

University of Toronto Mississauga
**STA305 H5S: Experimental Design -
Winter 2021**

Instructors: Dr. Ramya Thinniyam and Dr. Luai Al Labadi

FINAL PROJECT

Due Date: April 9th, 2021

Late submissions will not be accepted.

Project Policies:

This project is group work. You can discuss with your group members only. It is plagiarism (a serious academic offence) to submit solutions in other people's words (including but not limited to other students, the instructor's, solutions from previous years or courses, websites, etc). You may not use past experiments designed by others; your group should design the experiment and analyze the data on your own. You are responsible for knowing and adhering to the University of Toronto's Code of Behaviour on Academic Matters (see course outline).

This project is group work and will require you to:

- Choose a non-human target population and specific questions of interest
- Design an experiment to answer your questions of interest
- Conduct the experiment
- Analyze the data and report statistics
- Make inferences based on the analysis
- Discuss findings and comment on methods

Details are below (there are different components of the project due on different dates):

1. Student Groups - Due Feb 23rd, 11:59pm EST - 2%:

Each group should have a **minimum of 5 and a maximum of 6 students** (all students should be in the **same lecture section**). *Please note if your group has 5 students, there is a small possibility that another member may be randomly added in if that student cannot find another group and there is no available space elsewhere. If you have a group of 6, more students will not be added.*

To facilitate finding group members, we have made the forums, "final_projects_groups_l9101" and "final_projects_groups_l9102" on Piazza Discussion Board - you may post under the correct forum to find your own group. We strongly encourage you to work with the same group as the mini project, however, you may change groups if you want to. Either way, you have to submit your groups again for the final project.

To submit your groups, do the following:

- **Option A:** If you have joined a group with peers you already know/have met in class/met on Piazza:
Each student in the group should self sign up for that group on your lecture section's Quercus website. On Quercus, go to the “People” tab and then click on the “Final Project” tab at the top. Add yourself to your group.
- Please do not put yourself into someone else's group without their permission. Self sign up is for groups who have already decided on their members. If you cannot find a group, use Option B.
- If you need help with self sign up, refer to this article:
<https://community.canvaslms.com/t5/Student-Guide/How-do-I-join-a-group-as-a-student/ta-p/468>
- If you would like to form a group with students from both lecture sections, this may be possible in some special cases. For consideration, one group member email the course coordinator, Luai Al Labadi, luai.allabadi@utoronto.ca, using the following format:
 - Subject line should read “STA305 Final Project: Group across both sections”.
 - Include the first name, last name, student number, lecture section of each group member in the body of the email.
 - Explain the rationale of your request to form a group across both lecture sections. You will receive a reply with the decision. If your request is accepted, do NOT enroll in any group on Quercus (the TA will take care of enrollment for your group later.)
- **Option B:** If you cannot find your own group, you will be randomly assigned to a group with available space if you request so.
Email the TA, Karan, karan.agarwal@mail.utoronto.ca using the following format:
 - Subject line should read “STA305 (include lecture section number) Final Project: Please put me in a group”.
 - Include your first name, last name, student number in the body of the email.
 - Confirm that you want to be placed into a group.
You will be assigned to a group that has available space.
- **Option C:** We strongly recommend doing this project as a group since it will be a lot of work. Research is often done collaboratively like this with people you do not necessarily know so this will be good experience. Under extenuating circumstances, you will be permitted to do the project individually. To request to work alone, email the course coordinator, Luai Al Labadi, luai.allabadi@utoronto.ca, using the following format:
 - Subject line should read “STA305 (include lecture section number) Final Project: request to work alone”.
 - Include your first name, last name, student number in the body of the email.
 - Explain the reason why you have to work alone and cannot work in a group.
You will receive a reply with the decision.

- If you do not do Option A, B, or C by Feb 23rd, you will get a 0 on the project. It is your responsibility to submit a group or ask to be placed in one.

2. Proposal - Due March 4th - 5%:

Use either Arial 10 pt or Times New Roman 12 pt and use 2.5 cm margins around the page. The proposal should be no longer than 1 page single-sided and should include a description of the question of interest(s), variables, how the experiment will be conducted, and name the method(s) you are planning to use to analyze the data. (This is submitted before you actually start conducting the experiment and get any data.) You will receive feedback about your project so that you can continue with conducting the experiment / data collection.

Proposal should be uploaded on Quercus by March 4th, 11:59pm EST. *Late submissions will not be accepted.

3. Progress Report: Data - Due March 18th - 5%:

Submit your collected **data set in Excel format**. Be sure all data columns are clearly labelled with headings, and that the data is clean and ready for analysis. Include a description of each variable and how it was measured.

Data Progress Report should be uploaded on Quercus by March 18th, 11:59pm EST. *Late submissions will not be accepted.

4. Progress Report: Technical - Due April 1st - 10%:

Use either Arial 10 pt or Times New Roman 12 pt and use 2.5 cm margins around the page. Write this section as a technical report (define all variables, state all hypotheses, include and check all assumptions, formulas, computations, R codes, etc.). Begin by stating the objective of your analysis and any hypotheses you may be assessing. Include all relevant calculations and clearly state the conclusions you reach. Display relevant summary statistics and plots to show the results.

Technical Progress Report should be uploaded on Quercus by April 1st, 11:59pm EST. *Late submissions will not be accepted.

