STA255H1 – Statistical Theory

Course & Instructor Information

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Lecture Section	Lectures	Tutorial*
LEC0101	Mondays 10-11am in SS2118 Wednesdays 10am-12pm in SS2118	Mondays 11am-12pm *(check schedule on last page of this syllabus for weeks; locations posted on Portal)*
LEC0201	Tuesday 3-4pm in MS2158 Thursday 3-5pm in MS2158	Tuesdays 4-5pm *(check schedule on last page of this syllabus for weeks; locations posted on Portal)*

* Note – The location of your tutorial may not match the one for your registered section (i.e., TUT0101- TUT0105, or TUT0201-TUT0210) on the timetable. See Portal for more information. Also, you will <u>not</u> need to attend tutorial every week. Refer to the schedule on the last page of this syllabus and Portal for more information.

Instructor: Dr. Bethany White
Associate Professor, Teaching Stream
Department of Statistical Science

Instructor Contact Information & Office Hours

All course content or course administration questions <u>must</u> be posted to the appropriate Portal Discussion Board (Course Content Questions or Course Administration Questions) or brought to office hours. These types of inquiries sent will not be addressed over email. Any messages of a more personal nature (e.g., providing medical documentation for a missed assignment or midterm) should be emailed to the instructor directly at bethany.white@utoronto.ca (be sure to include the course number – STA255, your section and your UTORid in your email) or brought to Dr. White in her office hours. You can expect a response within about 48 hours (Monday-Friday) to a Discussion Board posting or to an email to your instructor.

Note: To discourage cramming, content-related questions posted within the 24 hour period preceding the midterm (the 1st midterm) or final exam will not be addressed by the instructor/TAs until after the midterm or final exam. No office hours will be held during these periods either.

Dr. White's STA255 Office Hours: Mondays 11am-12:30pm & Thursdays 1-2:30pm in SS 6024A
(unless otherwise indicated on Portal)

Calendar Description

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

Prerequisite: STA220H1/STA221H1/ECO220Y1 (note: ECO220Y1 may be taken as a co-requisite), MAT133Y1(70%)/(MAT135H1,MAT136H1)/MAT137Y1/MAT157Y1
Exclusion: ECO227Y1/STA257H1/STA261H1/STA247H1/STA248H1

NOTE: The prerequisites are <u>strictly</u> enforced in this course. Special permission to take STA255 will <u>NOT</u> be granted to anyone without the required statistics and calculus courses (or equivalent transfer credits).

Course Learning Outcomes

In this course you will:
- model random phenomenon using a variety of discrete and continuous probability distributions,
- compute probabilities and expected values and determine characteristics of random variables (and functions of random variables) using calculus and simulation,
- derive point and interval estimators for STA220 inference procedures and explore their behaviour (e.g., via simulation), and
- conduct appropriate STA220-level statistical inference procedures using statistical software (R), interpret results and identify potential limitations.

Textbook

Devore & Berk (2012) Modern Mathematical Statistics with Applications. 2nd Edition, Springer.

An electronic version is available free-of-charge through the University of Toronto Libraries: http://search.library.utoronto.ca/details?8331046&uuid=f5b471dd-de62-4a29-8cd5-e0d00d3fa639#
Alternatively, a hard copy is available for purchase through the Bookstore.

We will also be using iClickers in lecture. There is flexibility in the grading scheme so that you do not need to use an iClicker if you do not wish to do so. If you wish to participate with iClickers and do not already have an iClicker or a REEF subscription for another course, you can purchase either a 6-month REEF subscription so you can participate using your own device in class (ISBN# 978-1-498-60075-0) or, an iClicker device bundled with a 6-month trial subscription of REEF (ISBN# 978-1-498-60164-1) so you won't need your own internet-enabled device to participate.

Statistical Software - R

R is a popular open source statistical package that is widely used in both academia and industry. It is available for free download from: http://cran.ca.r-project.org for use on Windows, Mac OS X, and Linux (there's even a version on Android). You will need to be familiar with R code and output and will need to generate and interpret R code/output on your STA255 assignments.

