

University of Toronto
Department of Statistical Sciences
STA305H1S - LEC0101
Design and Analysis of Experiments
Course Outline - Summer 2024

Lectures

TU 11:00 AM – 2:00 PM in HS 610

TH 11:00 AM – 2:00 PM in HS 610

Instructor Office Hours

TU 2:00 PM – 3:00 PM in HS 610

TH 2:00 PM – 3:00 PM in HS 610

Instructor: Dr. Luai Al Labadi

Office: DH-3036

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TA Information: The TAs' contact information and office hours will be posted on Quercus.

COURSE OVERVIEW

- **Course Description:** Experiments vs observational studies, experimental units. Designs with one source of variation. Complete randomized designs and randomized block designs. Factorial designs. Inferences for contrasts and means. Model assumptions. Crossed and nested treatment factors, random effects models. Analysis of variance and covariance. Sample size calculations.

Prerequisites: STA302H1/STAC67H3/STA302H5

Exclusion: STA332H5 or STA305H1

Co-requisites: None

Exclusions: STAC50H3, STAC53H3, STA305H5

Pre-requisites are strictly enforced by the department, not the instructor. Students who do not meet the equivalent pre-requisites will be automatically dropped from the course.

- **Learning Outcomes:** By the end of this course, students should be able to:
 1. Understand and describe data.
 2. Design experiments that are appropriately gathering information of interest.
 3. Identify sources of bias within a study and comment on a study's design, including its weaknesses, strengths, and appropriate analyses.
 4. Carry out a variety of statistical analyses to make inference on the data.
 5. Clearly communicate results of statistical analyses to technical and non-technical audiences.

COURSE MATERIALS

- **Course Content:** All lecture slides, materials, and important announcements will be posted on Quercus <https://q.utoronto.ca>. Please make sure to check it regularly so you do not miss anything.
- **Textbook:** We will utilize material from the following textbooks. The first textbook listed serves as the primary reference for the course. Please note that access to these textbooks is not mandatory, but having them for reference is recommended.
 1. Design and Analysis of Experiments and Observational Studies using R by Nathan Taback. Link: <http://designexptr.org/index.html>
 2. Design and Analysis of Experiments, 10th ed. by Montgomery.
 3. Design and Analysis of Experiments with R by Lawson.
 4. Design and Analysis: A Researcher's Handbook, 4th edition, by Keppel & Wickens.
- **Calculators:** Handheld, **non-programmable** calculators may be used during quizzes and tests. Any calculator that has a logarithm, square root, and one memory button will suffice for this course, so there is no need to buy an expensive calculator.
- **Statistical Computing:**
 - This course uses the statistical package R/RStudio/Jupyterhub.
 - R is free statistical software and it can be downloaded from <http://cran.r-project.org/>.
 - JupyterHub (<https://datatools.utoronto.ca/>) allows you to work with this software without having to download anything to your computer.

COURSE COMPONENTS

- **Lectures:** It is important to attend the lectures, follow the topics, and not leave any questions behind. This is a higher-level course, and students will need all the lecture time and regular practice to learn the material well. Crunching before tests/exams is unlikely to be helpful.
- **Practice Problems:** Exercises for each topic are posted on Quercus. They are for practice only and do not need to be handed in.
- **Office Hours:** The instructor/TAs will hold office hours as described above or on Quercus. It is recommended that you visit office hours whenever you have a question about the material. It is very important to have material clarified as quickly as possible. Do not wait until the last minute to ask your questions. Any change in office hours will be communicated on Quercus or Piazza
- **Piazza:** This is for student-led discussion. All questions about course material should be posted here or asked during instructor/TAs office hours. The instructor and TAs will monitor the board and will help answer questions, but students are encouraged to answer posts and help their fellow classmates.

ASSESSMENTS AND DEADLINES

Type	Due Date	Weight
Test 1	July 18	25%
Test 2	August 1	25%
Final	TBA	50%

- **Term Tests Policies**
 - All the term tests start at 12:30 pm and end at 2:00 pm on the dates specified above.
 - There will be class from 11:00 am -12:00 pm on the day of term test.
 - Your test may be in a different room. The location will be communicated on Quercus.
 - *Missed Term Work:*
 - ✓ If you are unable to attend a test due to a valid reason, please send an email to Luai in advance, if possible. Additionally, it is important to declare your absence on ACORN.

