Stat 332 – Assignment 4
Prof. Samuel Wong – Winter 2019
Due: Friday, April 5 at 11:59pm on Crowdmark

General instructions: You may submit your work using one or more of the following ways:

- Type out work, for example using 'Latex', 'R Markdown', or Word.
- Present scans/photographs of handwritten work. If you choose this option ensure your work is legible. Illegible work will receive no credit.

For data analysis problems: When you are using R (which we strongly encourage), you must clearly present your final answers in addition to the commands you used.

1. You are responsible for setting up a hydroponics garden to grow tomatoes in a new high rise complex. You have two types of additives that may be used in your growing solution: one to speed plant growth and another to increase the size of each tomato produced. For the plant growth enhancer you have two choices: A and B. For the tomato size enhancer you have three choices: 1, 2 and 3. Therefore you have six treatments in all: A1, A2, A3, B1, B2 and B3. You have 36 hydroponic tanks with which to run your test. The tanks have been randomly divided into six groups of six tanks each, and each group has been randomly assigned to one of the six solution types. Unfortunately some of the tanks were contaminated by sloppy cleaning before the experiment, so no plants grew in them. The total mass of tomatoes yielded by each tank after three months (in Kg) are recored below. Missing values are denoted by NA. Data are available in the posted file `tomato.csv`.

tank	A1	A2	A3	B1	B2	B3
1	5.088	5.078	4.937	5.041	4.968	4.932
2	5.058	4.984	5.039	NA	4.904	4.971
3	5.046	4.939	5.017	5.032	4.900	NA
4	5.038	4.995	4.928	5.081	4.938	4.985
5	5.067	NA	5.031	4.933	4.987	4.966
6	5.029	4.912	4.970	5.094	4.997	NA

   (a) Compute the ANOVA table for this experiment.

   (b) Determine whether there is evidence of any differences among the six treatments at the $\alpha = 0.05$ level.

   (c) Compute a 95% confidence interval for the difference between treatments A1 and B3. Does this give us evidence that these two treatments are different?

2. A chemist wishes to test the effect of four chemical agents on the strength of a particular type of cloth. Because there might be variability from one bolt (or roll) to another, the chemist decides to use a randomized block design, with the bolts of cloth considered as blocks. She selects five bolts and applies all four chemicals to each bolt. The resulting tensile strengths are as follows. Data are available in the posted file `cloth.csv`.

	Bolt				
Chemical	1	2	3	4	5
1	73	68	74	71	67
2	73	67	75	72	70
3	75	68	78	73	68
4	73	71	75	75	69

(a) Write down the appropriate statistical model from class for this experiment and state the model assumptions and parameter constraints. Be sure to define all variables and parameters used in the model.

(b) Complete an ANOVA table using the given data. Test whether there are any significant differences among the means of tensile strength for the four chemicals at level $\alpha = 0.05$.

3. (In the old days) A manufacturer of television sets is (was) interested in the effect on tube conductivity of four different types of coating for colour picture tubes. The different types of coating are obtained by varying the levels of two factors, that we will simply call A and B. The following conductivity data are obtained. Data are available in the posted file `tv.csv`.

Coating Type	Factor A	Factor B	Conductivity			
1	low	low	143	141	150	146
2	low	high	152	149	137	143
3	high	low	134	136	132	127
4	high	high	129	127	132	129

(a) Write down the appropriate statistical model from class for this experiment, that can assess whether Factors A and B interact. Be sure to define all variables and parameters used in the model.

(b) Draw an interaction plot. Be sure to label your axes.

(c) Construct the ANOVA table, and test at the $\alpha = 0.05$ level:

i. if there any significant difference among treatments, and

ii. if the interaction parameters are significantly different from zero.

(d) Now use a contrast to test if the effect of Factor A is the same for each level of Factor B at the $\alpha = 0.05$ level. Does the p-value agree with part (c)?