

STA261: Probability and Statistics II

Shahriar Shams

Winter 2020 (last updated on Jan02)

1 Course Description

STA261H is a rigorous introduction to the theory of statistical inference and to statistical practice. Some of the topics that will be covered are: 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. This course builds on the material introduced in STA257H.

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 and tutorials, or for doing the weekly non-credit assignments.

There will be some lecture examples using statistical software **R**. Students are encouraged to get familiar 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.

2 Course Schedule

- **Lectures:**

- L0101- Room # MC-102, Mon (3 - 5pm) and Wed (3 - 4pm)
- L5101- Room # MS-3153, Wed (7 - 10pm)

- **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 write “STA261” at the beginning of the subject of your email. PLEASE!)
- **Office hours:** Room # HS-376, Mon & Wed, 1 - 2pm (Starting from Jan 13th)

3 Textbooks

1. **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/>

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

4 Tutorials & Quizzes

The tutorials will start on the second week and run until the last week of class except the week of the midterm. Tutorials will cover topics taught in the previous week’s lecture. In preparation for the tutorials, you should do weekly homeworks. There will be short **quizzes every other week starting from week 3** based on previous 2 week’s lectures and homeworks. You have to write the quizzes in your assigned tutorial (otherwise you will get zero). Out of the 5 quizzes, your lowest one will be dropped. The remaining 4 will worth 12% (3% each). You don’t need to submit any paperwork for your first missed quiz as the lowest mark will be dropped. You may shift the weight of one missed quiz (3%) to the final in case it’s missed for a valid reason. **If you miss more than two quizzes**, you will get zero for the third and onward quizzes irrespective of the cause. There are no make-up quizzes. You only write your quiz in your tutorial section.

5 Homeworks

Every week after the lecture a set of exercises will be provided. These homeworks are **not for credit**. They are only meant to give students opportunities to learn the materials and prepare themselves for the tutorials/quizzes/tests and exam. The instructor will help you solve few of these problems during the weekly office hours. And the TAs will also solve few during the tutorials.

6 Assignment for credit

Sometime during the middle/end of the term, you will be doing 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 3% and clear instructions will be given on how to complete and submit your work.

7 Evaluation

- **Quizzes + Assignment:** $12\% + 3\% = 15\%$
- **Mid-term:** $35\% \begin{cases} LEC0101(day) : MAR\ 04, 3 - 5pm \\ LEC5101(eve) : MAR\ 04, 6 - 8pm \end{cases}$
- **Final:** 50% (will cover everything taught in the course)

8 Missed test

There are **NO make-up tests**. If a test is missed for a valid reason, you must submit appropriate documentations (doctor's notes, prescriptions, money receipts) to the course instructor within 3 business days of the test. Print your name, student number, course number, and date on the submitted documents. If documents are not received in time, your test mark will be ZERO. If a test is missed for a valid reason, its weight will be shifted to the final exam.

9 Calculators

Hand calculators will be needed for this course. **NO phone calculators** are allowed in tests/exams/quizzes. Any regular one with a square root and logarithmic function will do.

10 Computing

Statistical software **R** will be used occasionally. **No previous computing experience is assumed**. In no way students will be tested on their expertise on this software. Any code used in the lectures to demonstrate any example will be available on the course web-page for students to practice at their own time. Here are the links to download this open source software:

- for windows: <https://cran.r-project.org/bin/windows/base/>
- for mac: <https://cran.r-project.org/bin/macosx/>

After you have installed **R**, you can install R-studio (an IDE for R) by downloading it from <https://www.rstudio.com/products/rstudio/download/#download>

11 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 like these will be ignored. 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 to set up a one-on-one meeting.

12 April 3rd: last date for grade center correction

After every quiz, your TAs will enter your mark within a week. Check periodically to make sure that the marks entered are correct. **Contact your TA** right away if you see any discrepancies. After April 3rd, no request for grade center correction will be accepted.

13 Academic Integrity

You are responsible for knowing the content of the University of Toronto's Code of Behaviour on Academic Matters (<https://www.academicintegrity.utoronto.ca/perils-and-pitfalls/>).

Table 1: STA261, Winter 2020 **tentative** lecture guide

Week	Dates	Readings	Quiz
1	Jan 06 - 10	Review, Some distributions and Intro to R	-
2	Jan 13 - 17	Method of moments, Maximum Likelihood Estimation, Unbiasedness, MSE	-
3	Jan 20 - 24	Unbiasedness and Sampling distribution of S^2 , $t_{(n-1)}$ distribution	1
4	Jan 27 - 31	Consistency, Sufficiency, Factorization theorem, Efficiency	-
5	Feb 03 - 07	Score, Fisher Information, CRLB, Distribution of MLE	2
6	Feb 10 - 14	Interval estimation, z , t , χ^2 intervals, MLE based confidence interval	-
-	Feb 17 - 21	<i>Reading Week</i> (No lecture/tutorial/office hours)	-
7	Feb 24 - 28	Testing Hypothesis, Type I & Type II error, Likelihood Ratio Test	3
8	Mar 02 - 06	Comparing two samples: independent and paired	Midterm week No tutorial
9	Mar 09 - 13	Goodness of Fit test, Model Checking, Normal Probability Plot	4
10	Mar 16 - 20	Bayesian Inference	-
11	Mar 23 - 27	Regression: Both X & Y continuous, Continuous Y and categorical X	5
12	Mar 30 - Apr 03	Regression cont... & review	-