Portal (Blackboard) Course Site

The two lecture sections will share a common Portal course site. It is your responsibility to check this Portal site regularly and to monitor your utoronto email inbox for messages about the course. Important announcements, information about how to get set up with iClickers/REEF and R, information about assessments, help (via the Discussion Board), your grades, etc. will be available on the Portal site and several course assessments will need to be submitted there through Portal tests. Outline lecture slides will also be posted there in .pdf format, 1 slide per page only, by 11:59pm the night before lecture. Alternative file formats will not be available. **Note that complete slides/lecture material used in class will <u>not</u> be posted or distributed in any form under any circumstances.**

The Discussion Board tool is enabled on the Portal website. Post questions and respond to your peers' questions about course content (e.g., lecture, readings, practice questions, etc.) or general course administration there. They will be monitored on a regular basis. If you email your instructor with a course content or general administration question, you will be directed to the Portal Discussion Board. This is an open Discussion Board and an extension of our classroom learning community so please be respectful of one another. Derogatory, discriminatory, or otherwise inappropriate language or topics will be removed and dealt with at the instructor's discretion.

Tutorials

There will be seven (7) one-hour tutorial sessions during the term: three (3) tutorials are required 'Group Tutorials' where you will need to complete and hand in answers to a small group assignment during the session, and four (4) tutorials are recommended, but optional, problem-solving sessions. The purpose of these tutorials is to provide you with an opportunity to work through problems applying the material learned in class with support from your TA and your peers. Refer to the schedule on the last page of this syllabus for the tutorial schedule and carefully mark your calendar for your tutorial weeks/times. You must attend the tutorials for your section at the location posted for you on Portal-you will not earn credit for attending another tutorial location/time/week.

Questions & Additional help

Have a course-related question? Need extra help with the material? Here are some options:
- **Have a question about STA255 course material, R, or general administration of the course?**
  - Review the questions already posted on the Portal discussion boards and if your question hasn't already been addressed, post it there with an informative subject line.
  - Visit the instructor's office hours or TA office hours (to be announced on Portal) or bring your question(s) to your tutorial. Note that the TAs will <u>not</u> be available by email or for extra help outside tutorials or any office hours they hold.
- **Need to reach the instructor about a private or personal matter (e.g., illness, grades)?** Email the instructor – do not post this on the Portal Discussion Board! E-mail should only be used for emergencies or personal matters and should include the course (STA255), your lecture section (LEC0101 or LEC0201) and your UTORid. If you email a question to the instructor about course material or course administration, then you will be asked to post your question on the appropriate Portal discussion board – these types of questions will not be answered via email.

Grading Scheme & Assessment Information

Your course grade will be automatically calculated using the grading scheme (of those below) that gives you the highest grade:

Assessment	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Course Structure Quiz	0.5%	0.5%	0.5%	0.5%
Intro Survey	0.5%	0.5%	0.5%	0.5%
Class Participation (iClickers)	6%	6%	0%	0%
Assignments (2)	14% (7% each)	14% (7% each)	16% (8% each)	16% (8% each)
Group Tutorial Assignments (best 2 out of 3)	9% (4.5% each)	9% (4.5% each)	13% (6.5% each)	13% (6.5% each)
Midterm	30%	15%	30%	15%
Final Exam	40%	55%	40%	55%

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 <u>no</u> exceptions to these policies.

Course Structure Quiz

This Portal multiple choice test covers details from this course syllabus, and will be available from the first day of classes (Thursday, January 5) until **10pm, on Wednesday, January 25**. This is a graded quiz (e.g., if there are 6 questions and you answer 3 of them correctly, you will earn 0.25% out of the possible 0.5% for the quiz). No credit will be given for quizzes that are not submitted by the due date. No accommodation will be made after the deadline for any reason (e.g., technical problems). Attempt the quiz early during the availability period so that any problems that arise can be dealt with before the deadline. If you encounter a technical difficulty, report the problem immediately by emailing your instructor at bethany.white@utoronto.ca

