STA442: Methods of Applied Statistics
Fall 2024

Course Information
- Lectures: **Tuesdays, 2 PM – 5 PM**
- Location: **Sidney Smith (SS) 2108**
- Instructor: **Jun Young Park**, PhD
- Teaching assistant: **Dayi (David) Li, Ruyi Pan** (PhD students in Statistical Sciences)

Important Dates
- October 22: Midterm exam, 2-5PM
- October 29: No class (Reading Week)

Getting Help with the Course
- Office hours: See Quercus for the Zoom links and time.
- Piazza: Use Piazza to discuss course contents, assignments, and administrative issues.
- Course Email: sta442@course.utoronto.ca
  - Use the course email to discuss personal issues where Piazza is not an appropriate way to discuss. Instructor and TAs will not respond to emails sent to individual accounts.

Course Description
Advanced topics in statistics and data analysis with emphasis on applications. Diagnostics and residuals in linear models, introduction to generalized linear models, graphical methods, additional topics such as random effects models, designed experiments, model selection, analysis of censored data, introduced as needed in the context of case studies.

Prerequisites
STA303 (a strict requirement)

Evaluations
The final grade will be the maximum of the two possible options

> **Option 1**: 40% Homework + 25% Midterm exam + 35% Final exam = 100%
> **Option 2**: 40% Homework + 60% Final exam   = 100%

- **4** assignments (40%)
  - Discussions with peers are allowed and encouraged, but these are to be completed (written up) on your own.
  - 4% of the final grade will be assigned to the neatness and clarify of the responses.
- **1** midterm exam (25%): Scheduled October 22, 2024
- **1** final exam (35%)
- Participation (Extra 3%): Extra credits will be given based on participation in class. Participation is defined by one of the following:
  - Responses to questions asked by the instructor, or
  - Questions to course contents. These *exclude* clarification questions.

  The "participation count" is defined by the number of classes you participated in discussion points made by the instructor, or asked insightful questions in class. Clarification questions (e.g. *could you explain it one more time?* or *I don't get that*.) do not count toward the count. Students with participation counts ≥ 6 will get an extra 3%, and counts ≥ 4 will get an extra 2%, and counts ≥ 2 will get an extra 1% credit.

Textbook

- Required: These are freely available at the [University of Toronto Library](#) (UTL) resources
  - [LM] *Linear Models with R* by Faraway (2nd edition)
  - [ELM] *Extending Linear Models with R* by Faraway (2nd edition)
  - [ISL] *Introduction to Statistical Learning* by James and others [[link](#)]
- Recommended: This course will use resources from below to understand the materials deeply
  - [ESL] *Elements of Statistical Learning* by Hastie and others [[link](#)]

Schedule (tentative)

Date	Topics	Reading	Note
9/3	**Statistical modeling and inference** Study planning, data generating process, statistical inference (Type 1/2 errors), simulation, sample size calculation		
9/10	**Topics in statistical inference** Multiple testing, family-wise error rate, false discovery rate, permutation	ISL Ch 13	HW 1 out (due 9/24)
9/17	**Linear models** Least squares (LS) from the perspectives of likelihood, Gauss-Markov theorem, weighted LS, modeling considerations, model selection	LM Ch 2, 3, 8.2, 10 ISL Ch 3, 6.1	
9/24	**Generalized linear models** Review of logistic and Poisson regression, likelihood-based inference, overdispersion, quasi-likelihood	ELM Ch 2, 5, 8 ISL Ch 4.1-4.3, 4.6	HW 2 out (due 10/8)
10/1			
10/8	**Bootstrapping** Parametric and nonparametric bootstrapping		
10/15	Midterm exam		
10/22	No class (Reading week)		
10/29	**Random effect models** Examples of correlated data, generalized LS, random effects, longitudinal data analysis, restricted ML (ReML), best linear unbiased prediction (BLUP)	ELM Ch 10, 11	HW 3 out (due 11/19)
11/5			
11/12	**Penalized regression** Bias-variance trade-off, ridge regression, LASSO and its variants, cross-validation (CV), generalized CV, random-effect viewpoint of penalized regression	ISL Ch 6 ESL 7.10	HW 4 out (due 12/2)
11/19	**Generalized additive models** Basis functions, smoothing splines, generalized additive models	ELM Ch 15 ISL Ch 7 ESL Ch 5	
11/26	**Bayesian thinking *** Prior and posterior distribution, choice of priors, Bayesian interpretation of penalized regression and GAM		

* These topics will not be covered (or partially covered) if previous materials need more time.

Software

Statistical programming is an essential part of this course. We will use **R** throughout this course, a free statistical software that is becoming more common in improving reproducible research. The software is publicly available for free at https://mirror.csclub.uwaterloo.ca/CRAN/, and it is also highly recommended to install RStudio (https://posit.co/downloads/) for an interactive programming environment. Note that the University of Toronto offers an open-source web application to use R and R studio: https://r.datatools.utoronto.ca/.

Sharing Course Materials

Sharing course materials require the instructor's permission.

Late Submission of Assignments

There will be a **1%** deduction in the final course grade every 24-hour period past the deadline. Valid forms for requesting extensions without penalties will be Absence Declaration, VOI, or equivalent (see below). Once these forms are submitted, the instructor will determine an appropriate extension.

Regrading

You are allowed to request for regrading if you believe your responses deserve higher marks. It is student's responsibility to justify why they deserve regrading. Upon satisfactory requests, I will be regrading them, but please note that there is no guarantee that the grade will increase (and it is possible that the grade may decrease).

Absence of Declaration / Verification of Illness

If you become ill and it affects your ability to do your academic work, consult the instructor right away. Normally, documentation in support of your specific medical circumstances is needed. It can be an Absence Declaration (via ACORN) or the University's Verification of Student Illness or Injury (VOI) form. The VOI indicates the impact and severity of the illness, while protecting your privacy about the details of the nature of the illness. You can submit a different form (like a letter from a doctor), as long as it is an original document, and it contains the same information as the VOI. For more information on the VOI or absence declaration tool for A&S students, refer to http://www.illnessverification.utoronto.ca/ and https://www.artsci.utoronto.ca/absence.

Accommodations

If you have a disability or health consideration that may require accommodations, please contact Accessibility Services at https://studentlife.utoronto.ca/as or (416) 978-8060. For students being supported by Accessibility Services, it is recommended (though not required) to keep the instructor updated so that individualized assistance or accommodations (beyond the ones offered by AS) can be applied if needed. All information related to privacy or health conditions must not be shared.

Use of Generative AI in Assignments

Students may use artificial intelligence tools, including generative AI, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

- Using someone else's ideas or words without appropriate acknowledgement
- Submitting your own work in more than one course without the permission of the instructor
- Making up sources or facts.
- Obtaining or providing unauthorized assistance on any assignment
- Misrepresenting your identity on exams

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If students have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, they are expected to seek out additional information on academic integrity from their instructors or from other institutional resources.