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

Textbook: *Linear Algebra* by Serge Lang.

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

Textbooks: *Numerical Analysis* by Richard Burden and J. Douglas Faires. *Numerical Analysis* by David Kincaid and Ward Cheney.

Topics: Solutions of Nonlinear Equations

Bisection method

Secant method

Newton's method

Fixed Point Iteration method

Rates of Convergence

Topics: Interpolation and Approximating Functions

Taylor polynomials

Lagrange polynomials

Divided differences

Splines quadratic and cubic

Least squares and orthogonal polynomials

Error analysis

Topics: Differentiation and Integration

Approximations to derivatives

Secant method

Newton's method

Quadrature formulae using Taylor or Lagrange polynomials

Error terms for each approximation

Topics: 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

Textbooks: *Real Analysis and Foundations,* 2nd edition (2004) by Krantz, Chapman & Hall, CRC Press, chapters 110 and 14 (except 10.5, 14.5 and 14.6). *Principles of Mathematical Analysis,* 3rd edition (1976) by Walter Rudin, McGraw-Hill, chapters 1-7 and part of 8.

Topic: Set Theory and Preliminaries

Least Upper Bound Property

Cardinality (countable and uncountable, Schoeder-Bernstein Theorem)

Topic: Sequences

$\varepsilon - N$ definition of convergence

Cauchy criterion and Cauchy sequences

Monotone Convergence Theorem

Pinching Theorem

$Bolzano - Weierstra\beta$

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/differentiabilty/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 and 5.2

Math/Stat 556 Theory of Statistics II

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

Topics:

Chapter 5, sections 5.4 to 5.7

Chapter 6, all

Chapter 7, all

Chapter 8, sections 8.1 to 8.4

Chapter 9, sections 9.1 and 9.3