

STA305H1/STA1004H: Experimental Design - Winter 2015

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Office hours: after Monday's class until 1300.

Teaching Assistants: Alexander Stringer, Qiqi Wang, Dechang Gao, Zhenhua Lin

Course webpage: Can be accessed through the learning portal

Classroom sessions:
Mon 11:00-12:00 in SS2118
Wed 11:00-13:00 in FG103

Course Content

This course will provide an introduction to the fundamental concepts of the design of scientific studies including the design of experiments and observational. Students will become acquainted with statistical methods used to design and analyze experiments and observational studies. In particular this course will cover: experiments versus observational studies, clinical trial design, group sequential methods, comparing several groups using a completely randomized design, randomized blocks, Latin squares, incomplete block designs, factorial designs, causal inference in randomized and non-randomized studies, and adjusting for selection bias using propensity score methods.

The learning objectives of this course are:

- Understand the ideas, principles, and considerations that are common to the design and analysis of scientific studies including the statistical design of experiments and observational studies.
- Develop a statistical toolbox of methods for the design and analysis of experiments and observational studies.
- Identify appropriate uses and interpretations of experimental designs, and observational studies, including their strengths and limitations.

Topics

Experiments, observational studies, and causal inference

Experiments versus observational studies, and causal inference in randomized experiments.

Selection Bias in Observational Studies

Causal inference in randomized experiments versus observational studies. Introduction to the propensity score and three ways to use the propensity score to adjust for selection bias: matching; sub classification; direct regression adjustment.

Probability and Statistics

Mathematical statistics used in experimental design.

Comparing Several Groups

Comparing several groups in an experimental and observational setting and deciding whether differences that are found are likely to be real or due to chance.

Design of Clinical Trials

The design and analysis of clinical trials with continuous, binary, or survival outcomes will be introduced. Group sequential methods will be used to design clinical trials they can be monitored for safety and efficacy without compromising the overall type I error rate.

Blocking techniques

Blocked designs, Latin squares, randomized incomplete block designs.

Factorial Designs

Factorial, blocked factorial, and fractional factorial designs will be discussed.

Split plot designs

Split plot designs will be discussed as an example of restricted randomization in the design of experiments.

Textbooks

Required

Statistics for Experimenters: Design, Innovation, and Discovery. Box, G.E.P., Hunter, J.S., Hunter, W.G. Wiley 2nd Ed. 2005

Optional

Design and Analysis of Experiments. Dean, A., and Voss, D. Springer. 1999.
UofT link to electronic copy: <http://go.utlib.ca/cat/2573215>

Design of Observational Studies. Rosenbaum, P. R. Springer 2010.
UofT link to electronic copy: <http://go.utlib.ca/cat/7890274>

Experiments: planning, analysis, and optimization. Wu, C.F.J., Hamada, M.S.
Wiley, 2009, 2nd ed.: <http://go.utlib.ca/cat/8598479>

NB: Both optional textbooks are available electronically through the UofT library (i.e., electronic copies of both these textbooks are available at no extra cost)

Evaluation

	Weight	Date	Time
Four hand-in assignments	5% \times 4=20%	Jan. 21, Feb. 11, March 18, April 1	Due at 11:10 in class(*)
Term test	35%	Feb. 25	11:10-12:40
Final exam	45%	Scheduled by Faculty	

(*) See assignment due date and time below for course rules regarding late assignments.

Assignment Due Date and Time

- Assignments are always due at the beginning of class on the due date and a paper copy must be handed in at the beginning of class.
- An assignment is considered late if the lecture has begun. An announcement will be made regarding the end of the time where assignments will be accepted.
- Assignments handed in after this announcement will be considered late and will receive a grade of zero.
- Late assignments will receive a grade of zero except for documented reasons beyond the student's control. In the case of a medical reason this must be documented using the UofT Student Illness or injury form.
- Electronic submission (e.g., email) of assignments will NOT be accepted. If an assignment is submitted by email then it will NOT be marked and a grade of zero will be assigned.

