

# Statistical Theory

University of Toronto  
Department of Statistical Sciences  
STA255H1S Winter 2025

<b>Time and Venue:</b> LEC0101 Tue. 11:00 - 13:00, NF 003 LEC0101 Thu. 12:00 - 13:00, BT 101 TUT0101 Thu. 11:00 - 12:00, MC 252 TUT0102 Thu. 11:00 - 12:00, MS 4171 TUT0103 Thu. 11:00 - 12:00, MS 2170 TUT0104 Thu. 11:00 - 12:00, HS 106 TUT0105 Thu. 11:00 - 12:00, MC 254	<b>Instructor:</b> Yaoming Zhen, Ph.D. <b>Course email:</b> sta255@course.utoronto.ca <b>Office hours:</b> Thu. 1-2 pm after class and by appointment TA: Dayi Li, dayi.li@mail.utoronto.ca TA: Jianhui Gao, jianhui.gao@mail.utoronto.ca TA: Muheng Li, muheng.li@mail.utoronto.ca TA: Daiqing Wu, daiqing.wu@mail.utoronto.ca TA: Leo Murao Watson, leo.watson@mail.utoronto.ca
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## 1 Course overview

**Course Description:** This course deals with the mathematical aspects of some of the topics discussed in STA220H1. Topics include discrete and continuous probability distributions, conditional probability, expectation and variance, sampling distributions, estimation and testing, and the linear models (Note: STA255H1 does not count as a distribution requirement course).

**Learning Outcomes:** By the end of the course, all students should be able to:

1. Understand the mathematical ideas, principles, considerations, and theory in statistical methods,
2. Recognize the common and unique characteristics among different statistical models, which is important for further learning or designing new models,
3. Explain statistical concepts and theory to various audiences as would be required in the job market or collaborative environment, and
4. Outline the correct use of statistical models in a coherent and reproducible analysis plan.

**Pre-requisites:** STA220H1/ STA221H1/ STA288H1/ ECO220Y1 (note: ECO220Y1 may be taken as a co-requisite)/ STAB22H3/ STA220H5/ ECO220Y5; MAT133Y1 (70%)/ (MAT135H1, MAT136H1)/ MAT137Y1/ MAT157Y1/ (MATA32H3 (70%), MATA33H3 (70%))/ (MATA29H3 (70%), MATA35H3 (70%))/ (MATA30H3, MATA36H3)/ (MATA31H3, MATA37H3)/ MAT133Y5 (70%)/ (MAT132H5 (70%), MAT134H5 (70%))/ (MAT135H5, MAT136H5)/ MAT137Y5/ MAT157Y5

**Exclusions:** ECO227Y1/ STA237H1/ STA238H1/ STA257H1/ STA261H1/ STA247H1/ STA248H1/ STAB52H3/ STAB57H3/ STA256H5/ STA260H5

## 2 Course materials

**Course Content:** We have a Quercus course page for this course. All lecture slides, assignments and any other materials will be posted on this Quercus course page. In addition, any important announcements will also be posted in Quercus. Please make sure to check it regularly.

**Textbook:** [A Modern Introduction to Probability and Statistics, Understanding Why and How](#), by F.M. Dekking, C. Kraaikamp, H.P. Lopuhaa, L.E. Meeester (Springer).

**Statistical Software:** We will use the R Statistical Software for performing statistical analyses in this course. R is a free software that can either be downloaded onto your personal computer or used in a cloud environment. We encourage all students to use RStudio through the [JupyterHub](#) for University of Toronto. This will allow you to login with your official UofT credentials and use RStudio without the need for a local installation and can be run on any device that has access to an internet connection.

## 3 Course components

**Lectures:** In-person lectures occur on Tuesday and Thursday (see ACORN for rooms). Breaks will be taken appropriately on Tuesday's lecture. When possible, you are encouraged to bring pens and draft paper, or writable electronic device for hands-on practice.

**Tutorials:** There will be weekly one-hour tutorial sessions throughout the term. To deepen your understanding of the course concepts, the teaching assistants (TAs) will provide tutorials to work thorough application problem sets related to the contents of the lecture. You are strongly encouraged to attend your tutorials and ask TA questions, as the tutorials are designed to help you with the quizzes and exams.

**Office hours:** The instructor's office hour is on Thu. 1-2 pm after class or by appointment. In addition, TAs will hold online office hours. Detailed schedule will be posted on Quercus once finalized.

**Piazza discussion:** We will use the Piazza (<https://piazza.com/utoronto.ca/winter2025/sta255>) as an online discussion forum. All questions about course material should be posted here or asked during instructor's or TAs' 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.

## 4 Grading scheme

Each student's final grade will be computed according to the below grading scheme. No special rounding rules or individual grade adjustments (e.g. to meet GPA cut-offs, minimal requirements for programs, etc.) will be used to calculate course grades. No special reweighting of assessments or extra work will be accepted to account for perceived poor performance, nor to account for any assessment(s) that have been missed without accommodation. There are no exceptions to these policies.

