

Probability and Statistics II

University of Toronto
Department of Statistical Sciences
STA261H1 S 2022

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Class Day/Time: M 3-5 PM ET (LEC 0101) and W 5-7 PM ET (LEC 5101)
Office hours: M 5-6 PM & W 7-8PM ET on Zoom

** This is an online course. Please note that since lectures and/or evaluations will be taking place during the above lecture times, you must be available during those times. No accommodations will be made for assessments missed during these times. o All students should consult the minimum technical requirements for participation in online learning. If you are facing financial barriers to obtaining the required technology, please contact your College Registrar's Office to obtain information regarding your potential eligibility for a need-based bursary. If you anticipate having difficulty connecting to University websites (e.g., Quercus), please submit your question here: <https://www.utoronto.ca/covid19-contact>*

*** As this is an online course and all assessments must be submitted through Quercus, it is the STUDENT'S responsibility to ensure they have a reliable internet connection.*

COURSE OVERVIEW

Course Description: Briefly, 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).

Content, emphasis, etc. of the course is defined by means of the lecture material — not only the posted lecture notes. It is important to attend all lectures, as there is normally no simple way to make up for missed lectures (perhaps obtain another student's notes). There will also be many lecture examples using statistical software R.

Pre-requisites: The prerequisites are:

Prerequisite: STA257H1/STAB52H3/STA256H5

Co-requisites: MAT235Y1/MAT237Y1/MAT257Y1/MATB42H3/MAT236H5;
MAT223H1/MAT240H1/MATA22H3/MATA23H3/MAT223H5/MAT240H5

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

Pre-requisites are **strictly enforced by the department, not the instructor**. If you do not have the equivalent pre-requisites, you will be un-enrolled from the course.

COURSE MATERIALS

Course Content: All lecture slides, recordings and materials will be posted on the Quercus course page for each lecture section. Furthermore, any important announcements will also be posted in Quercus. Please make sure to check it regularly so you don't miss anything.

Textbooks:

1. "Probability and Statistics: The Science of Uncertainty" by *Michael J. Evans and Jeffrey S. Rosenthal*. The free PDF can be downloaded from [here](#).
2. "Mathematical Statistics and Data Analysis", 3rd Edition, by *John A. Rice*

Statistical Software: We will be using R with RStudio for performing statistical analyses. R is a free software that can either be downloaded onto your personal computer or used in the cloud. If you choose to work with R on your personal computer, then installation will be a two step process:

1. The base R framework is available for download at <http://cran.r-project.org/> for Windows, Mac and Linux operating systems.
2. Next, RStudio is a good integrated development environment to R (makes it simpler to work in R) and can also be downloaded for free at <https://www.rstudio.com/products/rstudio/download/>.

If you don't want to download the program or run into problems with installation, you may want to consider University of Toronto JupyterHub ([link](#)) with RStudio selected which only requires you to login with your Utoronto email and connect to our course project via the link provided. In lectures, examples with R syntax will be provided, which should be sufficient for you to learn how to apply the statistical methods.

COURSE COMPONENTS

Lectures: Lectures will take place live on Zoom with recordings posted afterwards. During lectures and videos, we will cover important course materials, as well as cover a number of examples illustrating the uses of these methods. Lecture slides/videos will contain some R code and output to show how to perform these methods in practice. Each lecture builds on the material from previous weeks, so it is recommended that you attend lectures regularly/stay on top of the material.

Tutorials: There will be 10 tutorials for this course. You will all be assigned to specific tutorials. Some of the tutorials will be online and some (after January 31) will be (tentatively) held in-person. However, until January 31st all the tutorials will be online. The tutorials will start from the third week of the semester.

Office Hours: The instructor will hold office hours through Zoom. The office hour schedule will be posted on Quercus. It is recommended that you visit office hours whenever you have a question about the material. It is more important than ever in an online accelerated class to have material clarified as quickly as possible. Don't wait until the last minute to ask your questions.

Quercus Discussion Board: We will be using the Quercus Discussion Board as an online discussion forum. **All questions about course material should be posted here** or asked during instructor 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. Please don't email any course material related questions to the instructors, since, those will not be replied to.

GRADING SCHEME

All students will be evaluated in the following way:

Assessment	Date Due/Occurring	Marks (%)
Tutorial Quizzes (×8)	At the end of each week period (starting from week 3)	21%
Term Test 1	16th February	22%
Term Test 2	30th March	22%
Final	TBA	35%

Please note that the last day to drop the course without penalty is March 14, 2022.

EVALUATION BREAKDOWN

Online Quizzes: There will be 8 online quizzes, and the lowest marked quizzes will be dropped. That is the best 7 quizzes will be selected for each student. Each worth 3% of the overall grade; these will occur during the last 30 minutes of the tutorial time other than during the days of the term tests. Quizzes will begin on **Wednesday January 26th** during the tutorials and will continue until the last lecture period. The quizzes will be uploaded in Quercus and please make sure that you have a decent internet connection.

