

STA261H1-S: Probability and Statistics II

Shahriar Shams

Winter 2021 (last updated on Jan 10, 2021)

1 Course Description

A rigorous introduction to the theory of statistical inference and to statistical practice. Statistical models, parameters, and samples. Estimators for parameters, sampling distributions for estimators, and the properties of consistency, bias, and variance. The likelihood function and the maximum likelihood estimator. Hypothesis tests and confidence regions. Examples illustrating statistical theory and its limitations. Introduction to the use of a computer environment for statistical analysis. (Note: STA261H1 does not count as a distribution requirement course).

Contents, emphasis, etc. of the course is defined by means of the lecture materials - *not only the texts*. Table 1 shows the tentative lecture guide. Lecture slides will be uploaded every week. However, they are just rough, point-form notes, with no guarantee of completeness or accuracy. They should in no way be regarded as a substitute for attending the lectures, or for doing the weekly non-credit homework.

Important announcements, problem sets, additional examples, and other course info will be posted on the course web page on Quercus. Check it regularly.

Prerequisite: STA257H1/STAB52H3/STA256H5

Corequisite: MAT235Y1/MAT237Y1/MAT257Y1/MATB42H3/MAT236H5; MAT223H1/MAT240H1/MATA23H3/MAT223H5/MAT240H5

Exclusion: ECO227Y1/STA238H1/STA248H1/STAB57H3/STA260H5/ECO227Y5

Breadth Requirements: The Physical and Mathematical Universes (5)

2 Course Schedule

- **Lectures:**

- We will have synchronous lectures.
- Lectures will be on BBcolab.
- L0101- Mon(3-5pm) and Wed(3-4pm) (local Toronto time)
- L5101- Wed(6-9pm) (local Toronto time)
- We will not have live tutorials. We will use the tutorial times for quizzes and tests. Students should not sign up for other courses that conflict with the lecture and tutorial times of this course. No accommodation will be provided to students missing assessments due to a conflict with another course.

- **Instructor: Shahriar Shams,**

PhD in Biostatistics candidate, Dalla Lana School of Public Health,
Assistant Professor(teaching stream), Department of Statistical Sciences,
University of Toronto.

- **Email:** sta261@utoronto.ca (Please add your section number at the beginning of the subject of your email.)

- **Office hours:** On BB colab, time to be announced later.

3 Textbooks

1. **Mathematical Statistics and Data Analysis**, 3rd Edition, John A. Rice

2. **Probability and Statistics: The Science of Uncertainty**, Second Edition, by Michael J. Evans and Jeffrey S. Rosenthal

Available online (FREE!) on the web-page of Professors Evans and Rosenthal

<http://www.utstat.toronto.edu/mikevans/jeffrosenthal/>

4 Homework

Every week after the lecture a set of exercises will be provided. This homework is **not for credit**. This is only meant to give students opportunities to learn the materials and prepare themselves for the quizzes/tests and exam. Student polls will be used to determine the harder problems for every lecture. Some of the harder problems will be solved by a TA and the session will be recorded offline. Recorded tutorials will be made available for all the students.

5 Quizzes

There will be five quizzes in total. Your lowest mark will be dropped and the best four will worth 10% each. Quizzes will be administered using Crowdmark.

Quizzes are section specific. Visit your ACORN page to know which section you are enrolled in and write your quizzes with that section only. Please note that Quercus doesn't show which section you are enrolled in. It will show LEC0101 on the top of page for all the students.

	Date	Coverage
Quiz-1	Feb 03	Lectures 1 and 2
Quiz-2	Feb 10	Lectures 3 and 4
Quiz-3	Mar 10	Lectures 6 and 7
Quiz-4	Mar 24	Lectures 8 and 9
Quiz-5	Apr 07	Lectures 10 and 11

Table 1: Time table and coverage for Quizzes

On these dates, students in LEC0101 will write their quizzes between 4-5pm and students in LEC5101 will write between 5-6pm. (local Toronto time)

6 Mid-term

- Mid-term will be held during the first week of March.
 - For L0101: Mar 03, 3-5pm (local Toronto time)
 - For L5101: Mar 03, 5-7pm (local Toronto time)
- It will cover lectures 1 to 5 and will be administered using crowdmark.
- Students will be required to write complete answers on paper (or using electronic devices)
- If written using pen and paper, students will be required to take pictures of their complete answers and upload them to crowdmark.
- If written using electronic devices, students can upload their answers as screenshots or saved images.
- More instructions on how to upload documents to crowdmark will be given later.
- [Midterms are section specific as well. Students will write the midterm with the section that they enrolled in.](#)

7 Assignment for credit

At the middle/end of the term, you will do an assignment which will help you to understand few of the theories that we will be using in this course. The assignment will be a bit tedious if

you are doing the calculations by hand. But using a software (like R) will make it a really easy one to complete. It will worth 15% and clear instructions will be given on how to complete and submit your work. More information on this will be announced on Quercus in mid-March.