<b>Assessment</b>	<b>Date Due/ Occurring</b>	<b>Weight</b>
<u>Quizzes via Quercus</u> 10 weeks	Post weekly on Thursday until 11:59 pm on Sunday	20%
<u>Midterm</u> Midterm Test (during scheduled class)	Feb. 13, Thu., 11:20 - 13:00 BT 101 & PB B250	30%
Final exam (during final exam period)	Scheduled by the FAS	50%

**Remark 1:** If your final exam grade is better than your midterm, the weighting will be 70% final plus 10% midterm.

**Remark 2:** The quiz mark will be calculated based on the student's best 8 out of 10 quizzes.

**Remark 3:** The last day to drop the course without penalty is March 10, 2025.

## 5 Evaluation breakdown

**Quizzes via Quercus:** Students will have 10 quizzes via Quercus due at 11:59pm on Jan. 19, 26, Feb. 2, 9, March 2, 9, 16, 23, 30, and April 6, respectively. They will cover that week's materials. Once you start the quiz, you will have exactly **60 minutes** to complete and submit your answers. There are no extensions on the availability periods under any circumstances. The quizzes are open book but must be completed independently (no collaboration permitted – and absolutely no sharing and/or posting of questions and/or answers is permitted).

**Term Test:** The term test will be conducted in person during the scheduled class time, and it will be 100 minutes long. The test will cover materials taught before Feb. 12, 2025.

**Final Exam:** The details about the final exam will be provided during the last week lectures. the final exam will be 3 hours in duration and will be scheduled by the Faculty of Arts and Science during the final assessment period.

## 6 Late and missed assessment policy

**Missed quizzes:** There will be no accommodations made for late or missing the online quizzes.

**Missed Term Test:** If a student is experiencing a serious personal illness or emergency on the date of the test, the student **must declare their absence on ACORN and notify the teaching team via email no later than one week after the date of the test.** If a student misses the term test for a valid reason then the weight of the term test (30%) will be shifted to the weight of the final exam. In such case, the weight of the final exam will be 80%.

## 7 Extension request policy

**Extreme Situations/Prolonged Illness:** Should a student be experiencing a prolonged illness or other situation that prevents them from turning in their work, they should immediately contact their instructor and College Registrar to inform them of their situation. They should also submit an Absence Declaration form on ACORN or a Verification of Illness (VOI) form that lists every day during which they were incapacitated and unable to work. Accommodations will not be considered without a completed declaration or VOI, and will only be considered for extreme circumstances at the request of the College Registrar.

**Accessibility-Related Extension Requests:** Students registered with Accessibility Services should notify the instructor as soon as possible if additional time is needed on assessments that are eligible for such accommodation. Please notify the instructor by email of your situation and cc your accessibility advisor in the process. The instructor will work with the accessibility advisor to determine an appropriate accommodation for your situation.

## 8 Regraded requests

Regrade requests will be accepted for all assessments. Regrade requests must provide a justification for where there exists a grading error and/or how the work meets the grading rubric. These justifications must further be backed up with concrete references to the course materials. All regrade requests will be accepted by email and will be accepted no later than one week after the grade for that assessment is released. No regrade requests will be accepted after the 1 week deadline. The instructor further reserves the right to re-evaluate the assessment in its entirety (i.e. grades can go up, down, or remain unchanged). Please allow 2 weeks for regrade requests to be processed by the instructor.

## 9 Intellectual property

Course materials provided on Quercus, such as lecture slides, assessments, and solutions are the intellectual property of your instructor or TAs and are for the use of students currently enrolled in this course only. In class lectures and tutorials might be recorded and be made available to other students enrolled in the course.

**Providing course materials to any person or company outside of the course is unauthorized use and violates copyright.**

## 10 Use of artificial intelligence

ChatGPT and other generative AI tools can perform a variety of functions for us. However, students **cannot** use ChatGPT and other AI tools in their online quizzes. The instructor reserves the right to ask students to explain their solutions in the online quizzes.

## 11 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 behaviors 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/>).

## 12 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](mailto:accessibility.services@utoronto.ca) or <http://accessibility.utoronto.ca>.

## 13 Tentative schedule of topics

Below is a tentative schedule of topics to be covered in class. The schedule is subject to change and modification.

Week	Topics	Book Chap.	Activities
Week 1 (Jan. 7, 9)	Concepts on probability theory	1 - 2	
Week 2 (Jan. 14, 16)	Counting and discrete random variables, Bayes rule and independence	3 - 4	Tutorial, Quiz
Week 3 (Jan. 21, 23)	Discrete and continuous random variables	4 - 5	Tutorial, Quiz
Week 4 (Jan. 28, 30)	Expectation and variance, Transformations of random variables	7 - 8	Tutorial, Quiz
Week 5 (Feb. 4, 6)	Joint distributions, Covariance and correlation	9 - 11	Tutorial, Quiz
Week 6 (Feb. 11, 13)	Review	1 - 11	Midterm
Week 7 (Feb. 17-21)	Reading week		
Week 8 (Feb. 25, 27)	Law of large number and central limit theorem	13 - 14	Tutorial, Quiz
Week 9 (March 4, 6)	Exploratory data analysis, basic models, Bootstrap	15 - 18	Tutorial, Quiz
Week10 (March 11, 13)	Estimators and their properties	19 - 21	Tutorial, Quiz
Week11 (March 18, 20)	Least Squares, confidence intervals	22 - 24	Tutorial, Quiz
Week12 (March 25, 27)	Hypothesis testing, sampling distributions	25 - 28	Tutorial, Quiz
Week13 (April 1, 3)	Wrap-up and review	1 - 28	Tutorial, Quiz