STAT:5100 Statistical Inference I, Fall 2021

SYLLABUS

Course Home Page	ICON (login at https://icon.uiowa.edu/)
Lectures	10:30-11:20am, MWF, 14 SH
Student Drop-In Hours	3:15-4:45pm, MW [zoom]; TA-led help session (to be scheduled); or by appointment [zoom]
Instructor	Professor Joseph B. Lang, 207 SH, joseph-lang@uiowa.edu
Pre-Requisites	MATH:2850 and STAT:3101, or equivalent
Department, College	Statistics and Actuarial Science, College of Liberal Arts and Science
DEO	Professor Kung-Sik Chan, 335-0712, kung-sik-chan@uiowa.edu
Department Main Office	241 SH

Required Text:

Casella, G. and Berger, R.L. (2002). *Statistical Inference*. 2nd edn. Belmont, CA: Duxbury Press.

Supplementary Texts:

DeGroot, M.H. and Schervish, M.J. (2002). *Probability and Statistics*, 3rd ed. Boston: Addison-Wesley.

Hogg, R.V. and Tanis, E.A. (1997). *Probability and Statistical Inference*, 5th ed. Upper Saddle River, NJ: Prentice Hall.

Hogg, R.V. McKean, J.W., and Craig, A.T. (2005). *Introduction to Mathematical Statistics*, 6th ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Wackerly, D.D., Mendenhall, W. and Scheaffer, R.L. (1996). *Mathematical Statistics with Applications*, 5th ed. Belmont, CA: Duxbury Press.

Description: This is the first course in the two-semester, masters level, probability theory/distribution theory/statistical inference sequence STAT 5100-5101. This first course covers probability and distribution theory and introductory stochastic asymptotics. We cover most of the material from Chapters 1-5 of Casella and Berger (2002). Supplementary material, with more worked examples and summaries of results, will be available online in ICON. A non-exhaustive list of topics covered includes epistemic probability; the axiomatic development of probability models; properties of probability functions; the equally-likely probability model and counting rules; independence of events and trials; conditional probability; Bayes' rule and updating epistemic probabilities; random variables (continuous, discrete, and mixed); probability density and cumulative distribution functions; expectations (mean, variance, mgf, etc); useful inequalities; commonly encountered distributions (e.g. binomial, geometric, negative binomial, Poisson, multinomial, Gamma, Normal, multivariate Normal, etc.); conditional expectation; joint, marginal, and conditional distributions; independence of random variables; distributions of functions of random variables; common sampling distributions and their derivations (e.g. Student's t, F, chi-squared);

large-sample stochastic asymptotics (e.g., convergence in probability, almost surely, and in distribution; weak and strong laws of large numbers; central limit theorem; convergence of mgfs; delta method; etc.). Finally, we will use computer simulation to corroborate many of the important results.

Course Objectives:

The successful student will leave this course with a basic understanding of many of the important foundational concepts in probability, distribution theory, and stochastic asymptotics. This student will be comfortable using a wide variety of mathematical tools for solving probability, distribution theory, and asymptotic problems. And, they will appreciate the usefulness of the computer program R for addressing questions and for simulating to corroborate findings and to check answers.

Course Organization:

Lectures. The 50-minute meetings on MWF will be used to work through examples and to give a running summary of the material ("the big picture"), as seen from the instructor's perspective. Students will be expected to participate in the worked examples. We will cover topics from Chapter 1 through much of Chapter 5, in Casella and Berger (2002). To be better prepared for lectures, students are strongly encouraged to look over the relevant online supplementary material (see Modules in ICON), which includes worked examples and important results. The homework assignments (see Assignments in ICON) will serve as a guide to see where we are and will be in the material.

Homework Exercises. Homework solutions will be submitted electronically to ICON, as a **single PDF file**, before 10:30am, on most Fridays. (For those of us without scanners, there are free apps available for taking pictures of multiple pages and combining them into a single PDF file—I've had some success with the iOS version of the free *Adobe Scan* app.) It is your responsibility to make sure that your submission is easily readable. Assigned problems, which will come from the supplementary material and the textbook, will be posted well in advance (typically, at least two weeks) on the Assignments page in ICON. Students are encouraged to work ahead and to consult the online supplementary material for relevant worked examples.

