**Homework Assignment #1, Math 740/840, Fall 2019**

**Due Wednesday9/18/2019**

I want the completed assignment handed in electronically through myCourses as a PDF document. You can upload the completed assignment through the Assignment page on myCourses. Do note email your completed assignment to the instructor they must be submitted through myCourses (Canvas). **Important**: in the **name of the file** that you submit please be certain to include your name (last name, then first name), the course number, and the assignment number; this helps greatly with grading.

You may discuss the homework with each other; however, you must turn in your own original solutions – no copying. The intent is that you may participate in a study group, but you must do your own work. Remember, copying someone else’s work and presenting it as your own is cheating (and stealing from them). If you have any questions about cheating, then I suggest that you read the student handbook section on academic honesty. Access the handbook at <https://www.unh.edu/student-life/09-academic-honesty>. The rules will be enforced.

**Please show all work for each answer**; i.e., show how you arrived at the answer.

Also, in order to get full credit, where asked to use JMP to answer questions you must turn in a copy of the portion of the JMP output that is relevant to your solution. **Do Not just write down answers**, I need to see where you got the information from the JMP output. Remember the selection tool (fat plus sign) on the Cursor Tool Bar can be used to copy paste output from JMP to other applications.

1. (10 pts) Civil engineers are studying four different water filtration systems for municipal water supplies. The response of interest is the level of impurities (in ppm) remaining in the water after filtration. The four systems were hooked up in parallel to the same input water source for the experiment. Over a period of one week, after the filters were properly conditioned, individual gallons of water were randomly obtained from each of the filtration system and the amount of remaining impurities in the water samples measured. Use the data set **Impurities.JMP** and the JMP software to answer questions about this experiment.  
   1. What is the experimental unit (EU) for this experiment?
   2. Write out the one-way ANOVA model for an experiment with replication and no subsampling.
   3. State the null and alternative hypotheses for a one-way ANOVA analysis of the data.
   4. Use the Fit Y by X platform in JMP to perform a one-way ANOVA on the experimental results. Be sure to include the relevant portions of the JMP output in your report.
   5. Based upon the JMP output what is your conclusion concerning possible mean impurity level differences among the filtration methods.
   6. From the scatter plot in Fit Y by X which filtration may be best? Which may be worst?
2. (15 pts.) Use JMP to analyze the dataset **Chips.JMP**. Notice that this design involves subsampling, so you should use Fit Model to perform the correct analysis – see the Fit Model analysis for the Electroplate example in Chapter 2. The data consists of an experiment studying three different processes to manufacture semiconductors (chips). For each of the four processes 3 replicate chips were selected for electrical testing, and on each chip four measurements were taken at different locations. The response is resistance.  
   1. What is the EU? What is the OU”
   2. Write out the One-way ANOVA model for an experiment with replication and subsampling and briefly explain the terms in the model.
   3. State the null and alternative hypothesis for a treatment or process effect.
   4. What is your decision concerning the null hypothesis based upon the F test for a treatment or process effect? What is the p-value for the test of the treatment effect?

Do the analysis in the Fit Model platform of JMP using the electroplating example from the Chapter 2 notes as a guideline.

* 1. Which contributes more random variation in the observed resistance values, the replicate chips within each process or the measurements taken from within each chip? Explain.
  2. Suppose you could redo the experiment, however budgetary constraints prevented you from increasing the number of measurements taken. Would you prefer to include more replicates (chips) per process and fewer measurements per chip or perhaps fewer chips and more measurements on each chip? Explain? I am only asking for a brief qualitative answer based on your results from the analysis of the data.