STA257H1-F: Probability and Statistics I

Shahriar Shams

Summer 2020 (last updated on May 02)

1 Course Description

STA257H is a mathematically rigorous introduction to probability, with applications chosen to introduce concepts of statistical inference. This course serves as the necessary foundation for many of the core statistics courses that follow. Broadly, this course will cover the following: probability models,random variables, discrete and continuous distributions, multivariate models, large-sample limiting results, some statistical applications.

Contents, emphasis, etc. of the course is defined by means of the lecture materials - *not only the texts*. Table 2 shows the tentative lecture guide. Lecture slides will be uploaded every week.

There will be some lecture examples using statistical software **R**. Students are encouraged to familiarize themselves with this software through the course however *no previous exposure is expected*. Important announcements, problem sets, additional examples, and other course info will be posted on the course web page on Quercus. Check it regularly.

Prerequisite: (MAT135H1 (70%), MAT136H1(70%))/ MAT137Y1/ MAT157Y1 (MAT137Y1/ MAT157Y1 is strongly recommended)/MATA36H3(70%)/ MATA37H3/MAT135Y5(70%)/ MAT137Y5/MAT157Y5
Corequisite: MAT235Y1/ MAT237Y1/ MAT257Y1 (MAT237Y1/ MAT257Y1 is strongly recommended)/MATB41H3/MAT232H5/MAT233H5; MAT223H1/ MAT240H1/MATA23H3/ MAT223H5/MAT240H5
Exclusion: ECO227Y1, STA247H1, MAT377H1, STAB52H3, STA256H5, ECO227Y5
Breadth Requirements: The Physical and Mathematical Universes (5)

Learning Outcomes: By the end of this course student should understand the concepts above, be able to solve straight forward problems regarding the material, as well as be able to approach an unfamiliar problem and recognize how it is solved by an extension of the material presented during lectures.

2 Course Schedule

- **Lectures:**
  - We will use a mix of synchronous learning and asynchronous learning.
  - Lecture slides along with pre-recorded voice overs will be uploaded (at least) 36 hours before the scheduled lecture time.
  - We will use the scheduled lecture times (Tuesdays and Thursdays 2-5pm) for live question-answer(QA) sessions.
  - The live QA sessions will run approximately 1-1.5 hours on each day.
  - Live QA sessions will be recorded and made available to the students.

  For example: The first lecture on "Set notation, Venn diagrams, Probability models and basic combinatorics" will be uploaded by May 3rd end of the day(Toronto time). On May 5th, at 2:10pm(Toronto time) we will have our live QA session based on the lecture-1.

- **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:** shahriar.shams@mail.utoronto.ca (Please add "STA257" at the beginning of the subject of your email. PLEASE!)

- **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 on the web-page of Professors Evans and Rosenthal
http://www.utstat.toronto.edu/mikevans/jeffrosenthal/

4 Tutorials

The tutorials will start on the second week and run until the last week of class. The tutorials will run on Tuesdays from 1-2pm (we will use Thursdays 1-2pm for assessments) where a member from the teaching team will go over some of the exercises from the materials covered in the previous week. Students will have option to ask questions during these tutorials.

5 Quizzes

There will be four quizzes in total, each covering the materials covered in the previous week. Each quiz will worth 10%. Quizzes will be administered using Quercus.

	Day and time	Coverage
Quiz-1	May 14 (1-2pm)	Lectures 1 and 2
Quiz-2	May 21 (1-2pm)	Lectures 3 and 4
Quiz-3	Jun 04 (1-2pm)	Lecture 7
Quiz-4	Jun 11 (1-2pm)	Lectures 9 and 10

Table 1: Time table and coverage for Quizzes

6 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 require some hand calculations and some coding in R. It will worth 15%. The assignment will be released on June 1st (tentatively) and will be due on June 12th. Clear instructions will be given on how to complete and submit your work.

7 Mid-term

Mid-term will be held on May 28, 1-3pm(Toronto time). It will cover Lectures 1 to 6 (first three weeks). Students will be able to access the questions through Quercus.

- 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 on Quercus.
- If written using electronic devices, students can upload their answers as screenshots or saved images.
- More instructions on how to upload documents to Quercus will be given later.

8 Evaluation

- **Quizzes (May 14, May 21, Jun 04, Jun 11)**: 10% * 4% = 40%
- **Assignment for credit:** 15%
- **Mid-term:** (May 28, 1-3pm, Toronto time): 20%
- **Final assessment:** 25% (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 except for the final assessment.

- Taking the final assessment is mandatory for every student.
  - Students who miss the final assessment due to illness or another legitimate reason are required to email the instructor within *one* week of the final assessment to request accommodation. 0% will be recorded for a missed final assessment otherwise.
  - Students who are granted accommodation for a missed final assessment will do an oral assessment in Bb Collaborate to make up for their missed final assessment.
- For the rest of the assessments (Quizzes, Mid-term, Assignment):
  This term work (i.e. quizzes, Mid-term, assignment) has been planned to help keep you on track in the course, so it is important that you complete everything at the scheduled times. However, you may need to miss an assessment due to illness or another legitimate reason sometime during the term. There are *no* make-ups or extensions for these assessments, but the grading scheme has been designed to accommodate a small number of these missed assessments automatically as follows:
  - A student is only allowed to miss assessments (Quizzes, Mid-term, Assignment) worth up to a total of 35% toward their course grade, irrespective of reason missed. Students are not required to submit any doctor's note for their missed assessment.
  - The weight of the missed work (up to 35%) will be automatically be proportionately distributed among the other assessments.
  - A student missing assessments worth a total of more than 35% toward the course grade, irrespective of reason missed, will not pass this course as it is not possible to award a meaningful grade with such a substantial amount of course work missed.

10 Calculators

Hand calculators will be needed for this course. Any calculator with a square root and logarithmic function will do.

11 Computing

Statistical software **R** will be used occasionally. **No previous computing experience is assumed**. Any code used in the lectures to demonstrate examples will be available on the course web-page for students to practice at their own time.

12 Communicating with your Instructor

Please do not email your instructor asking questions like "how to do problem 10.3.4?", "when is the midterm?", "how to submit the assignment?". Emails with questions like these will be ignored. Otherwise, students should expect a reply within 48 hours. Questions like these should be posted on the discussion board on Piazza.

13 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

14 Academic Integrity

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 quiz or test questions with anyone (not even with other students taking this course). Sharing questions and submitting works completed by someone else is a huge academic offence. Please stay away from this type of behaviors.

15 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: STA257, Summer 2020 **tentative** lecture guide

Lecture	**Date**	**Readings**	**Sections in Rice**
1	May 05	Set notation, Venn diagrams, probability models, basic combinatorics	1.1-1.4
2	May 07	Rules of probability, conditional probability, Bayes' rule, independence	1.5-1.6
3	May 12	Discrete random variables and distributions	2.1
4	May 14	Continuous random variables and distributions	2.2
5	May 19	Functions of random variables, univariate transformations	2.3
6	May 21	Expectation, variance, Moment generating functions and inequalities	4.1.1, 4.2, 4.5
7	May 26	Multivariate distributions, joint, marginal, independent random variables	3.1-3.4
8	May 28	Term test, No lecture	-
9	Jun 02	Conditional distributions, covariance, correlation, conditional expectations	3.5, 4.1.1, 4.1.2, 4.3
10	Jun 04	Functions of joint random variables, sums, quotients, Jacobians and order statistics	3.6-3.7
11	Jun 09	Limit theorems, Law of Large numbers, central limit theorem, convergence	5.1-5.3
12	Jun 11	Distributions derived from the Normal, sample means and variances	6.1-6.3