Term test and exam

The test will be written during class time but in a location to be announced.

You are allowed a two-sided 8-1/2"x 11" (standard letter size) hand-written aid sheet on the term test and a two-sided hand-written aid sheet on the final exam. You must bring your student identification to the term test and the final exam.

You will not need to know R syntax on the tests and exam, but you will need to know how to interpret output from R.

Marking concerns

Any requests to have marked work re-evaluated must be made in writing within one day of the date the work was returned to the class. The request must contain a justification for consideration.

Missed Tests

- If a test is missed for a valid reason, you must submit documentation to the course instructor.
- If a test is missed for a valid medical reason, you must submit the University of Toronto Verification of Student Illness or Injury form to your instructor within one week of the test.
- The form will only be accepted as valid if the form is filled out according to the instructions on the form.
- The form must indicate that the degree of incapacitation on academic functioning is moderate, serious, or severe in order to be considered a valid medical reason for missing the term test. If the form indicates that the degree of incapacitation on academic functioning is negligible or mild then this will NOT be considered a valid medical reason.
- If a test is missed for a valid reason then the test weight will be shifted to the final exam. This means that your final exam will be worth 80% of your final grade. Otherwise, a student missing a term test will receive a grade of zero.
- Other reasons for missing a test will require prior approval by your instructor. If prior approval is not received for non-medical reasons then you will receive a term test grade of zero.

Computing

We will use R for all examples. R is freely available for download at <http://cran.r-project.org> for Windows, Mac, and Linux operating systems. For the test and exam, you will need to know how to interpret output from R. We will support the use of R to complete the assignments. If you wish to use other statistical software such as SAS or SPSS to complete the assignments you may do so, but we will not be providing sample code for you to complete the assignments in other languages.

I recommend using R Studio as an integrated development environment to R. It is freely available at <http://www.rstudio.com/products/rstudio/download/>

If you wish to use R at UofT then you will need to sign up for a CQUEST account. To get an account and find out more information about using CQUEST go to <http://www.cquest.utoronto.ca>

I am assuming that students have never used R before. I will provide you with the R syntax for all examples in lecture, which should be sufficient for you to do your assignments.

Calculators

You will need a calculator. Any calculator that has logarithmic functions will be sufficient. Calculators on phones or other devices equipped to communicate with the outside world (for example, through the internet or cellular or satellite phone networks) will not be permitted during the term test and the final exam.

Piazza

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and the lecturers. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza. To sign up for the discussion forum click on the link :

<https://piazza.com/utoronto.ca/winter2015/sta305h>

Additional help

Need extra help with the coursework? Here are some options:

- For continued class discussion and questions outside of class, try posting on the discussion forums. The instructor and TAs will be monitoring them regularly.
- You can visit your instructor or the teaching assistants during their office hours.
- There is a drop-in Statistics Aid Centre in New College: Wetmore Hall 68A. See http://www.utstat.toronto.edu/wordpress/?page_id=154 for the schedule.

E-mail should only be used for emergencies or personal matters.

How to communicate with your instructor

Questions about course material such as:
How do I do question 3.7 in the textbook?
What is standard deviation?
When is the midterm?

Can be posted on the discussion forums. Questions can be posted anonymously (so that the author is anonymous to other students but not to the instructors), if desired.

For private communication, such as: I missed the test because I was ill e-mail your instructor.

Use your utoronto.ca e-mail account to ensure that your message doesn't automatically go to a Junk folder and include your full name and student number.

Academic integrity

You are responsible for knowing the content of the University of Toronto's Code of Behaviour on Academic Matters at <http://www.governingcouncil.utoronto.ca/policies/behaveac.htm>. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact your instructor.

Accessibility needs

The University of Toronto is committed to accessibility. If you require accommodations for a disability, 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>.

Your responsibilities

The classroom sessions for this class is designed to actively engage you in the course material. We hope you'll find them interesting, challenging, and fun, and an excellent opportunity to truly learn the material. In order for these sessions to be effective, coming prepared, by learning about the week's concepts through the textbook, is essential.