STAT 461/561 – Statistical Inference

University of British Columbia - Winter 2022/2023 - Term 2

Course Description

Detailed development of the theory of inference (testing of hypotheses, confidence regions), Bayesian models and inference. Additional topics selected from: Bootstrap, Robust Statistics, High dimensional models, Hidden Markov Models, model selection, and prediction.

Instructor

Matias Salibian Barrera. Contact information is available on Canvas.

Prerequisites

STAT 460 or STAT 560.

Audience

Undergraduates honour students in Statistics and graduate students.

Textbook

There is no textbook for the course. Notes from different sources will be available on Canvas. In addition, reading from the following books may be assigned. Electronic access to these books is available from the library.

- Shao, J. Mathematical Statistics. (2003). Second edition. Springer texts in Statistics. Available to download from the UBC library (https://go.exlibris.link/cP0nxFWt (Links to an external site.))

- Bickel, PJ and Docksum, KA. (1977). Mathematical Statistics: Basic ideas and selected topics. Also, its 2nd edition, volumes 1 and 2, (2015, 2016). Taylor and Francis.

- Casella, G. and Berger R.L. (2002). Statistical Inference. Second Edition. Thompson Learning.

- Lehmann, E.L. and Casella, G. (1998). Theory of Point Estimation, Springer texts in Statistics. Available to download from the UBC library (https://go.exlibris.link/SVp9HXJP (Links to an external site.))

- Lehmann, E.L. and Romano, J.P. (2010). Testing Statistical Hypotheses. Springer texts in Statistics. Available to download from the UBC library (https://go.exlibris.link/jFYHdYF4 (Links to an external site.))

- van der Vaart, A. (2012). Asymptotic Statistics - Cambridge University Press. Available to download from the UBC library (https://go.exlibris.link/MwZ2N0HP (Links to an external site.))

- Hall, P. (1992). The Bootstrap and Edgeworth Expansion. Springer series in Statistics.

Available to download from the UBC library (https://go.exlibris.link/fN97qddl (Links to an external site.))

- Davison, AC., Hinkley, DV. (1997). Bootstrap methods and their applications. Cambridge University Press. Available to download from the UBC library (https://go.exlibris.link/hD6xmhY0 (Links to an external site.))

- Shao, J. and Tu, D. (1995). The Jackknife and Bootstrap, Springer Series in Statistics. Available to download from the UBC library (https://go.exlibris.link/822RXMSh (Links to an external site.))

Course Evaluation

All course evaluations (marks) will be conducted on-line (mostly likely on WebWork).

- Assignments (40%). I anticipate 3 assignments. Only a randomly chosen subset of questions will be graded. These are formative assessments: (https://www.cmu.edu/teaching/assessment/basics/formative-summative.html).

- Midterm Exam (30%): There will be one Midterm Exam. This is a summative assessment (https://www.cmu.edu/teaching/assessment/basics/formative-summative.html).

- Final Exam (30%): The Final Exam will cover the material discussed in all components of the course. This is a summative assessment (https://www.cmu.edu/teaching/assessment/basics/formative-summative.html).

- A series of "Practice sets" will be made available during the Term. Assignments may include some of these problems. These are formative assessments (https://www.cmu.edu/teaching/assessment/basics/formative-summative.html).

Policy regarding missed exams, quizzes and assignments

There will be **no make-up Assignments or Midterm Exams**. If you have **valid grounds** for an **academic concession** regarding a **Midterm** or **Final Exam**, one may be granted if you **apply** for it. You can find more information about **what constitutes valid grounds for an academic concession** at https://science.ubc.ca/students/advising/concession

Students who miss a **Midterm Exam**:

1. Should notify the instructor prior to (if possible) or immediately after the midterm; and

2. **Must, within 48 hours of the missed Midterm Exam**, fill out and **submit** to the course instructor a "**Student Declaration of Academic Concession" form** (available on the Canvas page of the course). Failure to do this will result in a grade of zero in the Midterm Exam.

Students who miss the **Final Exam**:

1. Must report to their Faculty Advising Office within 48 hours of the missed Final Exam and must supply supporting documentation;

2. Faculty of Science students please refer to https://science.ubc.ca/students/advising/concession/deferredstanding;

3. Must notify your instructor prior to (if possible) or immediately after the Final Exam;

4. Deferred exams will ONLY be provided to students who have applied for and received Deferred Standing from their Faculty Advising Office;

5. If you are granted Deferred Standing you will be expected to write your Deferred Exam with the next offering of STAT 302. Note that you may not have access to the Canvas website after the Term in which you were registered in this course ends.

Syllabus

The syllabus below is a tentative schedule. The topics covered and the order in which they will be presented in this course may change.

1. Review: point estimation, exponential families, asymptotics.

2. Inference: introduction, hypothesis tests, Neyman-Pearson approach, optimality, likelihood ratio tests, score and Wald tests. Permutation and bootstrap tests.

3. Confidence regions. Univariate and multivariate cases. Connection with hypothesis tests.

4. Robust Statistics.

5. High-dimensional linear regression models, high-dimensional non-parametric regression models.

6. Bayesian statistics. MCMC and alternatives.

7. Hidden Markov Models.

8. Model selection (AIC / BIC, regularization, the problem of inference).

Office Hours

Students are encouraged to attend **on-line Office Hours** for help with questions about the course material. Their schedule will be announced on Canvas.

Your personal health

- If you're sick, it's important that you stay home – regardless of what you think you may be sick (e.g., cold, flu, other).

- Your precautions will help reduce risk and keep everyone safer. In this class all marks are collected with online assessments and exams. The marking scheme is intended to provide flexibility so that you can prioritize your health and still be able to succeed.

- If you do miss class because of illness:

  o Make a connection early in the term to another student or a group of students in the class. You can help each other by sharing notes. If you don't yet know anyone in the class, post on the discussion forum to connect with other students.

o   Consult the class resources on Canvas (slides, readings, etc.)

o   Contact me to arrange for virtual office hours.

o   If you are sick on a Midterm Exam day, please see the "Policy regarding exams" section above.

o   If you are sick on the Final Exam day you must apply for deferred standing (an academic concession) through Science Advising no later than 48 hours after the missed final exam/assignment. Students who are granted deferred standing write the final exam/assignment at a later date. Learn more and find the application online: https://science.ubc.ca/students/advising/concession. For additional information about academic concessions, see the UBC policy here: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0 Please also refer to the "Policy regarding exams" section above.

Statement of Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

Discipline for Academic Misconduct
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,0

Academic Misconduct
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959

Faculty of Science - A Letter to Students Regarding Academic Integrity
https://science.ubc.ca/students/blog/letter-students-academic-integrity-oct2020

UBC policies and resources to support student success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available here:

https://senate.ubc.ca/policies-resources-support-student-success

More UBC resources for student success

Academic and learning resources
https://students.ubc.ca/enrolment/academic-learning-resources

Academic Concessions
https://students.ubc.ca/enrolment/academic-learning-resources/academic-concessions
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0

Academic Honesty and Standards
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0

Attendance
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,36,0,0

Grading Practices
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,42,0,0

Student Conduct and Discipline
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,0,0

Viewing Marked Work
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,93,0