

Likelihood Theory and Extensions

University of Iowa

BIOS:7110

Fall 2020

September 9, 2020

Instructor: Prof. Patrick Breheny
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Office hours: 10:00 a.m. - 11:00 a.m. Tuesday
2:00 p.m. - 3:00 p.m. Thursday
Also, feel free to e-mail and set up an appointment
Office hours will take place via Zoom; meeting details will be e-mailed

Lecture: 1:30 p.m - 3:20 p.m.
Monday & Wednesday
C301 CPHB

Course description: This course has three fundamental goals: (1) To gain familiarity with the use of rigorous mathematical techniques to prove statistical theorems, with an emphasis on multivariate results and on technical arguments involving regularity conditions that are typically skipped in other courses; (2) To focus on theoretical results involving likelihood, the most widely useful inferential construct in modern statistics; and (3) To introduce and illustrate some of the challenges that likelihood-based analyses may face, and various modifications to the likelihood that have been proposed for addressing those challenges.

Textbook: There is not one specific textbook that this course will follow. The concept and flow of the course with respect to its emphasis on likelihood is partially inspired by:

In All Likelihood (2001), PAWITAN Y. Oxford.

The book, however, is not particularly technical in the derivation of its theoretical results. The technical results, proofs, etc., in this course are largely adapted from the following textbooks:

- *A Course in Large Sample Theory* (1996), FERGUSON TS. Chapman & Hall.
- *Theory of Point Estimation*, Second Edition (1998), LEHMANN EL and CASELLA G. Springer.

Prerequisite: BIOS:5720 (or equivalent) and either STAT:4101 or STAT:5101.

Course website: The course notes, assignments, proofs, and other relevant materials will be made available on the course web site:

<http://myweb.uiowa.edu/pbreheny/7110/f20>

Homework: There will be (approximately) one homework assignment per week, due the following week at the beginning of class on Monday. Graded assignments will be returned the following week. If you turn in an assignment late, I will still grade and return it to you, but a penalty will be deducted.

Feel free to compare answers with other students, although each student must turn in a copy of each assignment. Group discussions are great ways to make lasting friendships, they are valuable for retention and understanding of the material. Furthermore, working well in a group is a vital part of being a professional. However, make sure you understand the material, as the majority of your overall grade comes from your exam scores.

Exams: There will be three exams in this class. All exams are closed-book, although students may bring one page of notes if they wish to do so. The exams will take place during class time on the following dates:

- Exam 1 Wednesday, October 7
- Exam 2 Wednesday, November 11
- Exam 3 TBD (Finals week)

Grading: Your grade will be based on a weighted average of homework (25%), Exam 1 (25%), Exam 2 (25%), and Exam 3 (25%).

Attendance: Regular attendance in this course is expected (see next page for what “attendance” means in light of the COVID-19 pandemic). No direct penalty will be applied for missing lectures. However, assignments and exams will be based entirely on lecture material, so skipping lecture is likely to hurt your grade and, of course, your understanding of the material.

Corrections: This is the first time this course has been taught, and there will undoubtedly be many mistakes in the notes. If you spot a mistake, I very much want you to let me know about it so that I can correct it. I will award 1 bonus point (to be added to your homework total) for pointing out a typographical error and 2 bonus points for an error in content. Corrections will be made to the online version of the notes and any substantive errors announced on the course home page.

Electronic communication: I will occasionally send notices to the class through e-mail (to your `uiowa.edu` account), so please check that account regularly.

Course schedule: See <http://myweb.uiowa.edu/pbreheny/7110/f20/notes.html> for the schedule of topics.

Feedback: I would love to hear feedback on how the course is going, both positive and negative aspects. This is particularly valuable this semester, as it is a brand new course. I have e-mailed out a link to you that allows you to provide anonymous feedback at any time.

I look forward to getting to know you, and I hope that we have a great semester together.

COVID-19 considerations

Lectures: At the beginning of this course, lectures will take place in person in room CPHB C301. At some point (possibly Thanksgiving, possibly before), however, lectures will be delivered remotely over Zoom. All lectures, both in-person and remote, will be recorded and posted to ICON. Additional remarks concerning remote lectures:

- Most of you presumably are familiar with Zoom meetings by now. If not, or if you have any concerns about using this technology, please let me know – it is important that you are able to attend both office hours and remote lectures without technological barriers.
- If unexpected problems arise that prevent you from attending a lecture, please feel free to schedule an appointment if you still have questions after looking through the notes and watching the recording.
- For remote lectures, please turn on your camera so that I can see my students. Lecturing to a blank void that you can't see or hear is depressing.

Exams: In-person exams (1 and 2, pending developments) will take place in CPHB C301 during class time. Exam 3 will take place remotely. For remote exams, you must join the Zoom meeting and turn your webcam on so that I can keep an eye on you. You will then turn in a scanned or photographed copy of your assignment.

Q & A: Normally, I love it when students come up and ask questions after class. Unfortunately, doing so is not prudent during a pandemic as the University tries to minimize congregation near entrances and exits. We (this involves effort from both you and I) should do our best to leave the room not much later than the scheduled time of 3:20. However, I certainly do not want to stifle questions, so please either (a) ask these questions during class time, (b) bring them up in office hours, (c) ask them over e-mail, or (d) I will reserve 5-10 minutes during class, mainly as a break from 2 hours of math, but this would also be a good time for discussion if there is anything you'd like to bring up.