- The quizzes will cover material from the previous set (previous week) of lectures. You may wish to have a calculator/computer available at this time to aid in any calculations/computations.
- Quizzes can be found on Quercus under the “Quizzes” tab in the navigation bar, or through the link provided in that week’s module, and will only be available during the designated quiz time. Quizzes must be done individually.
- **Missed quiz policy:** Students can miss up to **one (1)** quizzes without academic penalty. There will be no make up quizzes. If a student misses more than one quiz then the first one will be ignored and for the remaining ones the student will be assigned a 0.

Term Tests: The term test has to be submitted online via Quercus assignment. More information on this test will be provided later. If a student misses the term test for a legitimate reason then the weight of the term tests will be shifted to the final and the quizzes. However, students need to let the instructors know via email (needs to be send to the course email) about the reasoning beforehand or within two business days of the term tests.

Final Exam: Details of the final exam will be provided during the later part of the course.

MISSED ASSESSMENT POLICY

Students are responsible for completing all of the assessments detailed in the previous section. If a student is sick and needs to request an extension or accommodation on a term test, they must send an email to their instructor. In order for the request to be considered, the email:

- must be received at least one day before the assessment is due (or within two business days of the term test);
- must include the course code in the subject line;
- must include your full name and student number;
- must specify for which assessment is being requested;

- must include the following sentences:
 - “I affirm that I am experiencing an illness or personal emergency and I understand that to falsely claim so is an offence under the Code of Behavior on Academic Matters.”
 - “I understand that the weight of this assessment will be moved to the weekly quizzes (10%) and to the final exam (12%)”

COMMUNICATION

Please do not email the instructor with questions related to the content of the course. These types of questions are much easier to answer through the discussion board or during office hours. Emails that do not contain sensitive or personal information will be directed to post the questions on the discussion board. If you need to email the instructor for personal reasons, please use your official University of Toronto email address, include “**STAB261 H1 S 2022**” in the subject and also include your full name and UTORid in the body of the email (in case we need to look anything up). However, instructors may not be able to reply to all the emails, since they receive a large volume of emails before term tests and finals. : If contacting the instructors via email, regarding a personal inquiry, please ensure you are using your official UofT (@mail.utoronto.ca) email. Emails that come into the inbox that are not from UofT email addresses will not receive a reply.

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/>). Here are a few guidelines regarding academic integrity:

- You may consult class notes/lecture slides during quizzes and tests, however sharing or discussing questions or answers with other students is an academic offence.
- Students must complete all assessments individually. Working together is not allowed.
- Paying anyone else to complete your assessments for you is academic misconduct.
- Sharing your answers/work/code with others is academic misconduct.
- Looking up solutions to test/quiz problems online or in textbooks and copying what you find is an academic offence.
- All work that you submit must be your own! You must not copy mathematical derivations, computer output and input, or written answers from anyone or anywhere else. Unacknowledged copying or unauthorized collaboration will lead to severe disciplinary action, beginning with an automatic grade of zero for all involved and escalating from there. Please read the UofT Policy on Cheating and Plagiarism, and don’t plagiarize.

ACCESSIBILITY NEEDS

The University of Toronto offers academic accommodations 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>.

CLASS SCHEDULE - TENTATIVE

This is the tentative outline for Winter 2022. Topics may be reduced or additional topics may be added by course instructor's discretion. The book chapters are given from Evans and Rosenthal. However, we will be solving problems from Rice also.

Lecture Week	Content
Week 1 (January 10 & 12)	Review of STA257. Convergences, law of large numbers and sampling distributions
Week 2 (January 17 & 19)	Chapter 5.1 - 5.2: Statistical Inference and Probability Models
Week 3 (January 24 & 26)	Chapter 5.3 - 5.4: Statistical Models, Data Collection and exploratory data analysis and Quiz 1
Week 4 (Jan 31 & Feb 2)	Chapter 5.5 - 6.2: Likelihood Inference & Maximum Likelihood Estimators and Quiz 2
Week 5 (February 7 & 9)	Chapter 6.2 - 6.3: MLE (Cont.), Sufficient Statistics bias and consistency of an estimator and mean squared error (MSE) and Quiz 3
Week 6 (February 14 & 16)	Chapter 6.3: Interval estimation and Term Test 1
<i>February 21 & 23</i>	<i>Reading Week</i>
Week 7 (Feb 28 & Mar 2)	Chapter 6.3: Test of Hypothesis, power calculations and p-values and Quiz 4
Week 8 (March 7 & 9)	Chapter 7.1 - 7.2: Bayesian Inference and Quiz 5
Week 9 (March 14 & 16)	Chapter 6.5: Large Sample Properties of the MLEs and Quiz 6
March 14	Deadline to drop course without penalty
Week 10 (March 21 & 23)	Chapter 6.4: Distribution free Methods (Bootstrapping and other resampling methods) and Quiz 7
Week 11 (March 28 & 30)	Chapter 10.1: Least Squares Estimates and their properties, ANOVA and Term Test 2
Week 12 (April 6 & 8)	Chapter 10.1: Least Squares Estimates and their properties, ANOVA and review for final and Quiz 8