THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 4302
COMPUTATIONAL STATISTICS
SPRING 2024

Course overview

Instructor

Instructor: Xiaoxuan Cai
Email address: cai.1083@osu.edu
Class location: Cockins Hall (CH) 312
Class time: 9:35 am - 10:55 am on Tuesday and Thursday
Office hours: 11:00 am - 11:30 am on Tuesday and Thursday at CH 428C or by appointment.

Teaching Assistant / Grader:

Sang Wan Lee
Email address: lee.10007@osu.edu
Office hour: to be posted

Course description

This course covers a number of topics in the area of computational statistics, using the R statistical software package. Students will use their knowledge in theoretical and applied statistics to design and perform classical and modern Monte Carlo experiments. The students will also be exposed to statistical inference based on resampling methods (bootstrap, jackknife and permutation tests). Throughout the course students will be working with modern data sets. The course will put emphasis on effective and efficient functional programming techniques, which will be taught throughout the course via tutorials and in-class coding examples.

Prequisites: Stat 3301 and Stat 4301 or permission of the instructor.

Course learning outcomes

Upon successful completion of the course, students will be able to:

1. Import data sets of various formats into R.
2. Design and perform simple Monte Carlo experiments.
3. Use resampling methods to carry out statistical inference.
4. Produce numerical and graphical summaries of their analysis.
5. Communicate findings through written reports and online tools.

Course materials

Required

Maria L. Rizzo (2019), Statistical Computing with R, 2nd Edition, CRC Press, Boca Raton, FL.
Note that this is the second edition of the book

I will highlight other useful references as the course progresses.

Course technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** http://ocio.osu.edu/selfservice
- **Phone:** 614-688-HELP (4357)
- **Email:** 8help@osu.edu
- **TDD:** 614-688-8743

Necessary software

- This class requires you to use the statistical software package called R (The R Project for Statistical Computing; http://www.r-project.org/). This software package is available as Free Software.
    - You can download R for Windows, Mac, and Linux, from the CRAN archive at https://cran.r-project.org.
    - An in-depth introduction to R is available at http://cran.r-project.org/doc/manuals/R-intro.pdf
    - Hands-on tutorials are available in the Swirl system, which you can learn about at http://swirlstats.com/. In particular, "R Programming: The basics of programming in R" is an appropriate first tutorial for students who have never used R.

- Students will be required to use RStudio software. RStudio can be downloaded for free at https://www.rstudio.com/. Before downloading RStudio, you must also download and install R first. You are expected to install R and RStudio on your personal computer by downloading the software from the links above.
- More details will be given in recorded lectures and on the class web site.

Course delivery

For the Spring 2024 offering, the course will be taught in-person on 9:35 am - 10:55 am on Tuesday and Thursday at Cockins Hall (CH) 312. Course materials, including slides, notes, in-class codes, and in-class quizzes, will be posted on the course Carmen website. You will be responsible for attending classes in person, reading assigned book chapter, studying course material, working through statistical theories and R coding examples presented in the class.

The instructor will hold weekly office hours in office. The time and location are given above.

Grading and faculty response

Assignment or category	Percentage
Homework	**20**
In-class attendance	**5**
Midterm 1	**25**
Midterm 2	**25**
Final exam	**25**
Total	**100**

Grades will be recorded on the class website.

Homework will be assigned most weeks during the semester. ***No late homework will be accepted***. However, if you are unable to complete an assignment on time, please get in touch with me **24 hours before the deadline** so we can discuss your situation. You are encouraged to work together on the homework, but do not copy any part of a homework. Each student must produce his/her own homework to be handed in. All homework must be submitted online through the class website. Feel free to ask help to instructor and teaching assistant after you have made an attempt of the questions.

The teaching assistant/grader for the course does not have the time to provide detailed explanations on each question that is graded. To make up for this, I will endeavor to create homework solutions that are detailed enough to allow you to understand how the question could be approached.

Homework preparation rules: Homework should be typed up, preferably using Rmarkdown. Handwritten homework will not be accepted. Put your name at the top of your assignment. Submit the problems in order, making sure that the computer output and discussion is placed together (do not put the computer output all at the end of homework). Make it clear what parts of the output are relevant and show how they answer the questions posed in the homework.

