

# STAT:5400

## Fall 2020

# Computing in Statistics

**Lectures** MWF 9:30 AM – 10:20 AM  
Zoom meet

**Instructor** Boxiang Wang, 261 SH, [boxiang-wang@uiowa.edu](mailto:boxiang-wang@uiowa.edu)  
**Office Hours** Th 8:00 AM – 11:00 AM, or by appointment.  
**Teaching Assistant** Max Sampson, [max-sampson@uiowa.edu](mailto:max-sampson@uiowa.edu)  
**Department** Statistics & Actuarial Science, 241 SH.  
<http://www.stat.uiowa.edu>  
**DEO** Professor Kung-Sik Chan, DEO, 319-335-0712,  
[kung-sik-chan@uiowa.edu](mailto:kung-sik-chan@uiowa.edu)

**Course Website.** I will post announcements, homework problems, lecture notes, and other course information in ICON <http://icon.uiowa.edu>.

### Course Description and Objectives.

This is a required course for master students in statistics. Through hands-on experience with real problems, we will learn computing skills essential in applied statistics and in research in methodological and theoretical statistics.

The first component of this course is to introduce methods in statistical computing. Topics include generating random variables, Monte Carlo studies, resampling methods (Bootstrap, jackknife, and permutation tests), computations in high-dimensional statistics, optimization algorithms (Bisection search, Newton's method, gradient descent, for example), machine learning methods, and other topics if time permits. The second component is Tech Guide, which introduces useful tools. Topics include the Linux operating system, R, R Markdown, LATEX (mathematical document preparation language), GitHub (version control), Sublime (text editor), C and Fortran, writing R packages, parallel computing, among other topics.

**Textbook.** No required textbook.

Optional Reference:

Maria L. Rizzo (2008). *Statistical Computing with R*. Chapman & Hall/CRC.

Rafael A. Irizarry (2019). *Introduction to Data Science*. Chapman & Hall/CRC.

Online: <https://rafalab.github.io/dsbook/>

**Grading.** Your semester grade will consist of the following components:

Homework	25%	
Midterm Exam	25%	Oct 28
Instructional Project	25%	
Computing Project	25%	
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Total	100%	

Grading will be on a curve, with  $+/-$  grade used. A grade of A+ represents exceptional work and is given only in extraordinary situations.

**Homework.** In general, weekly homework will be assigned each Friday and will be due in class the following Friday. Exceptions to this schedule will be announced in class. Homework should be submitted electronically through the ICON submission tools for this course ([icon.uiowa.edu](http://icon.uiowa.edu)). Show your work when solving written homework problems. Complete code and output must be submitted for computer problems. Always document your answer.

You are encouraged to study with others. However, if you do work with others on homework assignments, please: a) write up your own assignment and make sure you completely understand all solutions that you submit, and b) write the names of the others in your study group on your assignment.

Late homework is accepted only as required by university policy, i.e. due to “illness, mandatory religious obligations, or other unavoidable circumstances or University activities.” This is a strict rule; however, you are allowed to drop two lowest homework grades.

**Office Hours.** The office hours are held 8-11 am every Thursday. Reserve your slot using the following google sheet and send me a zoom link before the scheduled time.

[https://docs.google.com/spreadsheets/d/1MxnkTpgPK9PwChutJfGHZt2R1nYKuy2\\_t3XqEdsFXxA/edit?usp=sharing](https://docs.google.com/spreadsheets/d/1MxnkTpgPK9PwChutJfGHZt2R1nYKuy2_t3XqEdsFXxA/edit?usp=sharing)

To protect your privacy, you are free to use a nickname to reserve the office hours. You can reserve consecutive slots if you need more than 15 minutes. You are encouraged to visit the office hours in group.

**Proficiency Exam.** The Incoming Statistics Graduate Students Computer Programming Proficiency Test is designed to determine whether you have already met the programming proficiency requirement. Students who are not deemed proficient will be required to do an extra programming practice homework in this class. The exam result will not affect the grade of this course. The exam results of statistics graduate students will be reported to DGS of the department.

The exam will be held online. You are allowed to use any resource but you cannot communicate with others about the exam. You may use your choice of the following programming languages, R (preferred), Python, C, C++, and Fortran.

The proficiency exam will be posted on 10:30 AM Aug 24 and will be due by 9:30 AM

Aug 26. No late submission is accepted.

**Exams.** There is a two-hour hands-on computing midterm exam on 8:45 PM Oct 28, 2020. The computing exams are open book and open notes. You are not allowed to discuss with others about the exam.

The exam will end at 10:45 PM. Your grade will be 30% off if the submission is later than 10:45 PM but earlier than 11:00 PM. No submission is accepted if submission is later than 11:00 PM. You are responsible for reliable internet connection.

Students must take exams as scheduled except in cases of officially university-approved absence such as class conflict with official exam time, illness, religious observance, and NCAA athletic competition.

Makeup exams are not available for other reasons, including student org field trips, club competitions, job interviews, and personal events.

