

Syllabus: STAT 6730

Introduction to Computational Statistics

Autumn 2023

Course Information

- **Course times and location:** MW 1:50pm – 2:45pm in
 - Drees Lab 264 (Mondays)
 - Eighteenth Avenue Building 295 (Wednesdays)
- **Credit hours:** 2
- **Mode of delivery:** In-Person (P)

Instructor



- **Name:** Sally Paganin
- **Email:** paganin.1@osu.edu
- **Office location:** 229 Cockins Hall
- **Office hours:** in person Mondays 3pm-4pm
Zoom by appointment

Preferred means of communication:

- My preferred method of communication for questions is **email**.
- My class-wide communications will be sent through the Announcements tool in CarmenCanvas. Please check your [notification preferences \(go.osu.edu/canvas-notifications\)](https://go.osu.edu/canvas-notifications) to be sure you receive these messages.

Teaching Assistant

- **Name:** Haotian Xie
- **Email:** xie.908@osu.edu

Course Prerequisites

This course is intended to be taken during the second year of the MAS program. It is expected that students will have exposure at a mathematical level to foundational concepts in probability and statistics including random variables, estimation, hypothesis testing, and linear regression. The formal prerequisites for this course are: Stat 6301 and 6302 or equivalent; Stat 6410 and 6450, or Stat 6910 and 6950, or permission of the instruction. Previous programming experience is not required, but familiarity with computer systems is expected.

Course Description

Computational statistics is an area within statistics that encompasses computational and graphical approaches to solving statistical problems. Students will learn how to manipulate data, design, and perform simple Monte Carlo experiments, and be able to use resampling methods such as Bootstrap. They will be introduced to technologies that are useful for statistical computing. Through creating customized graphical and numerical summaries students will be able to discuss the results obtained from their analyses. The topics of the course include:

1. Introduction to R
2. Dynamic and reproducible reports with Quarto
3. Data manipulation in R
4. Visualization of data
5. Smoothing and density estimation
6. Generating random variables
7. Monte Carlo simulation
8. The Bootstrap
9. Permutation methods
10. Cross-validation

Learning Outcomes

By the end of this course, students should successfully be able to:

- Produce dynamic and reproducible reports with Quarto
- Visualize various types of data in R using the ggplot2 package
- Import, manipulate and summarize data in R
- Write and execute R functions that involve iterations or conditional statements

- Apply computational methods including Monte Carlo, smoothing and density estimation, the bootstrap and permutation methods

Course Materials, Fees and Technologies

The primary resource for reading will be slides and additional references assigned for reading by the instructor. There is one required book for the course that will be used for the parts of the course dealing with data manipulation and visualization in R. The web version of the books can be accessed freely from any web browser.

Note that there are two editions of the book. A second edition of the book has been released in June 2023. However, some important chapters have been discarded in the second edition, so few readings will refer to the first edition of the book.

Required Materials

- **[R4DS_1]** Hadley Wickham, and Garrett Golemund (2017): *R for Data Science*
Electronic version: <https://r4ds.had.co.nz/index.html>
- **[R4DS_2]** Hadley Wickham, Mine Çetinkaya-Rundel, and Garrett Golemund (2023): *R for Data Science (2e)*.
Electronic version: <https://r4ds.hadley.nz>.

Required Equipment

- **Computer:** current Mac (macOS) or PC (Windows or Linux) with high-speed internet connection, capable of running R and RStudio (described below)

Required Software

- This class requires you to use the statistical software called R (The R Project for Statistical Computing; <http://www.r-project.org/>). This software 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>
- An easy-to-use interface to R is available in the software package **RStudio**. This package is available for Windows, Mac, and Linux and can be downloaded for free from <https://posit.co/downloads/>. **Note that RStudio requires R to be installed.**



Grading and Faculty Response

How Your Grade is Calculated

Assignment Category	Percentage
Homework	15%
Labs	15%
Exam 1 (October 4)	20%
Exam 2 (November 8)	20%
Final project	30%

See [Course schedule](#) for due dates.

Assignment Information

Homework

- Homeworks will generally be assigned on a biweekly basis
- Students are required to use **Quarto** for their homeworks. The homeworks should be written in a style that smoothly integrates prose, code, tables, and graphics. It should be **human-readable**, and it should not simply contain computer output with no explanation.
- Submit both the **Quarto** source (.qmd) and **HTML** output to CarmenCanvas.
- Homework will be graded on a 3-point scale: 1 point for good-faith effort, 1 point for technically correct working solutions, 1 point for well-formatted and easily-readable code.