Exams:(Tentative)

There will be three take-home/in-class exams:

Midterm 1	During part of week of February 19
Midterm 2	During part of week of March 25
Final	During part of week of April 22 (Exam week)

There will be three exams, 2 midterms and 1 final exam. The format of exams can either be a in-class exam or a take home exam. Take home exams will be in the format of a small statistical project. You will be asked to write a report which must be word-processed, and you may be asked to include numerical and graphical summaries of your analyses as well as your computer code. Further details will be given in class and posted on the class website. However, if you are unable to complete an exam on time, please get in touch with me **48 hours before the deadline** so we can discuss your situation.

Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

Grading and feedback

For assignments, you can generally expect feedback within **7-10 days**.

If you have any questions about your graded assignments, please send an email to grader within 14 calendar days of the posting of grades.
If you have any questions about your graded exams, please send an email to instructor within 14 calendar days of the posting of grades.
PLEASE DO NOT USE CARMEN.

E-mail

I will reply to e-mails within **48 hours on school days**.

Attendance, participation, and discussions

Student participation requirements

The following is a summary of everyone's expected participation:

- **In-person class**:
  You are required to attend all classes in person. If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible.*
- **Office hours**: **OPTIONAL**
  All office hours, are optional. If you are required to discuss an assignment with me, please contact me at the beginning of the week if you need a time outside my scheduled office hours.

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using correct grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.
- **Tone and civility**: Let us maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm does not always come across online.
- **Citing your sources**: Please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)
- **Backing up your work**: Consider composing your academic posts in a text editor or word processor, where you can save your work, and then copying into Carmen.

Other course policies

Health and safety

The Ohio State University Wexner Medical Center's Cornavirus Outbreak site (https://wexnermedical.osu.edu/features/coronavirus) includes the latest information about COVID-19 as well as guidance for students, faculty and staff. Guidelines and requirements for campus safety from the University's COVID-19 Transition Task Force are published on the Safe and Healthy website (https://safeandhealthy.osu.edu).

Student academic services

Student academic services offered on the OSU main campus:
http://advising.osu.edu/welcome.shtml.

Student support services

Student support services offered on the OSU main campus: http://ssc.osu.edu.

Academic integrity policy

Policies for this course

- **Quizzes and exams**: You must complete the quizzes, midterms, and final exam yourself, without any external help or communication.
- **Written assignments**: Your written assignments should be your own original work.
- **Reusing past work**: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- **Falsifying research or results**: All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- **Collaboration and informal peer-review**: The course will include opportunities for formal collaboration with your classmates. While study groups are encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

Ohio State's academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors and Graders are required report all instances of alleged academic misconduct to the Academic Misconduct committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, at titleix@osu.edu

Accessibility accommodations for students with disabilities

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; http://slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Carmen (Canvas) accessibility
- Streaming audio and video
- Synchronous course tools

Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at suicidepreventionlifeline.org

Disclaimer

This syllabus should be taken as a reliable guide for the course content. However, you cannot claim any rights from it and I reserve the right to change due dates or the methods of grading and/or assessment if necessary. Any changes will be communicated to you through official course announcements.

Course schedule (tentative)

Week	Dates	Topics
1	Jan 9, 11	Introduction to Computational Statistics and R
2	Jan 16, 18	Working with Data in R
3	Jan 22, 24	Working with Data in R
4	Jan 30, Feb 1	Methods for Simulating Random Variables
5	Feb 6, 8	Methods for Simulating Random Variables
6	Feb 13, 15	Methods for Simulating Random Variables **Midterm 1**
7	Feb 20, 22	Monte Carlo Methods
8	Feb 27, 29	Monte Carlo Methods
9	Mar 5, 7	Monte Carlo Methods
	Mar 12, 14	**Spring break – no classes**
10	Mar 19, 21	Bootstrap & Jackknife
11	Mar 26, 28	Bootstrap & Jackknife **Midterm 2**
12	Apr 2, 4	Permutation Tests Numerical Methods
13	Apr 9, 11	Numerical Methods Optimization
14	Apr 16, 18	Time Series Analysis (optional)