
Chapter 3, sections 3.1 to 3.6
Chapter 4, sections 4.1 to 4.4
Chapter 5, sections 5.1, 5.2, and 5.4