8 Evaluation

- **Quizzes:** $10\% * 4 = 40\%$
- **Mid-term:** 20%
- **Assignment for credit:** 15%
- **Final assessment:** 25% (3 hours timed assessment, will cover everything taught in the course, date and time will be fixed by faculty of Arts and Science and will be announced later)

9 Missed assessment

There are NO make-up assessments of any form in this course.

- **Taking the final assessment and submitting the assignment is **mandatory** for every student in order to pass this course.**
- For quizzes, the lowest mark will be dropped. So missing one quiz will not affect your grade. If you miss two quizzes, your other three quiz scores will be counted and the missing 10% will be distributed to all your timed assessments (quiz, mid and final). If you miss more than two quizzes, you will get a zero for your third and onward (fourth or fifth) missed quiz irrespective of reason missed.
- If you miss the midterm, your midterm weight will be distributed among the other timed assessments.
- Students are not required to submit any doctor's note for missing any assessment.

10 Computing

Statistical software **R** will be used extensively. Students will learn solving probability problems using simulations in R. *No previous exposure is expected* and R will be introduced starting from the basics. Any code used in the lectures will be available on the course web-page for students to practice at their own time.

11 Communicating with your Instructor

sta261@utoronto.ca is the only email id that the students should be using for this course. Please do not email asking questions like “how to do problem 10.3.4?”, “when is the midterm?”, “how

to submit the assignment?”. Emails like these will be ignored. Otherwise, students should expect a reply within 48 hours. If you need help with any problem you can either talk to your instructor right after the class if you expect the answer to be brief or come during the office hour. If you have any question/concern that you don't want to ask in front of others you can email the instructor (sta261@utoronto.ca) to set up a one-on-one meeting.

12 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 at accessibility.services@utoronto.ca or <http://www.accessibility.utoronto.ca>

13 Academic Integrity

Academic integrity is fundamental to learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the University of Toronto degree that you earn will be valued as a true indication of your individual academic achievement, and will continue to receive the respect and recognition it deserves. Familiarize yourself with the University of Toronto's Code of Behaviour on Academic Matters available at (<https://www.academicintegrity.utoronto.ca/perils-and-pitfalls/>)

Students are not allowed to share quizzes, assignment, tests and exam questions or answers with anyone (not even with other students taking this course) at any point in any platform. Sharing questions or answers and submitting work completed by someone else is a huge academic offence. Please stay away from this type of behavior.

14 Copyright

Students agree to the following terms:

- Course materials (i.e. slides, recordings, assessment questions) are your instructor's intellectual property and have been created by your instructor for students' personal use and under no circumstances should be shared, posted or distributed anywhere.
- Non-compliance with these terms violates an instructor's intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct.

Table 2: STA261, Winter 2021 **tentative** lecture guide

Week	Week of	Readings	Quiz
1	Jan 11	Review, Some distributions and Intro to R	-
2	Jan 18	Method of moments, Maximum Likelihood Estimation, Unbiasedness, MSE	-
3	Jan 25	Unbiasedness and Sampling distribution of S^2 , $t_{(n-1)}$ distribution	-
4	Feb 01	Consistency, Sufficiency, Factorization theorem, Efficiency	1
5	Feb 08	Score, Fisher Information, CRLB, Distribution of MLE	2
-	Feb 15	<i>Reading Week</i> (No lecture/tutorial/office hours)	-
6	Feb 22	Interval estimation, z , t , χ^2 intervals, MLE based confidence interval	-
7	Mar 01	Testing Hypothesis, Type I & Type II error, Likelihood Ratio Test	Midterm week
8	Mar 08	Comparing two samples: independent and paired	3
9	Mar 15	Goodness of Fit test, Model Checking, Normal Probability Plot	-
10	Mar 22	Bayesian Inference	4
11	Mar 29	Regression: Both X & Y continuous, Continuous Y and categorical X	-
12	Apr 05	Regression cont... & review	5

Final assessment will be scheduled by the faculty of arts and science. Date and time will be announced later.