Intro Survey

This Portal survey will be available from the first day of classes (Thursday, January 5) until **10pm, on Wednesday, January 25**. Your responses will be treated anonymously (i.e., they will not be linked to you) and there are no 'right' and 'wrong' responses, so this will be graded based on completion only (e.g., if you submit your responses by the deadline, you will earn the full 0.5%). No credit will be given for surveys that are not submitted by the due date. No accommodation will be made after the deadline for any reason (e.g., technical problems). Attempt the survey early during the availability period so that any problems that arise can be dealt with before the deadline. If you encounter a technical difficulty, report the problem immediately by emailing your instructor at bethany.white@utoronto.ca

iClickers/REEF

iClickers (or REEF) will be used to promote engagement and provide feedback on your understanding during classes as well as to provide you with credit on your lecture participation. The information below provides further details. Note that iClicker/REEF participation is optional – alternate grading schemes are available for students who do not wish to participate this way (see Grading Schemes 3 and 4 above).

iClicker questions will be asked during lecture. The proportion of questions you answer (starting the week of January 23) will determine the fraction of the available participation grade (6%) that you earn, as shown in the table on the right. There will be around 3 clicker questions per class. However, some classes will have more or fewer questions. Clicker participation only requires that you try; you do not have to get the questions correct to earn this part of your course grade. Notice that you can miss up to 25% of the clicker questions for any reason without affecting your grade. Due to this flexibility, there is no accommodation for missed clicker participation for any reason (e.g., legitimately missed lectures, technical problems, incorrectly registered iClicker/REEF).

% Questions answered	Class Participation Mark (/6%)
0%	0%
0 < % answered < 15	1%
15 ≤ % answered < 30	2%
30 ≤ % answered < 45	3%
45 ≤ % answered < 60	4%
60 ≤ % answered < 75	5%
75 ≤ % answered ≤ 100	6%

It is your responsibility to register your iClicker device (see http://teaching.utoronto.ca/ed-tech/teaching-technology/iclickers/registering-your-iclicker/) or set up your REEF account correctly (information is posted on Portal) to ensure that your clicker participation is recorded properly. Use of an iClicker device or REEF account associated with a UTORid other than your own or granting permission for someone else to submit answers on your behalf in your absence are academic offences and will be dealt with as such.

Assignments

There will be two (2) equally-weighted assignments to be completed **independently** (no collaboration permitted) and submitted through Portal (as a Blackboard 'Test') by their respective deadlines (**Assignment #1 – 10pm, February 8 and Assignment #2 – 10pm, March 22**). Assignment questions will be posted on Portal no later than one week before the due dates. Assignments must be completed and submitted through the appropriate Portal test by the deadlines to avoid late penalties. Late assignments will be accepted through the appropriate Portal test with a penalty of **20% per calendar date** (e.g., if the submission deadline is 10pm on Feb 8, and you submit at any time between 12:00am and 11:59pm on Feb 9, your maximum possible score will be 80% - e.g., if you earn 76%, then your recorded grade will be 56%, etc.).

Refer to the "Missed Assignments and Midterm" section below for information on how to request accommodation for a missed assignment and what accommodation may be possible.

Group Tutorial Assignments

The class will be randomly divided up into two groups: Group X and Y. The weeks you need to attend your Group Tutorial depend on whether you are assigned to Group X or Y (check Portal for your Group). On your assigned weeks there will be three (3) small group assignments to be completed collaboratively during your tutorial (small groups will be formed in your Group Tutorial). Paper versions of the assignment questions will be distributed by your TA at the beginning of your Group Tutorials and the assignment must be worked on collaboratively with your small group, signed by each small group member who contributed and handed-in by the end of the tutorial session. You must be present and actively contribute to your small group's answer in your assigned week/tutorial in order to earn credit for the assignment. There are no make-ups for missed Group Tutorial Assignments - if you miss one, 0% will be recorded. Your top 2 out of 3 Group Tutorial Assignments will count toward your STA255 grade so you can miss one without penalty. Due to this flexibility, there is no accommodation available for missed Group Tutorial Assignments.

Midterm

There will be a **75-minute** midterm during class time the week before Reading Week:
* **10:30am-11:45pm, Wednesday, Feb 15 for section LEC0101**, and
* **3:30pm-4:45pm, Thursday, Feb 16 for section LEC0201**.

The location and information on coverage will be posted on Portal in advance. You must bring your student identification to the midterm. **You <u>must</u> attend the midterm for the lecture section in which you are <u>officially</u> enrolled.**

Refer to the "Missed Assignments and Midterm" section below for information on how to request accommodation for a missed midterm and what accommodation may be possible.

