STA305/1004 - Project

For this project, each student - no groups allowed - will design, analyse, and communicate the results of a homemade ***replicated*** 2^k factorial experiment, where $k \geq 2$. Each student is required to submit **five** items:

1. A draft proposal of the experiment that you plan to conduct; (due: Aug 3, 2020 23:59 on Quercus)

2. a peer review of a classmate's draft proposal; (due: Aug 10, 2020 23:59 on Quercus)

3. a `R Markdown` document(s) used to author your report, along with necessary data file(s); (due: Aug 17, 2020 23:59 on Quercus)

4. a pdf export of your report; (due: Aug 17, 2020 23:59 on Quercus) and

5. a video presentation of the objectives, methods, results, and conclusions of your experiment. (due: Aug 17, 2020 23:59 on Quercus)

Detailed description and requirements are provided below.

Description.

Each student is asked to plan and perform a homemade factorial experiment. The experiment must be a replicated 2^k factorial experiment, where $k \geq 2$, and the number of replications is at least two. That is, the experiment should include at least 2 factors of two levels each replicated twice at the minimum. There should be at least 8 measurements in total.

Students should start thinking about what they want to study. The number of possible topics is very large. We strongly recommend selecting a topic that you are interested in and will enjoy working on. e.g., how can I achieve a faster baseball pitch speed?

Submission requirements.

You are responsible for submitting the following via Quercus by the due dates. The grading rubric for the project is attached at the end of this document.

1. Draft Proposal of Experiment.

Due date: August 3, 2020 23:59

Please submit an R Markdown document (i.e., has .Rmd extension) and pdf export of the R Markdown document that states your experiment's objectives, methods, statistical analysis plan.

- The objectives should be concise statements about what you hope to learn. In the example of the baseball experiment in the introductory video (link) the objective could be stated as: "What are the effects of grip, and stance on a baseball pitch speed."

- The methods are your plan for collecting the data - i.e., how you plan to coduct the experiment. The method could be stated as: "I will collect measurements of my ball speeds while varying grip and stance at two different levels each. I will vary my grip with placements of the index and middle fingers, open versus closed. The stance factor will be based on the height of the left leg during the wind-up motion. I will perform 5 repetitions in a randomised order since my arm may loosen up and/or tire out effecting the ball speeds. The order will be radomised using an R script prior to the measurement session. I will also randomly pick a baseball from a ball cart each time I pitch. It is well known that a baseball with worn out seams result in lower ball speeds. Finally, a friend will measure the speeds using a speed radar gun while I pitch following the radomised order."

- The statistical analysis plan is a brief description of how you plan to analyse the data, including which summary statistics and data visualizations you plan to include.

The draft will not be graded based on the plan. If a draft with the content outlined above is submitted then you will receive full credit. TAs will give students feedback on their draft as soon as possible. One of your classmates will also review and provide a feedback on your draft. The draft is an opportunity for you to receive early feedback on your ideas and plans so that you can incorporate the feedback into your final submission.

Note that you will not be assigned to a classmate for the Peer Review component if you fail to submit your proposal on time. You will automatically receive a grade of 0 for the Peer Review component.

2. Peer Review of a Draft Proposal.

Due date: August 10, 2020 23:59

You will be assigned to an anonymous draft proposal submission by your peer for a review. Provide a constructive feedback on the plan and fill out the rubric that will be available on Quercus for the proposal.

Your review will not count towards the proposal author's grade. The peer reviews will provide an opportunity to assess an experiment design critically and reflect upon on your own proposal.

3. R Markdown document.

Due date: August 17, 2020 23:59

You are required to write your report and perform your analysis in an R Markdown document using `R`. Submit an error-free R Markdown document (`.Rmd` file) that contains the `R` codes used to perform analysis and author your report. If your code requires extra files such as your observed data, you must include them as well. **Please keep your data files and `.Rmd` file in the same directory and use relative path when working on the dcoument** to

help accelerate the grading process. The grading TA must be able to run your R Markdown document without any error on their machine after downloading the files as they are. (The TA will install extra packages if necessary.)

