Your Own Notes: You may use any notes or aids that you want. Certainly, it helps to summarize the notes for yourself rather than flipping through lots of notes.

I will provide
- $t$-table
- Expected Mean Squares handout.

Refer back to the study guide for Exams 2 and 3.
- The final exam includes material covered on the second exam and later except
  - No computations for 3-way ANOVA other than df.
    - On some old exams there were questions involving main effects or 2 factors interactions. Those types of questions would still be fair game, but they would be asked in terms of a 2 factor example rather than a 3 factor example.
  - Only constant variance situations
  - No power or sample size calculations
    - There could be questions about why/if/when power or precision is improved
    - But no questions to compute a numerical value of $n$ or power.
  - No questions explicitly about Johnson or Hahn articles
- Only topics covered on homework, in class or posted example questions would be on the exam.
  - Any other information in the text would not be on the exam.
- As on the other exams, I will ask some understanding questions that require prose answers.

Material on Final not covered on second exam:
- Unbalanced data
  - Type I vs Type III SS
    - What each tests in terms of reduction in residual/error SS
      - Be able to specify how much the Error SS would be increased by if a factor is left out of the model
        - For a single factor: Type III SS.
        - Sum of Type I SS for last factors listed
    - Correspondence to adjusted or unadjusted means.
    - When Type I and Type III SS are different
    - Be able to calculate for yourself
      - First of the Type I SS: Just like 1-way ANOVA SS
        - ANCOVA if the treatments are first in the model
        - Randomized blocks
        - Factorial design
      - Type III SS for 2x2 design as on assignment 10.
  - Least squares (adjusted) means versus unadjusted means for ANCOVA, 2x2 design and randomized blocks
    - When these will differ
    - Will the lsmean be less than, equal to or greater than unadjusted mean?
    - Calculation of LS Means
      - From summary data for 2x2 design
      - From proc glm parameter estimates
- ANCOVA
- Blocks with a missing observation

- Computations for 2x2 unbalanced data like the on exam 3.
- Calculations for unbalanced blocked design as on assignment 10.

**Specifying sources, df, E(MS) and denominators in ANOVA table for an experiment**

- Recognizing design aspects of an experiment
  - Blocking
  - Fixed vs random effects
  - Nested effects
  - Split plot
  - Repeated measures
    - For repeated measures, only be able to recognize that a design has repeated measures aspects so that other methods that we haven't covered need to be used.
    - The section in the book on analysis of repeated measures doesn't go far enough.
      - There are better methods in many cases.
    - I will give you at least one experimental set-up and ask you to give the sources and df.
      - See examples from class and problems posted under Exam Info
    - I will give you at least one experimental situation along with the sources and df and ask you to give Expected Mean Squares and denominators of F-tests.

**Some general points**

- What do we need to assume for any particular analysis?
  - All analyses from chapter 8 on assume
    - Normal errors
    - Independent errors
    - Equal variances
  - ANCOVA also assumes linear, parallel responses
  - For example if we analyze a randomized block experiment without blocks in the model,
    - The errors in a given block will be correlated.
    - A block with large values will have generally larger errors
    - Once the block effect is included, the errors are no longer correlated
      - Errors in each block average to zero after subtracting block effects.
      - Errors in one block are not generally higher or lower than in other blocks.
  - Deciding if those assumptions are being met.
    - Questions to ask about the experimental setup
    - Deciding based on graphical or other given information.
    - Deciding what to do next after diagnosing problems with assumptions
    - Deciding if a particular analysis tool is right for some particular data.
      - It's just as important to know when to use or not use a tool as it is to know how to use the tool.
      - For example problem 3 on Exam 2 for 2007
Study materials

- Go back over the lecture notes and book, especially the lecture notes.
  - These will make more sense now that you have used the methods.
  - Understand why we are doing various things, not just memorized.
    - Memorization won’t work when the situation is changed a bit from the exact example in class or the exact question asked on homework.
- Go over the assigned questions and in class exercises
  - Go over posted answers to assignments
    - There is more there than just the numerical answers.
- Go over posted sample problems.
  - Work the problem first yourself before checking answers.
- Think about advantages and disadvantages of different approaches and what goes wrong if we make wrong choices.
- Old exams will not be perfect, all inclusive study guides
  - Certainly, you do want to be able to do the specific tasks on those old exams and more.
  - The exams definitely give an idea of the types of questions I put on exams.
  - What I said and what I emphasized this time around aren't exactly the same as previously.
    - “You could not step twice into the same river; for other waters are ever flowing on to you.” Heraclitus
    - Exams will change as well to fit the material from that semester.
  - I will go back to see what problems to add to problems listed for exams 2 and 3.
- Sample Problems
  - I will go back to see what problems to add to problems listed for exams 2 and 3.

The current DRAFT of the final exam includes in part the following types of questions. Most questions include multiple parts. I will be making final decisions on the exam down the line, so just because a question is not on this list does not mean it will not be on the final.

- First I describe an experimental situation. The factors in this experiment are ….
  - Give the sources and df in the resulting ANOVA table.
  - Circle sources that you would assume to be random.
- Given ANOVA table with only sources listed.
  - Decide which factors should be random effects.
  - Find degrees of freedom
  - Show expected mean squares
  - What mean square would you use in testing certain effects?
- Something with nested effects
- Something with a split plot design.
  - A random effect nested within only one of the fixed effects.
- The attached graph or graphs represent data for ….
  - What is the most important piece of information (other than the data or other numerical summaries) you need to ask about in order to analyze these data properly?
  - Assessing assumptions of the usual ANOVA model based on plots.
- Something about interactions.
- Something with unbalanced blocks
- Something with ANCOVA
- Something with results back-transformed from a log scale.