Math/Stat 423 and Stat 523 Spring 2014

Homework 1 (Due January 23 Thursday)

1. Section 7.4, #48 (2-sided CI)

2. Section 8.2, #22

3. Section 9.1, #12 (2-sided CI)

4. Section 9.1, #10 a

5. Section 9.2, #19

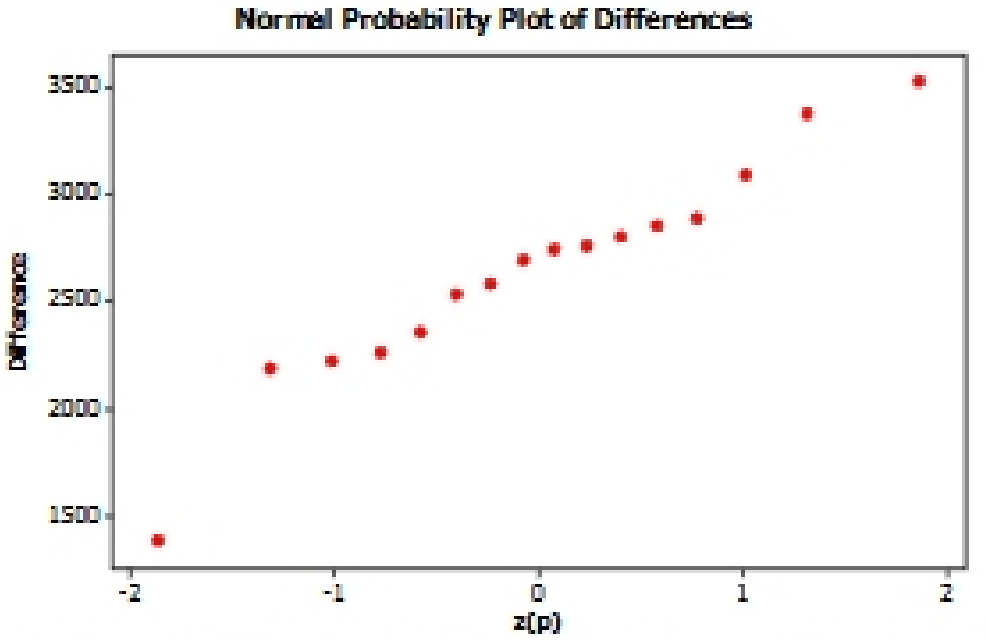
6. Section 9.2, #25 (2-sided CI). **Skip the last question.**

Homework 2 (Due January 30 Thursday)

1. Section 9.2, #30 a (Two-sided CI. There's no ν=37 in the table, so use ν=36 instead.)

2. Section 9.2, #32 b (Give the rejection region.)

3. See Problem #46 of Section 9.3. **Follow these instructions**:
   a. A normal probability plot of the differences is given below. Does the plot cast strong doubt on the approximate normality of the population distribution of differences? Explain briefly.



   b. Calculate and interpret an upper 95% confidence bound for the true average differences between 1-minute modulus and 4-week modulus.

4. A chemical engineer is designing the production process for a new product. The chemical reaction that produces the product may have higher or lower yield, depending on the temperature and the stirring rate in the vessel in which the reaction takes place. The engineer decides to investigate the effects of combinations of four temperatures (50°C, 60°C, 70°C, 80°C) and two stirring rates (90 rpm, 120 rpm) on the yield of the process. She will process two batches of the product at each combination of temperature and stirring rate.
   a. What are the experimental units and how many are required?
   b. What are the explanatory variables?
   c. What are the treatments and how many are there?
   d. What is the response variable?

5. You wish to compare four treatments for effectiveness in preventing flu: (1) a flu vaccine, (2) 1 gram of vitamin C per day, (3) an Echinacea pill, and (4) a placebo taken daily. (A placebo is a dummy pill which contains no active ingredient and should have no physical effect.)
   a. In clinical experiments involving people, it is strongly recommended that a placebo be included among the treatments. Explain why.
   b. What is an appropriate response variable?
   c. Suppose that 1200 volunteer subjects are available for the study. Draw a diagram showing a design of your experiment. Clearly indicate where randomization, replication and control are applied in the experiment.

Homework 3 (Due February 6 Thursday)

1. Section 10.1, #3
   - Give the reject region. Do not compute the p-value.

2. In a study, mosquitos were divided into four groups of eight mosquitos each: infected rhesus and sporozites present (Trt 1), infective rhesus and oocysts present (Trt 2), infective rhesus and no infection developed (Trt 3), and noninfective (Trt 4). Distances flown by the mosquitos within 24 hours were recorded. The summary data are:

   $\bar{x}_{1\cdot} = 4.39, \bar{x}_{2\cdot} = 4.52, \bar{x}_{3\cdot} = 5.49, \bar{x}_{4\cdot} = 6.36, \bar{x}_{\cdot\cdot} = 5.19, \sum\sum x_{ij}^2 = 911.91.$

   Use the ANOVA F test at level 0.05 to decide whether there are any differences between true average flight times for the four treatments.
   - Show all hand calculations using the formulas discussed in class.
   - Give the reject region. Do not compute the p-value.

3. An experiment was carried out to compare the electrical resistivity for six different low-permeability concrete bridge deck mixtures. There were 26 measurements on concrete cylinders for each mixture. A partially complete ANOVA table for analyzing he data is given below. Fill in the remaining entries and carry out the appropriate hypothesis test.

Source	df	SS	MS	F
Mixture				
Error			13.929	
Total		5664.415		

   - Use SSTr=SST-SSE and SSE=I(J-1)×MSE

4. (Read the entire problem first before suggesting an experiment design.) An agronomist wants to compare the yields (kg/ha) of 2 wheat varieties. There are 8 farm plots available for this experiment. A preliminary study reveals that the farm plots are very distinct. In particular, soil fertility and soil moisture varied significantly among the plots.
   a. Design an experiment for comparing the wheat varieties that would account for the differences among plots. Wheat varieties will be grown at the same time. You may describe the design in words and/or with a diagram.
   b. Assume data are normally distributed. What test of hypothesis would you conduct on the data to determine which wheat variety has a higher yield? State the appropriate null and alternative hypotheses. (Hint: Your choices are: a two-sample t-test of Section 9.2 or a paired t-test of Section 9.3).