We recommend using `https://rstudio.cloud/` if you don't already have RStudio and/or LaTeX installed on your computer. Please contact the course instructor as soon as possibe if you wish to get access to the class's workspace onr RStudio Cloud where you will find a basic `.Rmd` template files.

4. PDF report.

Due date: August 17, 2020 23:59

A maximum 4 page PDF report that contains the following sections. You are required to use R Markdown to create your report. However, the final PDF report must not include any R codes. Include `knitr::opts_chunk$set(echo=FALSE)` in your first code chunk to hide code chunks throughout your output PDF document.

1. **Description (1 page maximum).** Include how and why you conducted the experiment. What do you hope to learn by doing this experiment?

2. **Analysis of data (2 pages maximum).** Include appropriate plots and calculations used to answer experimental question(s). These may include main effects and interactions, estimated variance of the effect; confidence intervals for the true values of effects; Lenth plot; or half normal plot.

3. **Conclusions (1 page maximum).** State your conclusions based on the results of your experiment in a paragraph or two.

5. Video presentation.

Due date: August 17, 2020 23:59

Please submit a video presentation of your study. Please review the attached rubric and the list of criteria carefully before submitting your video. Failure to meet the requirements may result in a grade of 0 for the video presentation component.

- In the beginning of the video, you must clearly present your student ID along with yourself. The grading TA must be able to identify you - both in person and on the student ID - and your student ID number. **Failure to present your student ID will result in a 0 grade for the video presentation.** We recommend that you update your Quercus profile with a picture where your face is clearly identifiable.

- The presentation should not exceed 5 minutes. Any video beyond 5 minutes will not be viewed by the grading TA, and will not be considered when marking.

- In the video you should describe the objectives, methods, results, and conclusions of your experiment.

The video may be of any form, so be creative! For example, you may include clips of yourself conducting the experiment while describing the experiment - beware that the clips will also count towards your 5 minute limit. See an example here from last year.

Submission Instructions.

1. Submit your draft proposal including the PDF document and `.Rmd` file under *Project: Draft Proposal*.

2. For submitting a peer review, please refer to the guide here.

3. Submit your report and analysis including the PDF document, `.Rmd` file, and any associated data files under *Project: Report*.

4. Submit your video presentation under *Project: Video*. You may use Quercus's built-in media recorder or upload your own video file. The uploading process may take a few minutes.

Notes on video submission.

- If you are using a Mac, the Quercus media recorder submission page may not work on your Safari browser. The recorder works well on Chrome or Firefox on both Mac and PCs.

- Beware that the Quercus media recorder doesn't allow pauses but you are able to retake your videos as many times as you want.

- Quercus accepts media file uploads of size up to 500MB if you are uploading a file. The supported file types for playbacks are *FLV, ASF, QT, MOV, MPG, MPEG, AVI, M4V, WMV, MP4, and 3GP*. If you upload any other file types, the TAs may not be able to assign you a grade.

Grading Rubric

	Excellent (5)	Marginal (3)	Inadequate (1)
Draft Proposal (5).			
Completeness of the content.	All appropriate components - the objective, the method, and the statistical analysis plan - are included in the proposal.	One of the required components is missing in the proposal.	Two of the required components are missing in the proposal.
Peer Review (5).			
Depth of review.	Proivdes a constructive review of the draft proposal on whether the experiment method and analysis plan appropriately addresses the objective. Provides appropriate comments or annotations that address the described assumptions or any additional assumptions that may be required for the analysis.	Proivdes some comments but these comments do not necessarily address whether the methods and the analysis plan appropriately addresses the objective.	Completes the rubric but does not provide any constructive comments.