- ✓ If you missed **one** term test, no makeup will be given for the missed term test. The mark of the missed term test will be substituted based on the final exam.
- ✓ If **both** tests are missed, a makeup test will be held on Thursday, August 8 from 2:30 pm to 4:00 pm. More information will be provided on Quercus. The makeup test will cover all course material and count for 25% of the final grade. Any unallocated weight from the missed tests will be shifted to the Final exam. **Not attending the makeup test will result in a score of zero on the test, with the weight of the final exam being 75% in that situation.**
- **Re-mark Policy:** If you believe there is an issue with the marking, you can request a re-mark. The re-mark policy is in place to correct mistakes. Any request should clearly identify the error, such as an unmarked question or an incorrectly calculated total. Requests to correct such mistakes must be addressed by your instructor, not the TA. To be eligible for a re-marking request, you should either make the request upon collecting the paper (if the test is not marked using crowdmark) or by emailing Luai within 7 business days from when the graded test was initially available (if crowdmark is used). Ensure that the subject line of the email includes STA305, provide your full name and student ID number, and present specific, clear, and concise reasons for each request. Cite potential errors or omissions made by the marker. Re-marking requests lacking specific reasons will not be accepted. Note that your entire test may be remarked when submitting a re-marking request. Therefore, it is possible that your mark may go down if the regraded mark is lower than your original mark.

Final Exam

- Final exam is scheduled during the June examination period by the Office of Registrar. The final exam will cover the entire course. Final exam grades will not be posted in Quercus. Issues related to final exams (e.g. time conflict, remark requests/exam viewing) should be addressed to the Registrar's office. See
 - ✓ <https://www.artsci.utoronto.ca/current/faculty-registrar/exams-assessments/exam-conflicts>
 - ✓ <https://www.artsci.utoronto.ca/current/faculty-registrar/exams-assessments/exam-viewing>
- *Missed Final Exam:* Students who cannot complete their final examination due to illness or other serious causes must file an online petition: <https://www.artsci.utoronto.ca/current/faculty->

[registrar/petitions/deferred-exam](#). Students must also record their absence on ACORN on the day of the missed exam or by the day after at the latest. Please refer to

<https://www.artsci.utoronto.ca/current/faculty-registrar/petitions/deferred-exams>

for more information on how to request a deferred exam, and deadlines.

USE OF GENERATIVE AI: In this course, students may use artificial intelligence tools, including generative AI, as learning aids. However, their use is strictly prohibited during term tests and final exam.

EMAIL POLICY: Your email must originate from your University of Toronto email account when you contact your instructor by email. The subject line should contain the course number and a relevant subject (indicating what the email is about). Be sure to include your full name and student ID number in the body of the message. Before you send an email, make sure that you are not asking for information that is already available from the course outline/website/announcements, or questions about the course material that are more appropriate for discussing during office hours or discussion board on Piazza. **In general, your instructor and TAs will not answer technical questions about the course material by email.**

INTELLECTUAL PROPERTY: Course materials provided on Quercus, such as lecture slides, assignments, tests and solutions are the intellectual property of your instructor and are for the use of students currently enrolled in this course only. Providing course materials to any person or company outside of the course is unauthorized use. This includes providing materials to predatory tutoring companies.

ACADEMIC INTEGRITY: The University treats cases of plagiarism and cheating very seriously. It is the students' responsibility for knowing the content of the [University of Toronto's Code of Behaviour on Academic Matters](#). All suspected cases of academic dishonesty will be investigated following procedures outlined in the above document. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <http://academicintegrity.utoronto.ca/>). Offences include, but are not limited to:

On tests and exams:

1. Using or possessing unauthorized aids.

2. Looking at someone else's answers during an exam or test.
3. Obtaining or providing unauthorized assistance.
4. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources.

ACCESSIBILITY NEEDS: The University of Toronto offers academic accommodation for students with disabilities. If you require accommodations, or have any accessibility concerns about the course, the classroom, or course materials, please contact Accessibility Services as soon as possible: accessibility.services@utoronto.ca or <http://accessibility.utoronto.ca>.

EQUITY, DIVERSITY AND INCLUSION: The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

APPROXIMATE LECTURE SCHEDULE: This schedule is subject to change. Updates will be announced in lectures and posted on Quercus.

Topic
Unit 1: Introduction: Types of Data, Types of Sampling, Basic Principles of Experimental Design
Unit 2: One-Way ANOVA with 2 Levels
Unit 3: One-Way ANOVA with a Levels
Unit 4: Contrasts & Post-Hoc Analysis
Unit 5: Linear Model, ANOVA Coding Schemes
Unit 6: Non-parametric Methods
Unit 7: Effect Size, Sample Size Calculations, and Power
Unit 8: Factorial Designs
Unit 9: Blocked Designs: Randomized Complete Block (RCB) Designs
Unit 10: The Latin Square Designs
Unit 11: Incomplete Block Designs
Unit 12: General Linear Model, Analysis of Covariance (ANCOVA)
Unit 13: Repeated Measures (if time permits)