Portfolios. You are encouraged to collect all your worked exercises (graded and un-graded) in a portfolio. Although you will not turn it in, you will find that a well-organized portfolio can be useful for preparing for exams and will be a valuable resource throughout your career.

Computing. Some of your homework will require the use of the computer. I will give sample code as needed. The freeware package R will typically be used to perform calculations, create graphics, and carry out small-scale simulation studies.

Note: R is available on the HP machines in the UNIX Computing Lab (346 SH) and most all the ITC labs, such as the Myers Computing Lab (41 SH). It can also be downloaded to your personal computer from http://cran.us.r-project.org.

Exams. There will be two online exams in this course: a midterm (submission deadline is 5:00pm, Friday, October 15th) and a final exam (submission deadline is to be determined, but will be due during finals week, December 13th – 17th). Both exams are (tentatively) open-book and open-web, and you may use the computer as you wish. However, you must work alone on these exams! For instance, you may consult existing documents online, but **you may <u>not</u> pose a question to elicit a response**. Of course, you may email clarification questions to the instructor. Your exam solutions,

like homework solutions, must be submitted to ICON in a **single PDF file** by the submission deadline. It is your responsibility to make certain your submission is clearly readable.

Point Earning Opportunities. Point-Earning Opportunities (PEOs) may be given on occasion; some will be pre-announced. PEOs may be in the form of in-class exercises, minute papers, or attendance checks.

Course Pace (Tentative):

Lectures 1.1-1.6	(CB Chap 1)	Weeks 1-3	
Lectures 2.1-2.4(e)	(CB Chap 2,3)	Weeks 3-7	
Lectures 3.1-3.2	(CB Chap 2)	Weeks 6-8	Midterm Exam (due 5:00pm, Fri, Oct 15)
Lectures 4.1-4.4	(CB Chap 4)	Weeks 8-9	
Lectures 5.1-5.4	(CB Chap 4)	Weeks 9-10	
Lectures 6.1-6.2	(CB Chap 4)	Week 11	
Lectures 7.1-7.9	(CB Chap 5)	Weeks 12-15	Final Exam (to be determined)

Course-Specific Guidelines and Policies:

Course Web Page. Announcements, homework, exam descriptions, and supplementary materials will be made available on ICON. You should check the course for announcements and updates daily.

Stay Caught Up. It is vitally important that you are self-disciplined enough to stay caught up. You should take note of the due dates of the homework problems and make sure to read and view the supplementary notes at least up to that point.

Effort Expectations. My effort expectations align with the guideline adopted by the college of LAS: "*for each semester hour credit in the course, students should expect to spend two hours per week preparing for class sessions (e.g., in a three-credit-hour course, standard out-of-class preparation is six hours)*." Of course, you need to keep in mind that the '*6 hours per week*' is an average taken over the weeks in the semester. It is also an average taken over a heterogeneous collection of [undergrad and grad] students and courses. Thus, effort amounts will vary. It is fair to say, however, that the more effort you put in, the more you will get out of the course.

Attendance and Participation. Students are strongly encouraged to attend all lectures. Students are expected to participate through the point-earning-opportunities (PEOs) described above.

Working Together. You must work <u>alone</u> on exams! Unless instructed otherwise, you may work together on the homework problems. However, you must write up your own solutions in your own words. If you are personally asked to write up your own solutions, but then subsequently turn in material that is obviously in the same words as a fellow student, the work will be considered plagiarized. Plagiarism will be dealt with according to the policies of the College of Liberal Arts and Sciences and the University (see additional information at the end of this syllabus).

Late Homework. Late submissions of homework will be penalized by 50% each 24-hour period. For example, if you scored a 20 out of 25 on a homework, but it was submitted an hour late, you would

receive a score of 10 out of 25; and if you submitted it 25 hours late, you would receive a score of 5 out of 25.

Grading Questions. Questions about grading must be asked within one week of the graded work's return. It is recommended that you reach out directly to the grader, Zongyi Xu, at zongyi-xu@uiowa.edu.

