**Guidelines for Final Project and Reports**

**Math 740/840 Design of Experiments I, Fall 2019**

**The Project due date is the end of the day on Wednesday December 11th.**

The following are guidelines for the class project and written report. Please read the directions very carefully. The project must be based upon a designed experiment that you or your team design, run, and analyze; you are not to use a published experiment nor are you to use experiments done by others. Also, data previously collected from an observational study is not acceptable for the project. The point of the project is for you to gain experience in designing, performing, and analyzing experiments. The **experiment must contain elements of the methodology covered in this course Math 740/840 Design I**.

Since the mid-term Helicopter Experiment involved the use of a traditional three-factor, two-level, full factorial, **I want the final project experiment to incorporate some of the material covered after the midterm. For example, mixture designs, factorials with blocking, definitive screening designs, optimal designs from Custom Design in JMP, RSM designs, etc**. Your experimental design must have **at least three different experimental factors** with a minimum of two levels per factor; designs with mixed levels of the different factors are also acceptable. **The response(s) must be continuous**; nominal responses with two or more categories such as Yes/No (1 or 0) or say response categories like A, B, or C are not appropriate for this project. Depending upon your experiment you may have a combination of continuous and nominal factors in your experiment. The experiment can be performed by an individual or by a team, however the **maximum allowable team size is 4 persons**.

Please note, **experiments involving the boiling of water or popping of popcorn are not allowed**. These topics have been dramatically overused in the past. Also boiling water experiments always end up confirming the obvious – the less water you have in a pot the faster it boils (we do not do experiments to confirm the obvious). Make an effort to come up with an experiment on a topic that is of interest to the team and is challenging to perform. Most of you are from engineering and science and should have no trouble coming up with interesting and challenging experiments to perform

Since clear and concise communication is a highly valued skill for researchers and employees, a well-written and well-organized technical report will be have weight in determining the team (or individual) grade for the project. The typical length of a written report is around 4-5 pages, JMP output and tables that are important to the understanding of the experiment, results, and conclusions (e.g., JMP output) **must be incorporated into the body of the report** approximate to where they are referenced; do not put important output at the end of the report nor in an appendix. Additional supporting tables, output, etc., can be put in an appendix if you wish to include them. **The project report must be in PDF format and submitted as an electronic copy via myCourses**; this is just has you have done for the homework assignments.

Each team should upload a single copy of the report (one team member performs the upload) and please be certain that that the name of the file you upload contains all of the names of the team members, just to be certain no one is inadvertently overlooked; of course the document itself should contain all of the names of the team members.

The following are the components that should be included in the written report:

1. **Title**. Choose an informative, descriptive title for your project;
2. **Abstract**. In one paragraph, summarize the important experimental findings. The abstract is a short, concise synopsis of the experiment and key results;  
     
   Note the Title and abstract should be the first page of the report along with the names of the team members.
3. **Methods and Materials**. This section explains the experimental problem addressed in the study and how the study was conducted. The following is a list of issues that one might include in the discussion for this section. How the data were collected? What are the factors and levels used? **Important** - you must explicitly show what type of experimental design was used and include a table or figure showing us the design. What randomization scheme was employed? Briefly describe any materials and methods used in performing the experiment. How measurements were made and what instruments were used in making measurements? Were nuisance sources of variation controlled by the experimenters and how were they controlled? What types of statistical analyses performed? Also, mention the software used in making performing the analyses. This section should **not** include a discussion of the results.
4. **Results.** Present the experimental results in summaries, tables, computer output, etc. Do not delve into interpretation and conclusions at this point. This section should clearly tell the reader where the various pieces of important information are located (e.g., figures, tables, computer output, etc.). Please be sure to clearly label and reference pictures, graphs, computer output, etc. so that reader can clearly understand what they are and what information they contain. In the results section it is **imperative that you provide details on the models you are fitting by providing Parameter Estimate tables and Effect Summaries** – we need to know exactly what models you have fit and selected. Also, we **want Actual by Predicted plots** to see how your model fits. Failure to provide adequate documentation will result in a deduction in grade.
5. **Confirmatory Trials.** Based upon your final analysis in the Results section **you are to perform a series of confirmatory trials to show that your resulting conclusions, e.g. final statistical model, are valid based upon the new data you collect**. Perform at least three confirmatory trials and the team should decide upon the settings to use. For example, if you used Desirability Functions in JMP to predict a set of best settings for your experimental factors, then you might want to confirm that the settings indeed yield the level of the response that the model predicted (within experimental error variation).
6. **Conclusion.** The findings and results of your experiment are objectively presented and objectively interpreted. Are there clear conclusions to be drawn? Are the results inclusive and why? Inclusive results do not indicate a poor experiment. Did the results the experiment surprise you in some way? Did unexpected results appear? What suggestions would you make for future experimentation if the project were to be extended? What are the key conclusions that you want to clearly and objectively convey to the reader?

In addition to the overall written discussion of the experiment, the grade will also include an assessment, by the instructor, of how thorough the team (or individual) was in designing the experiment, performing the experiment, and evaluating the results of the experiment. In the write-up please try to include details, which demonstrate the team's (or individual’s) thoroughness in designing the experiment, performing the experiment, and analyzing the results of the experiment. As an example, consider a discussion of how the team (individual) arrived at the number of factors to be studied and chose the type of design employed.

Please refer to the class notes on designing a good experiment for some guidance in both designing and performing your experiment. The notes also give you idea of the level of thinking and detail that I am looking for in your experiment and project write up.

Remember: If you work in a team, one grade is assigned to the entire team. It is up to the team to make sure that everyone does his or her fair share and that a well-written report is submitted -- as described above.