Final exam

There will be a **3-hour exam (mix of multiple-choice and written answers)** scheduled but the Faculty of Arts and Science during the April exam period. You must bring your student identification to the final exam. Information on coverage, along with some sample questions will be posted on Portal in advance.

Final exam conflicts (see http://www.artsci.utoronto.ca/current/exams/conflicts) and petitions for a deferred exam must be brought to the Faculty of Arts and Science, not your instructor. *Information on how to request a deferred exam from the Faculty of Arts and Science due to illness or another valid reasons is available at: http://www.artsci.utoronto.ca/current/petitions/common#deferred*

Calculators

A non-programmable calculator may be useful for the midterm and/or final exam. Any basic calculator will be sufficient (no special functions are necessary). Calculators on phones or other devices equipped to communicate with the outside world (for example, through the internet or cellular or satellite phone networks) will not be permitted during the midterm and final exam.

Marking concerns with Assignments or the Midterm

Any requests to have an assignment or midterm question regraded must be made in writing directly to your instructor at bethany.white@utoronto.ca (*unless directed otherwise on Portal*) **<u>within one week</u>** of the date the marks were posted on Portal. To be considered, your message <u>must</u> clearly identify the question you have concerns about, contain a detailed justification for your concern and make specific references to your answer and to the relevant course material. Keep in mind that it is possible for your assignment grade to go down if the regraded mark is lower than your original assignment grade.

Accommodations for Missed Assignments or Midterm

- If an assignment or your midterm is missed for a valid medical reason, you must email your instructor immediately, then submit the University of Toronto Verification of Student Illness or Injury form (http://www.illnessverification.utoronto.ca) to your instructor within **one week** of the assignment deadline or midterm. The form will only be accepted as valid if the form is filled out according to the instructions on the form. **The form must indicate that the degree of incapacitation on academic functioning is moderate, serious, or severe in order to be considered a valid medical reason for missing the midterm (and for assignments, it must cover at least the 2 days – the due date + at least 1 adjacent day – in order to be deemed valid). If the form indicates that the degree of incapacitation on academic functioning is negligible or mild or does not cover the midterm date or assignment due date (+ at least 1 adjacent day for assignments) then this will NOT be considered a valid medical reason.**
- Other reasons for missing a midterm or assignment will require <u>prior</u> approval by your instructor. If approval is not granted <u>in advance</u> for non-medical reasons then you will receive a grade of 0% for the missed midterm or assignment.
- Note: If you submit an assignment or write the midterm, it will be assumed that you deemed yourself fit enough to do so and your grade will stand as calculated. No accommodation will be made based on claims of medical, physical, or emotional distress after the fact.
- **Accommodation for missed assignments** - There are no make-ups for assignments. If accommodation is granted by the instructor for a missed assignment, the weighting for that assignment will be shifted to your final exam; otherwise 0% will be recorded for your missed assignment. <u>No</u> make-ups or accommodation is available for missed Group Tutorial Assignments – 0% will be recorded for missed Group Tutorial Assignments and only your higher 2 of the 3 Group Tutorial Assignments count.
- **Accommodation for a missed midterm** – There is no midterm make-up. If accommodation is granted by the instructor for a missed midterm, the weighting of your missed midterm will be shifted to your final exam so it will be worth 70%. If accommodation is not requested, nor granted from the instructor for your missed midterm, 0% will be recorded for your missed midterm and your final exam will remain 55% as indicated in the grading scheme.

Academic integrity

You are responsible for knowing the content of the University of Toronto's
Code of Behaviour on Academic Matters at http://www.governingcouncil.utoronto.ca/policies/behaveac.htm.

Academic offenses will be taken very seriously and dealt with accordingly. For all of the assessments in this course, submitting another student's answer(s) as your own, or providing your own answer(s) to another student for him/her to submit as his/her own is considered as an academic offense and will be reported as such. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact the instructor.

Intellectual Property Statement

Course material (i.e. lecture slides, assignment and midterm questions/solutions and other supplementary course material available on Portal) is the intellectual property of your instructor and is made available to you for your personal use in this course. Sharing, posting, selling or using this material outside of your personal use in this course is <u>not</u> permitted under any circumstances and is considered an infringement of intellectual property rights.