Grading Rubric

	Excellent (5)	Good (4)	Adequate (3)	Marginal (2)	Inadequate (1)
PDF Report (20).					
Description.	Strong evidence of original thinking and a clear explanation of how and why they conducted a replicated factorial experiment.	Evidence of original thinking and a mostly clear explanation of how and why they conducted a replicated factorial experiment.	An adequate explanation of how and why the experiment was conducted, and a replicated factorial experiment conducted.	A factorial experiment was not conducted, although the experiment that was conducted is appropriate for the stated objectives. There is little evidence of understanding a factorial experiment.	Little evidence to no evidence of experimental design or the analysis of experimental data.
Analysis.	Appropriate data analysis was conducted to answer objectives of experiment including appropriate calculations and plots.	Almost all of the data analysis was conducted to answer objectives of experiment. Most of the calculations and plots are appropriate.	Most of the data analysis was conducted to answer objectives of experiment. Some calculations and plots may be superflous or inappropriate.	Some of the data analysis was conducted to answer objectives of experiment, although there is no statistical evidence to support all of the objectives. Some calculations and plots may be superflous or inappropriate.	Most of the data analysis conducted does not help answer objectives of experiment. Several calculations and plots are superflous or inappropriate.
Conclusions.	All the conclusions are clearly stated, and supported by statistical analysis in the context of the experiment.	Almost all the conclusions are clearly stated even if a few are not clear. The clearly stated conclusions are supported by statistical analysis.	Some of the conclusions are stated, some may be missing or unclear. The stated conclusions are supported by statistical analysis.	Some of the conclusions are stated, some may be missing, and none are supported by statistical analysis in the context of the experiment.	None of the conclusions are stated, and none are supported by statistical analysis in the context of the experiment.
Organization.	Very well organized with clear headings and sections. Excellent flow from one section to the next with tables and plots carefully tuned and placed.	Well organized with clear headings and sections. Flow from one section to the next might be lacking.	Generally well organized but some sections were muddled. Appropriate tables and plots were used but might be poorly presented.	Sections unclear and no attempt to flow from one topic to the next. Some tables and plot might have fundamental flaws in their presentations.	Difficult to read the report. For example, the report does not contain headings, figures are far away from where they are referenced in the text. Missing required parts.

Grading Rubric

	Excellent (5)	Good (4)	Adequate (3)	Marginal (2)	Inadequate (1)
R Markdown notebook (5).					
Appropriate use of built-in `R` functions.	Appropriate `R` functions are used correctly to perform the intended tasks. Entire notebook runs without an error with necessary packages installed. Reproduces the same numerical results presented in the report.	Appropriate `R` functions are used but may contain mistakes in their usage. May contain errors but they do not interrupt the analysis steps. Reproduces similar results as presented in the report but some numeric results may be different.	`R` functions are often used inappropriately and do not perform the intended tasks. Contains errors that interrupt some parts of the analysis steps. Produces conflicting results for minor parts of the conclusions presented.	Most `R` functions are used inappropriately and do not perform the intended tasks. Contains errors that interrupt the analysis steps but requires only minor fixes. Produces conflicting results for most of the conclusions presented.	Contains major errors and does not reproduce the result presented.
Video presentation (5).					
Presentation.	Information is presented in a logical and interesting sequence. Experiment objectives, methods, results, and conclusions clearly stated, repeated appropriately, and strongly supported throughout the presentation. Clearly audible voice throughout the video.	Information is presented in a logical sequence. Experiment objectives, methods, results, and conclusions clearly stated and supported throughout the presentation. Audible voice throughout the video.	Presentation jumps around topics making it difficult to follow. Experiment objectives, methods, results, and conclusions are stated but minimally supported through out the presentation. Voice is not audible in some parts of the video.	Presentation has no sequence of information and audience cannot understand the presentation. Experiment objectives, methods, results, and conclusions are not explicitly stated and need to be guessed. Majority of the video is not audible.	A video presentation was submitted with the student ID presented, but the video is not audible throughout the presentation.