A student who is absent for more than five days or miss an exam due to an emergency or an illness may request the UI Service Center, 17 Calvin Hall, registrar@uiowa.edu, to notify me of the reason for the absence.

More teaching policies and resources are seen in:

<https://clas.uiowa.edu/faculty/teaching-policies-resources-examination-policies>.

**Instructional Project.** Students will work in groups of two to study and present a topic that is not covered in this class. You are expected to give a 50-minute lecture to introduce the topic to other students. You are free to use any resource, including some tutorials available online, but you must cite them clearly. You are encouraged to design your lecture in the format of a lab, allowing students to have hands-on experience of the tools that you introduce. You are also required to make a short homework question based on your material.

Possible topics include: R packages ggplot2, tidyverse, caret; introduction to Python, Hardoop, Julia. Students majoring outside statistics are encouraged to introduce the computing tools you use in your research.

The project is collaborative. Each student on a team is expected to complete a similar amount of work and to contribute equally to the final project. Students who misrepresent themselves as equal partners in this collaborative project but who are actually letting others do the bulk of the work will be reported to the College for academic dishonesty.

**Computing Project.** Students will work in groups of two to carry out projects involving application of the statistical computing methods covered in the course to problems of their own choosing. Examples of possible types of projects are:

- Design and carry out a simulation study to compare the properties of two or more statistical procedures.
- Learn to use two or more R packages that we have not studied as a class. Apply them to perform useful analyses of a real dataset.
- Choose a research paper, use simulation and find data to verify results in the paper.

The computing project will be carried out in two stages. Please meet with me while you are working on each stage.

- Project proposal (due 9:30 AM Nov 9. Grade is 30% off if submission is late within one less day, otherwise no grade is given.)

Each team should write a two-page summary. This is a detailed description of what you plan to do, including questions to be addressed, software to be used, and methods to be applied.

- Project presentation.

Each team will give a twenty-minute presentation during the week of Dec 7. A list of which tasks each team member has performed should be submitted.

**You should work with different people for the instructional and computing projects.**

**“Incomplete” Grades** A grade of “Incomplete” will only be given under extraordinarily extenuating circumstances that prevent the student from completing the course requirements. Having a failing grade in the course is not an extraordinarily extenuating circumstance.

### **College of Liberal Arts and Sciences: Information for Undergraduates**

**Absences and Attendance** Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, military service obligations, unavoidable circumstances, or University authorized activities. Students may use the CLAS absence form to aid communication with the instructor who will decide if the absence is excused or unexcused. The form is on ICON in the top banner under “Student Tools.” More information is at <https://clas.uiowa.edu/students/handbook/attendance-absences>.

**Academic Integrity** All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College’s Code of Academic Honesty. Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions

communicated with the student through UI email. Visit this page for information: <https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code>.

**Accommodations for Disabilities** UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at <https://sds.studentlife.uiowa.edu/>.

**Administrative Home of the Course** The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: <https://clas.uiowa.edu/students/handbook>.

**Class Behavioral Expectations.** Students are expected to comply with University policies regarding appropriate classroom behavior as outlined in the Code of Student Life. This includes the policies and procedures that all students have agreed to regarding the Steps Forward for Fall 2020 in response to the COVID-19 pandemic. Particularly, all students are required to wear a face covering when in a UI building, including a classroom. In addition, the density of seats in classrooms has been reduced; in some instances, this will allow 6 feet or more between students while other cases, it may be less. Regardless, wearing a face covering and maintaining as much distance as possible are vital to slowing the spread of COVID19. In the event that a student disrupts the classroom environment through their failure to comply with the reasonable directive of an instructor or the University, the instructor has the authority to ask that the student immediately leave the space for the remainder of the class period. Additionally, the instructor is asked to report the incident to the Office of Student Accountability for the possibility of additional follow-up. Students who need a temporary alternative learning arrangement related to COVID-19 expectations should contact Student Disability Services (<https://sds.studentlife.uiowa.edu/fall-2020/covid-19-temporary-learning-arrangements/>; +1 319 335-1462).

**Class Recordings: Privacy and Sharing.** Some sessions of a course could be recorded or live-streamed. Such a recording or streaming will only be available to students registered for the course. These recordings are the intellectual property of the faculty, and they may not be shared or reproduced without the explicit **written** consent of the faculty member. Students may not share these sessions with those not in the class; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and, in some cases, a violation of the Federal Education Rights and Privacy Act (FERPA).

**Communication and the Required Use of UI Email** Students are responsible for official correspondences sent to their UI email address (uiowa.edu) and must use this

address for all communication within UI (Operations Manual, III.15.2).

**Complaints** Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences; see this page for more information: <https://clas.uiowa.edu/students/handbook/student-rights-responsibilities>.

**Final Examination Policies.** The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals with very few exceptions made (for labs, ESL and some world language courses, and off-cycle courses): <https://registrar.uiowa.edu/final-examination-scheduling-policies>.

**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 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 (<https://diversity.uiowa.edu/eod>; +1 319 335-0705).

**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 must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see <https://osmrc.uiowa.edu/>.