Oral Qualifying Exam Syllabus

Robert Dougherty-Bliss

Major topic: Experimental mathematics

Minor topic: Probability theory

Experimental mathematics

- Computer algebra
  - Maple
  - Dynamic programming
  - Symbolic sums
  - Asymptotic estimates
- Combinatorial enumeration
  - Permutations
  - Set partitions
  - Integer partitions
  - Random sampling
- Generatingfunctionology
  - Deriving generating function equations
  - Inverses
  - Exponential formula
  - Asymptotics
- Polynomial sequences
  - Generating functions
  - Closure properties
  - Sums
- C-finite sequences
  - Generating functions
  - Closure properties
  - Closed forms
  - Asymptotics
- Famous examples
  - Binomial theorem
  - Fibonacci numbers
  - Catalan numbers

Probability theory

- Basics
  - Probability spaces, random variables, distributions, expectation, independence, Borel-Cantelli lemmas
- Limit theorems
  - Weak and strong laws of large numbers, weak convergence of probability measures, characteristic functions of random variables, weak convergence in terms of characteristic functions, Central limit theorem
- Conditional expectation
  - definition and properties
- Discrete time stochastic processes
  - filtrations, adapted and predictable processes, martingales, stopping times, martingale convergence theorems, optional stopping, Doob's decomposition