5. Final Written Report - Due April 9th - 15%:

Provide a written summary of your project. Reports should be word processed and organized appropriately with a proper title, headings, and sections. It is not appropriate to put code and all output in the body of the report - required output should be in the body with labeled figures and code and extra output should be in the appendix. The use of LaTeX to write reports is recommended but not required. Marks will be given for presentation. Your report should be no longer than 5 pages (single-sided). Use either Arial 10 pt or Times New Roman 12 pt and use 2.5 cm margins around the page. Include all of the following in your report:

1. **Title Page:** Group Number, Full Names, and Student Numbers, Lecture Sections of members, name of project.

2. **Description of Case Study:** background information (explain terminology that may be specialized to the field from which the data came), purpose of study, a non-human target population (do not choose a human population because we do not have time to go through ethics protocol), experimental units, questions of interest. Specify the importance of the case study to its field.
3. **Description of the Experimental Design:** describe the response variable, factors, and other predictors (how they will be measured and the measurement units of each), sample sizes, describe in detail how the experiment was conducted, and explain if it's a between-subjects or within-subjects design and why. A good design will include all of the Principles of an Experiment - Control, Blocking, Randomization, Replication. Explain how each principle was included in the design and why. If a principle was not included, justify why. Specify how experimental units are selected and how treatments are assigned to experimental units. The following should be considered but not used if they do not apply: control group, placebo treatment, blindness, double-blind. Include diagrams of the design, photos of the data collection process, etc.
4. **Data Analysis:** Name the methods used (One-Way, Two-Way ANOVA, Complete or Incomplete, Blocked Design, ANCOVA, etc.) and summarize the analysis. You must use 'R' for the statistical analysis. Include your sample sizes (with justification) and provide appropriate confidence interval(s) or estimates. Interpret the results in practical terms. Check the necessary assumptions for your models. Display relevant diagnostic plots/numerical values and comment with reference to them.
5. **Other Relevant Information:** Describe difficulties faced during data collection or analysis, other information relevant to the topic or the field of study.
6. **Limitations:** Discuss limitations in the design or analysis, and improvements that you would propose in the data collection/design.
7. **Overall Conclusion:** Include the relevance of your results to the field of study, applications, etc.

In addition to the 5 page report, please include:

- An appendix containing your raw data, code, and output (code should be commented).

Final Written Report should be uploaded on Quercus by April 9th, 11:59pm EST. *Late submissions will not be accepted.

6. Group Member Assessment - Due April 9th - 3%:

Evaluate each member of your group (other than yourself) based on the criteria in the "Group Member Assessment Rubric" provided. Fill out the evaluations using the Google form.

- If you work individually on the project, you will not submit a group member assessment. This 3% will be added to your written report weight.
- If you work as a group, each member in your group will submit their evaluation of you. These scores will be averaged and weighted for 3% of your mark. You will get the same mark as your group members for all other parts of the project. You may get different marks than others for this evaluation portion.

- The reason for doing such evaluations is to avoid having issues with members who do not contribute/cooperate with other members in the group but receive the same mark. This way, if there are such problems, it will be reflected in a poor evaluation by all other group members and in a lower mark for that member.
- For more serious problems with group members who do not contribute at all, see Notes below.

Group Member Assessment should be completed on [Google Forms](#) by April 9th, 11:59pm EST. *Late submissions will not be accepted.

NOTES:

- You may consult the instructors or TAs about your projects. We are here to give guidance, but cannot solve the project for you.
- Pick an experiment that can be performed within a week (or even within a day or two) - this is not a term long project. You only have a few weeks to plan the experiment, conduct the experiment, and analyze data. Examples are given below.
- It would be better to choose a simpler system and show statistical sophistication in the design of the experiment (adding relevant factors by controlling, blocking, and randomizing where appropriate, using replication on treatment and experiment level by performing several runs where appropriate, etc.) rather than choosing a complicated system which would not allow you to have enough time to properly conduct the experiment.
- Choose a topic that is of interest to you or has practical applications.
- Read ahead about the methods that have not been covered yet in lectures so that you can make a choice on which to use for the project.
- Each member of the group should provide an equal contribution to the project. However, it is up to you and your group to decide how to allocate duties fairly. You all do not have to be involved in each aspect. For example, due to COVID/lockdown, you may not be able to meet and collect the data together.
- It is recommended that you save all proof of your group meetings (schedules/emails/chats/shared documents). You may be asked to provide it if there is a dispute about a particular group member's evaluation. *(For example, suppose there is a case where every group member evaluates a particular student with a score of 0, saying that this person did not do any work and then this student disputes the evaluation. The course coordinator will then contact the group. The other group members will have to show proof of the student's lack of participation and the student would have to show that they did do work. The course coordinator will make a final decision.)*
- In rare cases where a group member does not do any work (and disappears from the project), that student will receive a 0 on the whole project (not just the Group Member Assessment) if all other group members prove it.
- See the attached file on how to upload / submit each file and to learn how you will receive feedback about each component of the project.

Project Suggestions:

1. Factors influencing the cooking time of rice
2. Fuel Efficiency of a Car
3. Yield of popcorn or some other kind of food, baking experiment
4. Stain removal in clothes
5. Testing wood varnishes
6. Growth of a plant
7. Ice Melting
8. Taste-testing a specific food product
9. Flying distance/time of a paper plane (or some other object)
10. Effects of specific factors on Bicycle Riding
11. Something related to another course in which you have lab access (Chemistry or Biology experiment)

These are just examples to give you an idea of the magnitude of the experiment. You do not have to choose one of these; you can choose your own topic and you are encouraged to do so!