Zoom/Electronic Etiquette. You are strongly encouraged to attend zoom meetings with your video ON. While in attendance, please remain attentive and listen respectfully to your fellow classmates and the instructor. Do not record any sessions without express permission.

Grading and Components for Evaluation:

Your final score S will be computed as $S = 0.35H + 0.30F + 0.30M + 0.05P$, where $H =$ percent credit on homework, $F =$ percent credit on final exam, $M =$ percent credit on midterm exam, and $P =$ participation score, which is the percent credit on point-earning-opportunities.

Letter grades (including $+$'s and $-$'s) will be awarded according to a 90-80-70-60 schedule (e.g. if $S \geq 90$ then a grade of A$-$ or better will be awarded). These are guaranteed cutoffs, so it is possible (but unlikely) that everyone receives an 'A.' I do, however, reserve the right to lower (but not raise) the cutoffs. Note that with this grading scheme you are not "graded on a curve," and so you are not competing with fellow students. Therefore, you are not penalized for working together to better understand concepts.

Miscellaneous Help and Resources:

Help Outside of Class:

This course has a teaching assistant (TA) who will hold a weekly help/problem-solving session. I also have regular zoom-based drop-in hours. Sometimes it is effective to ask specific questions via email. (Do be aware that the volume of email I receive is such that messages sometimes get lost. Do not hesitate to send your message again or to attend a drop-in hour.)

A list of tutors is maintained by the Department of Statistics and Actuarial Science. Start at https://stat.uiowa.edu/resources/tutoring .

Help with R software:

An Introduction to R (https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf) by W. N. Venables, D. M. Smith and the R Core Team (accessed 8/17/20)

SimpleR. Go to http://www.math.csi.cuny.edu/Statistics/R/simpleR/index.html , J. Verzani

Scanning Apps (for creating images and combining them into a single PDF file):

The iOS version of the free *Adobe Scan* app seems to work pretty well.

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COLLEGE OF LIBERAL ARTS AND SCIENCES (CLAS)

Graduate Course Syllabus Insert

Fall 2021

ATTENDANCE AND CLASSROOM EXPECTATIONS

Students are responsible for attending class and for knowing an instructor's attendance policies, which vary by course and content area. All students are expected to attend class and to contribute to its learning environment in part by complying with University policies and directives regarding appropriate classroom behavior or other matters.

ABSENCES

Students are responsible for communicating with instructors as soon they know that an absence might occur or as soon as possible in the case of an illness. Delays in communication could result in a forfeit of what otherwise might be an excused absence.

ABSENCES: ILLNESS, UNAVOIDABLE CIRCUMSTANCES, AND UNIVERSITY SPONSORED ACTIVITIES

Students who are ill, in an unavoidable circumstance affecting academic work, or who miss class because of a University sponsored activity are allowed by UI policy to make up a missed exam. Documentation is required by the instructor except in the case of a brief illness. Students are responsible for communicating with instructors as soon as the absence is known (https://opsmanual.uiowa.edu/students/absences-class#8.1).

ABSENCES: HOLY DAYS

Reasonable accommodations are allowed for students whose religious holy days coincide with their classroom assignments, tests, and attendance if the student notifies the instructor in writing of any such religious Holy Day conflicts within the first days of the semester and no later than the third week. (See the University Operations Manual: https://opsmanual.uiowa.edu/students/absences-class#8.2).

ABSENCES: MILITARY SERVICE OBLIGATIONS

Students absent from class due to U.S. veteran or U.S. military service obligations (including military service-related medical appointments, military orders, and National Guard Service obligations) must be excused without penalty. Instructors must make reasonable accommodations to allow students to make-up exams or other work. Students must communicate with their instructors about the expected possibility of missing class as soon as possible. (For more information, see https://opsmanual.uiowa.edu/iv-8-absences-class%C2%A0-0).

ACADEMIC MISCONDUCT

Plagiarism and the process for addressing academic misconduct of graduate students are defined in Section IV, Article F "Plagiarism by Graduate Students" of the UI Graduate College Manual of Rules and Regulations. Please contact the CLAS Associate Dean for Graduate Education for any necessary assistance in navigating the process mandated by the Graduate College.

