Final Revision Checklist   **Math 20 Fall 2014, Dartmouth College**

1. Basics
   - Randomness
     - Definition of random variable, sample space, event
   - Discrete
     - Distribution function m
     - Tree diagrams
     - Uniform distribution
     - Geometric distribution
   - Continuous
     - Continuous sample spaces
       - Spinners (pick a point on a circumference, uniform density wrt angle)
       - Throwing darts (pick a point on a circular target, uniform density wrt area)
       - Points on a stick problems
       - Bertrand Paradox: choice of coordinates matters
     - Density f
     - Cumulative probability
       - Dirac delta and Heaviside step function
     - Uniform density
     - Monte Carlo sampling
2. Combinatorics
   - Permutations
   - Stirling's formula
   - Combinations with and without order
   - Birthday Problem
   - Binomial coefficients
     - Probabilities in poker
     - Bernoulli trials
     - Binomial distribution
     - Expansion of $(1 + x)^n$
     - Hypothesis testing
   - Inclusion-exclusion
   - Fixed points
3. Conditional probability
   - Showing independence for discrete events
   - Mutually independent events
   - Joint random variables
   - Joint distributions
   - Continuous conditional probabilities
   - Continuous independent events
   - Joint densities
4. Functions of random variables and important distributions and densities
   - Poisson Distribution
   - Negative binomial distribution
   - Hypergeometric distribution
   - Exponential density
   - Functions of random variables
   - Normal density
5. Expectation and Variance
   - Calculating expected values of random variables
   - Expected values of functions and sums of random variables
   - Conditional expectation
   - Expectation of product of independent random variables
   - Calculating variance
   - Variance of sums of random variables
   - Expectation and variance of important distributions
6. Sums of independent random variables

- – Convolution of two uniform densities
- – Convolution of two exponential densities
7. Law of Large Numbers
 - – Using the Chebyshev inequality
8. Central Limit Theorem
 - – Statement of the Theorem and estimating probabilities
 - – Confidence interval for surveys
9. Markov chains
 - – Gambler's Ruin: absorption probabilities and time to absorption
 - – Simple random walk on the integers
 - – Simple random walk on a graph
 - – Transition probabilities
 - – Stationary distribution
 - – Absorbing and transient states
 - – Fundamental matrix
 - – Time to absorption vector
 - – Matrix of absorption probabilities
 - – Hitting times
 - – Ergodic/irreducible Markov chains
 - – Regular Markov chains, $P^n \to \dots$
 - – Ergodic Theorem
 - – Reversible Markov chains
 - – Metropolis-Hastings algorithm

Relevant chapters in the textbook: 1.2, 2.2, 3.1, 3.2, 4.1, 4.2, 5.1, 5.2, 6.1, 6.2, 6.3, 7, 8, 9, 11, 12.2