Labs

- Labs will consist of exercises to be completed during Wednesday meetings.
- As with homework, students are required to use Quarto and the lab report should be written in a style that smoothly integrates prose, code, tables, and graphics.
- Labs are due within 24 hours of the end of the class meeting and should be submitted as **Quarto** source (.qmd) and **HTML** to CarmenCanvas.
- Labs will be graded on the same 3-point scale as the homework.

Homework and lab assignments in the wrong format (e.g., .pdf, plain text, .doc) will receive 0 points automatically, no exceptions.

Exams

There will be two exams. Both exams are open book/internet access, but absolutely no communicating with other humans. Each exam is cumulative.

Final Project

Students will work in small groups on a final data analysis project. The instructor will provide a list of topics. Each group will cooperate on the data analysis, report writing, and making a presentation on the project in class. Details will be announced on CarmenCanvas and during one of the lectures.

Academic integrity and collaboration: Your written assignments, including discussion posts and code, should be your own original work.

Late Assignments

Generally, late homework and labs will not be accepted. However, if there are extenuating circumstances beyond your control, please contact the course instructor immediately.

Grading Scale

93–100: A
 90–92.9: A-
 87–89.9: B+
 83–86.9: B
 80–82.9: B-
 77–79.9: C+
 73–76.9: C
 70–72.9: C-
 67–69.9: D+
 60–66.9: D
 Below 60: E

Instructor 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 [614-688-4357 \(HELP\)](tel:614-688-4357) at any time if you have a technical problem.

- **Preferred contact method:** If you have a question, please contact me first through my Ohio State email address. I will reply to emails within **48 hours on days when class is in session at the university**.

- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check [your notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Discussion board:** I will check and reply to messages in the discussion boards within **48 hours on days when class is in session at the university**.
- **Grading and feedback:** For homework and lab assignments, you can generally expect feedback and grades within **7 days**.

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 good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online. I will provide specific guidance for discussions on controversial or personal topics.
- **Citing your sources:** When we have academic discussions, 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 word processor, where you can save your work, and then copying into the Carmen discussion.

Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](https://studentconduct.osu.edu) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct

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 shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

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.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth

and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

1. Online reporting form at equity.osu.edu,
2. Call 614-247-5838 or TTY 614-688-8605,
3. Or email equity@osu.edu

Religious accommodations

It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief.

Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.

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](tel: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](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the [Suicide and Crisis Lifeline](#).

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

Requesting Accommodations

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. 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.

If you are isolating while waiting for a COVID-19 test result, please let me know immediately. Those testing positive for COVID-19 should refer to the [Safe and Healthy Buckeyes site](#) for resources. Beyond five days of the required COVID-19 isolation period, I may rely on Student Life Disability Services to establish further reasonable accommodations.

Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

Accessibility of Course Technology

This online course requires use of CarmenCanvas (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 as early as possible.



- [CarmenCanvas accessibility](https://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](https://go.osu.edu/zoom-accessibility) (go.osu.edu/zoom-accessibility)



Course Schedule (tentative)

Refer to the CarmenCanvas course site for up-to-date information.

R4DS_1 - 1 edition <https://r4ds.had.co.nz/index.html>

R4DS_2 - 2 edition <https://r4ds.hadley.nz>

Date	Day	Topic	Reading	Due
8/23	W	Course overview and introduction	R4DS_2 Intro, 3	
8/28	M	Data types in R	R4DS_2 7.1	
8/30	W	Lists and data frames in R	R4DS_1 10	
9/04	M	No class (Labor Day)		
9/06	W	Data manipulation and summarization in R	R4DS_2 4	
9/11	M	Grammar of graphics	R4DS_2 2	
9/13	W	Lab 1: ggplot2		HW1
9/18	M	Smoothing		
9/20	W	Lab 2: Smoothing		
9/25	M	Functions	R4DS_2 26	
9/27	W	Lab 3: Functions		HW2
10/02	M	Density estimation		
10/04	W	Exam 1		
10/09	M	Generating random variables		
10/11	W	Lab 4: Conditionals and iteration	R4DS_1 21-21.4	
10/16	M	Monte Carlo integration		



10/18	W	Lab 5: Monte Carlo		
10/23	M	The Bootstrap		HW3
10/25	W	Lab 6: The Bootstrap		
10/30	M	Functional programming with purrr	R4DS_1 21.4-21.9	
11/01	W	Lab 7: Functional programming with purrr		
11/06	M	pipes and dplyr	R4DS_1 18	HW4
11/08	W	Exam 2		
11/13	M	Permutation tests		
11/15	W	Lab 8: Permutation tests		
11/20	M	rsample		
11/22	W	No Class		
11/27	M	Cross-validation		
11/29	W	Lab 9: Cross-validation		HW5
12/04	M	** Project presentations**		
12/06	W	** Project presentations**		
12/13	W	Final project due		

