Math 4610, Requirements for Final Exam

- 1.1. Equally likely outcomes, Odds and house percentage
- 1.2. Frequency interpretation of probability vs. subjective interpretation (opinion)
- 1.3. Distributions: partitions, rules of probability, named distributions. SKIP: empirical distributions
- 1.4. Conditional probability and independence. Multiplication rule. Tree diagrams. Rule of average conditional probabilities.
- 1.5. Bayes' rule.
- 1.6. Sequences of events. Birthday problem. Geometric distribution. Independence of three or more events.

- 2.1. Binomial distribution. Mode and mean.
- 2.2. Normal approximation to the binomial distribution. Normal distribution. Standard normal c.d.f. (Phi(x)). Using the normal table. SKIP: confidence intervals, skew-normal approximation (p. 101-107)
- 2.3. SKIP this section!
- 2.4. Poisson approximation. Formula for Poisson distribution. Know when to use normal approximation or Poisson approximation.
- 2.5. Random sampling. Sampling with and without replacement. Hypergeometric distribution. Know when to use the binomial distribution, and when to use the hypergeometric distribution.

- 3.1. Random variables. Distribution of a r.v. Joint distributions. Marginal probabilities. Independence of random variables. Same distribution vs. equal. Probabilities of events determined by X and Y. Conditional distributions. Multiplication rule. Multinomial distribution. Symmetry.
- 3.2. Expectation. Definition of expectation. Addition rule. Method of indicators. Tail sum formula. Markov's inequality. Expectation of a function of a random variable. Multiplication rule for expectation. SKIP: Gambling interpretation of expectation; expectation and prediction.
- 3.3. Standard deviation. Variance. Definition and computational formula for variance. Scaling and shifting. Chebychev's inequality. Using Markov's and Chebychev's inequalities to find bounds on probabilities. Sums and averages of random variables. Addition rule for variances. Square root law. Law of averages. Normal approximation. SKIP: random walk and skewness (p. 197-201).
- 3.4. Discrete distributions. Infinite sum rule. Expectation of a discrete random variable. Moments of the geometric distribution. Negative binomial distribution. Understanding the relationship between the geometric and negative binomial distributions. SKIP: the collector's problem.
- 3.5. Poisson distribution. Mean and standard deviation. Sums of independent Poisson random variables are Poisson. Be able to prove this. Know when to use a Poisson distribution as a model. SKIP: skew-normal approximation to the Poisson distribution (p. 225); random scatter (p. 228-233).

- 4.1. Probability densities. Calculate mean and variance using densities. Calculating probabilities by integrating the density. Uniform distribution. Normal distribution. SKIP: Fitting a curve; averages and integrals (p. 272-275).
- 4.2. Exponential distribution. Lifetime interpretation. Survival function. Mean and variance. Memoryless property. SKIP: relation to Poisson process; gamma distribution (bottom p. 283-p. 292).
- 4.3. SKIP this one!
- 4.5. Cumulative distribution functions. Definition. Draw for several discrete and continuous distributions. Relationship between c.d.f. and density. Find density from c.d.f. Find c.d.f. from density. Expectation formula using the c.d.f. Calculate the c.d.f. of a maximum or minimum of independent random variables. Percentiles, quantiles, quartiles. Inverse distribution function. SKIP: simulation via inverse distribution function. (bottom p. 320-p. 323).
- 4.4. Change of variable. Find the c.d.f. (and density) of a function of X from the c.d.f. of X. DO NOT use the formula in the box on p. 304! Linear change of variable for densities.

- **Note:** For Chapter 5, see the last day lecture notes on my web site at

  www.math.unt.edu/∼allaart/4610/last-day-lecture-notes.pdf

- 5.1: Uniform distributions
- 5.2: Joint densities, independence; see in particular the chart on p. 349. SKIP: Example 3
- 5.3: Sum of independent normal random variables (pp. 363-364); SKIP everything else.
- 5.4: Operations: distribution of sums (density convolution formula); distribution of products/ratios using the method of Section 5.2. SKIP: pp. 375-381.