Social distancing and mask policy: University policy dictates that students:

- Wear a face covering (mask or face shield) in all University buildings at all times
- Maintain an appropriate social distance of 6 feet or more, if possible
- Stay home if you have been exposed to, are diagnosed with, or experience symptoms consistent with COVID-19

If a student refuses to adhere to these requirements, I unfortunately have to cancel class and file a report with the Office of Student Accountability.

Changes: This syllabus reflects current plans, but things may change as the nature of the pandemic changes. I will communicate any changes to you promptly via e-mail. For any major changes, I will update this syllabus; see lower right to check whether your copy of the syllabus is current or not.

Academic misconduct: During exams, you are not allowed to copy off another student, consult reference materials (beyond the one sheet of allowed notes), or use a cell phone or any device capable of messaging, texting, or accessing the internet. Any of these actions will be considered cheating. On homework assignments, you are not allowed to copy and paste text from another student (if you copy text from some other source, it must be cited). Doing so will be considered plagiarism. The University of Iowa takes cheating and plagiarism very seriously. You can read more about the consequences of academic misconduct at <http://dos.uiowa.edu/policies/academic-misconduct>.

PhD in Biostatistics competencies:

- Demonstrate an increased level of knowledge and understanding of current statistical theory, methods, and practices in the health sciences.
- Communicate research findings, including new statistical methods developed, effectively to various audiences in writing and through oral presentation.

MS in Biostatistics competencies:

- Demonstrate a broad knowledge and understanding of current statistical theory, methods, and practices in the health sciences.

Concerns: Students with suggestions or complaints should see me first, and if we cannot come to an agreement, I will direct you to the Departmental DEO, Prof. Joseph Cavanaugh, N332 CPHB, joe-cavanaugh@uiowa.edu. Students may also contact the Undergraduate Program Director (if appropriate) or the Associate Dean for Academic Affairs in the College of Public Health. Another resource for students is the Office of the University Ombuds-person. If a complaint cannot be resolved at the departmental and/or collegiate level, students may file a formal complaint utilizing the procedure specified in Section II, Chapter 29.7 of the Operations Manual: <http://opsmanual.uiowa.edu>.

Accommodations for students with disabilities: The University of Iowa is committed to providing an educational experience that is accessible to all students. If you have a diagnosed disability or any other condition that would impair your ability to complete the course requirements as stated above, please inform me as early in the semester as possible, preferably at least two weeks prior to the scheduled activity. Students needing accommodations must register with Student Disability Services, (SDS): <https://sds.studentlife.uiowa.edu/students/apply> to obtain a Letter of Accommodation (LOA). The office is located at 3015 Burge Hall (319.335.1462). Students with complaints about disability accommodation should notify Student Disability Services and may be counseled to file a complaint with the Office of Equal Opportunity and Diversity. Read more about Disability Resources at <https://diversity.uiowa.edu/disability-resources>.

Administrative home: This course is given by the College of Public Health. This means that class policies on matters such as requirements, grading, and sanctions for academic dishonesty are governed by the College of Public Health. Students wishing to add or drop this course after the official deadline must receive the approval of the Associate Dean for Academic Affairs in the College of Public Health. Details of the University policy of cross

enrollments may be found at: <https://www.provost.uiowa.edu/sites/provost.uiowa.edu/files/crossenroll.pdf>.

Severe weather: In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit <http://hawkalert.uiowa.edu>.

Sexual harassment/misconduct: The University of Iowa prohibits sexual misconduct, dating/domestic violence, and stalking in any form, including sexual assault or sexual harassment, and any form of nonconsensual sexual conduct. Students should be able to live, study, and work in an environment free from all forms of sexual misconduct, dating/domestic violence, and stalking. Incidents of sexual misconduct can be reported to the Office of Sexual Misconduct Response Coordinator (OSMRC) or to the Department of Public Safety (DPS). If you are uncertain if what you have experienced from a student is sexual misconduct, see Section IV, Chapter 2 of the operations manual. If you are uncertain if what you experienced from a faculty or staff member is sexual harassment, see Section II, Chapter 4 of the operations manual. Students impacted by a Title IX issue (sexual misconduct, dating/domestic violence, or stalking) may be eligible to request an academic accommodation. Contact the OSMRC for assistance, definitions, and the full University of Iowa policy. If you or someone you know experiences sexual assault, sexual harassment, dating/domestic violence, stalking, or any other behaviors prohibited under this policy, you are strongly encouraged to seek assistance and support. See below for link to confidential resources.

- OSMRC: <https://osmrc.uiowa.edu>
- DPS: <https://police.uiowa.edu>
- Operations manual: <https://opsmanual.uiowa.edu>
- Confidential support: <https://osmrc.uiowa.edu/victim-resources/confidential-support>

Mental health: Students are encouraged to be mindful of their mental health and seek help if they are feeling overwhelmed and/or incapable of meeting course expectations. For assistance with the class, students are encouraged to talk to me. For additional support and counseling, students are encouraged to contact The University Counseling Service (UCS) in 1950 University Capital Centre Suite or 3223 Westlawn South. Call 319.335.7294 to schedule appointments. Find out more about the UCS at <http://counseling.uiowa.edu>. After hours, call the Johnson County Crisis Line at 319.351.0140 or 911 if you are having a mental health emergency.

Nondiscrimination in the Classroom and the College: The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity at diversity.uiowa.edu. Students are invited to optionally share their preferred names and pronouns with their instructors and classmates. Students are also able to state this information in the MyUI system under Student Information. <https://myui.uiowa.edu/my-ui/student/records/documents/preferred-name-pronoun.page>