ACADEMIC ACCOMMODATIONS

UI is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as a mental health, attention, learning, vision, and a physical or health related condition) through the Student Disability Services (SDS) office. The student is responsible for discussing specific accommodations with the instructor. Note that accommodations are not granted retroactively but from the time of the student's request to the instructor onward; additionally, accommodations must be requested at least two weeks in advance of the related assignment or exam (https://sds.studentlife.uiowa.edu/). Graduate students serving as Teaching Assistants, Research Assistants, or Fellows must contact Faculty and Staff Disability Services (https://hr.uiowa.edu/support/faculty-and-staff-disability-services) for assistance with accommodations.

CLASS RECORDINGS: PRIVACY AND SHARING

Course lectures and discussions are sometimes recorded or live-streamed. These are only available to students registered for the course and the intellectual property of the faculty member. These materials may not be shared or reproduced without the explicit written consent of the instructors. Students may not share these recordings with those who are not enrolled in the course; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and could be a violation of the Federal Education Rights and Privacy Act (FERPA); also see https://dos.uiowa.edu/policies/code-of-student-life/ .

COMMUNICATION: UI EMAIL

Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community (Operations Manual, III.15.2). Emails should be respectful and brief, with complex matters addressed during the instructor's drop-in hours, for example. Faculty are not expected to answer email after business hours or during the weekends.

FREE SPEECH AND EXPRESSION

The University of Iowa supports and upholds the First Amendment protection of freedom of speech and the principles of academic and artistic freedom. We are committed to open inquiry, vigorous debate, and creative expression inside and outside of the classroom. Visit Free Speech at Iowa for more information on the University's policies on free speech and academic freedom: https://freespeech.uiowa.edu/ .

COMPLAINTS ABOUT ACADEMIC MATTERS

Students with a complaint about a grade or a related academic matter should first visit with the instructor and then with the course supervisor (if applicable), and finally with the director of the school, department, or program offering the course. If a graduate student has not been able to resolve the issue through the director of the school, department, or program, they should contact the associate dean for graduate education in the College of Liberal Arts and Sciences.

FINAL EXAMINATION POLICIES

The final exam schedule is published during the fifth week of the fall and spring semesters or on the first day of summer classes; students are responsible for knowing the date, time, and place of their final exams. Students should not make travel plans until knowing this information. A student with exams scheduled on the same day and time or who have more than two final exams on the same day should visit this page for

how to resolve these problems by the given deadline (https://registrar.uiowa.edu/makeup-final-examination-policies). No exams are allowed the week before finals, but with some exceptions made for labs, language courses, and off-cycle courses (https://registrar.uiowa.edu/final-examination-scheduling-policies).

HOME OF THE COURSE

The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College. See https://grad.uiowa.edu/academics/deadlines .

MENTAL HEALTH

Students are encouraged to seek help as a preventive measure or if feeling stressed or overwhelmed. Students should talk to their instructors for guidance with specific class-related concerns and are encouraged to contact University Counseling Service (UCS) at 319-335-7294 during regular business hours to schedule an appointment. UCS offers group and individual therapy as well as counseling for couples about relationships while making referrals to other resources (https://counseling.uiowa.edu/). Student Health can also address related concerns (https://studenthealth.uiowa.edu/). These visits are free to students. After hours, students are encouraged to call the Johnson County Community Crisis Line at (319) 351-0140 or dial 911 in an emergency.

NONDISCRIMINATION IN THE CLASSROOM

The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals based on race, class, gender, sexual orientation, national origin, and other identity categories indicated by the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity at https://diversity.uiowa.edu/division/office-equal-opportunity-anddiversity-eod .

SEXUAL HARASSMENT

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff; all members of the UI community are expected to conduct themselves in a manner that maintains an environment free from sexual harassment and sexual misconduct. Those experiencing Incidents of sexual harassment are strongly encouraged to report incidents and to seek help (https://osmrc.uiowa.edu/).

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I do hope you all have an enjoyable and rewarding semester. Good luck in all your courses.