STA6209: Statistical Design Spring 2011
Prof. Casella

Assignment	Due Date	Chapter	Problems
1	Monday 1/24	1	1.3, 1.4, 1.5, 1.6ab, 1.13a, 1.16,1.21a, Stat Majors: 1.9, 1.23

Additional Problem An experiment was conducted on the control of the citrus snout beetle by 5 insecticides (A-E) applied in concentrations determined on an equal cost basis. Each treatment was applied to five trees in five different stands.The number of dead beetles was observed during the four week period following spraying.

Stand	A	B	C	D	E
1	24	67	25	117	145
2	27	54	42	77	47
3	38	149	87	70	202
4	39	129	72	161	182
5	28	134	115	193	210

1. Explain how you would carry out the randomization of treatments to trees

2. As stated, would you this experiment a completely randomized design or a randomized complete block design?

3. Analyze these data according to what you feel is the appropriate design. State and test the overall null hypothesis. (Don't be overly concerned by normality violations, but you should suggest a transformation of the data.)

4. The experimenter is also interested in finding out (i) Which insecticide is the most effective? and (ii) Does insecticide E perform better than insecticide C? Answer these questions for the experimenter.

Assignment	Due Date	Chapter	Problems
2	Monday 2/7	2	2.1, 2.5, 2.9, 2.12, 2.13 2.15a-c, 2.18, 2.24a, 2.31 Stat Majors: 2.19, 2.22

Additional Problem Before beginning an analysis a colleague warned the researcher that a reagent that is used in preparing the plant samples deteriorates rather quickly. The reagent must be added immediately before the sample is measured. The researcher decides that he does not have time to prepare more than one batch of this reagent for each day. What steps should he take to insure that the gradual deterioration of the reagent over the course of the day does not affect the results of his experiment? He considers (a) simply randomizing the order of plant samples through the day, (b) blocking on small time periods through the day, or (c) using a covariate to adjust for the degradation of the reagent.

1. Which of these options would you recommend? Justify your choice.
2. Do you have a better suggestion (if so explain why it is better)?

Assignment	Due Date	Chapter	Problems
3	Monday 2/20	3	3.3, 3.7, 3.9, 3.13, 3.14, 3.17, 3.20 Stat Majors: 2.26, 3.2 (3.2 will be graded)

Additional Problem (This is from the text by Dean and Voss) An experiment was conducted to study how to make fluffy biscuits. The two treatments of interest were H = "height of the uncooked biscuit" (.25, .5, .75) inches, coded as (1,2,3), and K = "kneading time" (7, 14 or 21 times), also coded as (1,2,3). Dean and Voss then say that the design used was a "general complete block design". The $b = 4$ blocks consisted of the four runs of the oven, and the experimental units consisted of the 18 positions on a baking pan, each of which got two replications of the 9 treatment combinations.

This is the biscuit data from the textbook by Dean and Voss. You can get the data at http://www.wright.edu/ dan.voss/bookdata/data.html

1. Do you agree with their definition of the experimental unit? Explain your position.
2. Explain how we can consider their "block" to be a random factor.
3. Write down the model for the experiment, identifying all terms.
4. Run the anova and state the conclusions

5. Dean and Voss want you to run an appropriate multiple comparison procedure to determine which treatment is best, and to evaluate whether blocking was worth while. Do this and report the conclusion.

Assignment	Due Date	Chapter	Problems
4	Monday 3/21	3-5	3.35, 4.3, 4.8, 4.9 5.1, 5.3, 5.4, 5.9, 5.13, 5.15 Stat Majors: 4.17ab, 5.31

Additional Problem (This is from the text by Kuehl; *Statistical Principles of Research Design and Analysis* 1994)

A research specialist for a large seafood company investigated bacterial growth on oysters and mussels subjected to three difference storage temperatures. Nine cold storage units were available. Three storage units were randomly selected to be used for each of the storage temperatures. Oysters and mussels were stored for two weeks in each of the cold storage units. A bacterial count was made from a sample of oysters and mussels at the end of the two weeks. The log of the bacterial count for each sample is given in the dataset `OystersMussels`.

1. What is this design? Identify the roles of the factors.

2. There could have been three replications for the study by simply taking three random samples of each seafood from a single cold storage unit set at one temperature. In this way only three cold storage units would have been needed for the study, one for each temperature. What is this design? Are there any potential problems with this?

3. As another alternative, with six storage units we could set two at 0^o, two at 5^o, and two at 10^o. The we could assign three batches of oysters to the three temperatures, and three batches of mussels to the three temperatures, so we don't mix oysters and mussels in the same unit. What is this design? Are there any potential problems with this?

4. Kuehl then asks:

   (a) Is there a significant increase in bacterial growth as temperature increases? Justify your answer.

   (b) Is there a significant interaction between type of seafood and increase in bacterial growth with temperature? Justify your answer.

(c) Write the model for your analysis, state the assumptions, and explain the terms.

(d) Determine whether your assumptions about the linear model are correct for these data.

Do what Kuehl asks. I will be particularly interested in how you answer (d). I am not sure how to do this.

Assignment	Due Date	Chapter	Problems
5	Monday 4/4	5-6	5.13, 5.15, 5.31, 6.1, 6.4, 6.8, 6.13abc, 6.20 Stat Majors: 5.31, 6.31

Two Additional Problems (These are from the text by Mead, my second favorite book on design)

1. For an experiment to compare seven treatments, 56 experimental units are available. The 56 units occur in seven natural blocks containing eight plots each. Two experiments are suggested:

   (a) Discard one plot from each block and use an RCB.

   (b) Split each block into two block of four plots each and use a BIBD for seven treatments in 14 blocks.

   Compare the variance of a treatment contrast for each design and make a recommendation.

2. A horticulturist wishes to test which of seven new varieties of aubergine plant produces the best crop. He has a maximum of nine greenhouses available in which to conduct trials; each greenhouse is to be allocated aubergine plants of three different varieties.

   Construct a design for this experiment, assuming that the horticulturist can obtain as many plants of each variety as needed. What are the advantages an disadvantages of the design?