Material Covered

Test 2 is cumulative and covers through Section 4.3 (and the portions of the appendices we have used) but omitting Sections 3.5 and 3.7–3.9. The emaphasis will be on things covered since Test 1, but you should not have forgotten things that were covered on Test 1.

Note that there is a summary at the end of each chapter that briefly reviews the most important topics of the chapter.

Format

The exam will include both an in-class portion and a take-home portion. For the in-class portion, no notes are allowed, but I will provide you with the table like the ones in the back cover of the book.

Things you should be sure to know

1. basics of linear algebra
   (a) addition and subtraction of vectors and matrices
   (b) dot products and matrix products
   (c) orthogonality and projection
   (d) transpose and inverse
   (e) notation
2. basics of random variables (continuous and discrete)
   (a) notation: X vs x, F vs f, subscripts on f and F, etc.
   (b) pmfs, pdfs, cdfs, probability and quantile calculations
   (c) using `integrate()` to compute probabilities, expected values, and variances from pdfs
   (d) how and why to use the cdf method
   (e) how and why to use the mgf
   (f) mean, variance, and standard deviation of a discrete random variable
   (g) various lemmas that simplify computation of means and variances. (Example: $E(X+Y) = E(X) + E(Y)$.)
3. favorite distributions (binomial, negative binomial, hypergeometric, Poisson, uniform, exponential, normal, Gamma, Beta)
   (a) situations where they are (or might be) good models
   (b) R functions: `dexp()`, `pexp()`, `qexp()`, `rexp()`, etc.
   (c) Using Tables A and B.
4. moment generating functions
   (a) calculation
   (b) obtaining mean and variance from mgf
   (c) uniqueness and distribution recognition
   (d) mgf of linear transformation of a random variable
   (e) mgf of an independent sum, connection to sample means
5. joint distributions

(a) joint pmfs and pdfs and probability calculations
(b) marginal and conditional distributions
(c) independence and covariance
(d) covariance lemmas
(e) expected value and variance of a sum
(f) expressing binomial and hypergeometric distributions as sums to make calculation of mean and variance easier

6. Hypothesis testing
   (a) 4-step approach
   (b) interpreting p-values
   (c) 1-sided and 2-sided tests
   (d) type I and type II error, power
   (e) Binomial Test (`binom.test()`)
   (f) Fisher's (Exact) Test (`fisher.test()`)
7. Method of Moments estimates for parameters
   (a) Estimand, Estimate, Estimator
   (b) Sampling Distribution

Some Additional Comments

- Be sure to look over your old homework so you can fix any problems detected there.
- No mystery numbers allowed. It should be clear where every number comes from.
  - If you use a calculator or computer to get a number, it must be clear from the work on your paper how someone else could get that number. (Write down the R code, for example.)
  - When doing combinatorics problems, make it clear where the component numbers are coming from.
  - Round as late as possible. Keep three significant digits. (Leading 0's are not significant digits.)
- Use notation well.
  - You are required to understand and use the notation we have introduced in class. This includes correct use of the equals sign (=).
  - If you received a "notation" comment on a problem set, be sure you understand it.
  - You may invent notation as long as you explain it.
- Don't be afraid to use words.

  In any case, do your work in "paragraph order" (left to right, top to bottom).
- When doing probability problems be sure to identify the events and random variables involved.

  For working with random variables, for example, it is often good to have statements like each of the following exaples as part of your solution:
  - Let X = the time until the next customer arives.
    (Describe the random variable in words.)
  - Then $X \sim \mathsf{Exp}(\lambda = 20)$.
    (Specify the particular distribution of the random variable if it is one of our familiar examples.)

- $P(X \geqslant 30) = 1 - P(X \leqslant 30) =$ `1 - pexp(30,20)`
  (Identify the probability you are calculating and the R code used to get it.)

A similar approach should be used for other probability problems as well. This approach will help you think clearly and avoid errors. It will also help me grade your work.