<u>**No**</u> **videotaping of lectures will be permitted under any circumstances.** If you would like to make an audio recording of the lectures in this course, you MUST ask permission from your instructor <u>in advance</u>. According to intellectual property laws, not asking permission constitutes stealing.

Accessibility Needs

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodation, please feel free to contact Accessibility Services at (416) 978 8060; http://accessibility.utoronto.ca

How to Succeed in this Course

- Read this course syllabus in its entirety and understand the course policies.
- Attend and participate in class regularly and take notes (obtain notes from a classmate for any missed classes).
- Attend and participate in tutorials (both your required Group Tutorials and the recommended, but optional ones) and work through the tutorial problems carefully for any missed tutorials.
- Regularly review class notes and read the textbook.
- If you find that you are having trouble with prerequisite statistics and calculus concepts, review your notes from those courses - this material is assumed to be known so will not be taught again in this course.
- Complete assignments carefully and as early as possible.
- Practice, practice, practice! Work through at least some of the recommended textbook exercises each week to make sure you understand the basic concepts. You need to study and do practice problems frequently (not just in the week before the midterm/exam) to keep up in the course.
- Take advantage of the help available & ask questions (lectures, tutorial, office hours, Portal Discussion Board).

Course Schedule

This is our tentative schedule for course topics. Some adjustments may be made as the course progresses, depending on the rate at which individual topics are covered. There will be recommended textbook problems posted on Portal.

Week	Textbook	IMPORTANT REMINDERS
Week 0 – Jan 5-6 *(partial week)*	N/A	*No class for L0201 on Thursday, Jan 5*
Week 1 – Jan 9-13	Chapter 1: Overview & Descriptive Statistics Chapter 2: Probability	*No tutorials*
Week 2 – Jan 16-20	Chapter 3: Discrete RVs & Probability	*Tutorials - recommended but optional for Groups X & Y*
Week 3 – Jan 23-27	Chapter 4: Continuous RVs & Probability	iClicker participation starts counting this week **Group Tutorial - required for Group X; <u>no</u> Tutorial for Group Y** **Course Structure Quiz due 10pm, Jan 25** **Intro survey due 10pm, Jan 25**
Week 4 – Jan 30-Feb 3	Chapter 5: Joint Probability Distributions	**Group Tutorial - required for Group Y; <u>no</u> Tutorial for Group X**
Week 5 – Feb 6-10	Chapter 6: Statistics & Sampling Distributions	*Tutorials - recommended but optional for Groups X & Y* **Assignment 1 due 10pm, Wed, Feb 8**
Week 5 – Feb 13-17		<u>*No classes or tutorials*</u> on Feb 13-14 but extra office hours-see Portal **Midterm** *(locations TBA on Portal)***:** STA255 L0101 – 10:30am-11:45pm, Wed, Feb 15 STA255 L0201 – 3:30pm-4:45pm, Thurs, Feb 16
Week 6 – Feb 20-24		*Reading week*
Week 7 – Feb 27-Mar 3	Chapter 7: Point Estimation	*Tutorials - recommended but optional for Groups X & Y*
Week 8 –Mar 6-10	Chapter 8: Statistical Intervals Based on a Single Sample	**Group Tutorial - required for Group X; <u>no</u> Tutorial for Group Y**
Week 9 – Mar 13-17	Chapter 9: Tests of Hypotheses based on a Single Sample	**Group Tutorial - required for Group Y; <u>no</u> Tutorial for Group X**
Week 10 – Mar 20-24	Chapter 10: Inference based on Two Samples	*Tutorials - recommended but optional for Groups X & Y* **Assignment 2 due 10pm, Wed, Mar 22**
Week 11 – Mar 27-31	Chapter 12: Regression and Correlation	**Group Tutorial - required for Group X; <u>no</u> Tutorial for Group Y**
Week 12 – Apr 3-5 *(partial week)*	Wrap-up	**Group Tutorial - required for Group Y; <u>no</u> Tutorial for Group X** *No class for L0101 on Wednesday, Apr 5* Apr 6-7 – U of T study days
Exam Period		Apr10-28 - Exam period Apr 14-Good Friday (U of T closed)

See Portal for your Group X or Y assignment and your Tutorial and Midterm locations (note your Tutorial locations <u>may</u> change from week to week and differ from the location listed for your tutorial section in the Timetable).