STAT 461/561 – Statistical Inference

University of British Columbia - Winter 2021/2022 - 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, M-estimation, MCMC, 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 Prof. Jiahua Chen will be available on Canvas. In addition, reading from the following books will be assigned regularly. Electronic access to these books is available from the library.

- Chen, J. (2020). Statistical Inference I & II, STAT 460/560 & 461/561, course notes. Unpublished.
- 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 (30%). 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 (40%): 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 Midterm Exams, Quizzes or assignments**. 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.
3. Confidence regions. Univariate and multivariate cases. Connection with hypothesis tests.
4. Inference based on asymptotic distributions (LRT, score and Wald tests redux).
5. Bootstrap.
6. Bayesian statistics. MCMC and alternatives.
7. Model selection (AIC / BIC, regularization, the problem of inference).
8. M-estimators.
9. Prediction as bias/variance trade-off. Model-based vs. model-free vs. “structured” model-free methods.

Communication

All communication to and from

Piazza & 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. There is also a **Piazza forum** for the course (access instructions will be available on Canvas), which is primarily meant **for students to help each other** by sharing and discussing questions about course material. Although the **Piazza** forum **will be monitored**, our interventions will mostly be limited to enforcing **rules** about **appropriate use** of the discussion board (please refer to the pinned posts at the top of the forum).

Covid Safety in the Classroom

- **Masks**: Masks are required for all indoor classes, as per the BC Public Health Officer orders. It is important that all of us feel as comfortable as possible while sharing an indoor space. For the purposes of this order, the term "masks" refers to medical and non-medical masks that cover our noses and mouths. Masks are a primary tool to make it harder for Covid-19 to find a new host. You will need to wear a medical or non-medical mask for the duration of our class meetings, for your own protection, and the safety and comfort of everyone else in the class. Your mask should cover your nose and mouth. Please do not eat in class. If you need to drink water, please keep your mask on between sips.

- **Vaccination**: If you have not yet had a chance to get vaccinated against Covid-19, vaccines are available to you, free, and on campus (http://www.vch.ca/covid-19/covid-19-vaccine). The higher the rate of vaccination in our community overall, the lower the chance of spreading this virus. Please arrange to get vaccinated if you have not already done so.

- **Seating in class**: To reduce the risk of Covid transmission, please sit in a consistent area of the classroom each day. This will minimize your contacts.

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).

- **A daily self-health assessment is required** before attending campus. **Every day**, **before** coming to **class**, complete the self-assessment for Covid symptoms using this tool: https://bc.thrive.health/covid19/en.

- Do not come to class if you have Covid symptoms, have recently tested positive for Covid, or are required to quarantine. You can check this website to find out if you should self-isolate or self-monitor: http://www.bccdc.ca/health-info/diseases-conditions/covid-19/self-isolation.

- 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:

    - 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.

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

    - Use the online discussion forum for help.

    - Come to virtual office hours.

    - If you are sick on a Midterm Exam day, please see the "Policy regarding exams"

section above.

- 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