THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 6450
APPLIED REGRESSION ANALYSIS
FALL 2023

Course overview

Instructor

Instructor: Xiaoxuan Cai
Email address: cai.1083@osu.edu
Class location: Jennings Hall 040
Class time: 9:05–10:55 am on Tuesdays and Thursdays
Office hours: Thursday 11:00-12:00 am at CH 428C.
Additional office hour are available with a 48-hour advance appointment.

Grader or Teaching Assistant

Hyoin An (an.355@osu.edu)
Office hours: TBD

Course description

Statistics 6450 is intended to be an introduction to regression analysis techniques. Its focus will be on the application of linear regression models in practice but will also cover basic theory of the linear model. Topics of Stat 6450 include:

Simple Linear Regression (SLR) model

- Methodology for fitting models
- Statistical inference
- Diagnostics for verification of assumptions (graphical tools and formal tests)
- Transformations, weighted least squares

Multiple Linear Regression (MLR) model

- Methodology for fitting models and use of matrix algebra
- Statistical inference
- Diagnostic measures of model fit
- Binary indicator (1/0) and qualitative predictors
- Piecewise linear models

Variable selection and model building

- Stepwise regression methods
- Lasso and ridge regression
- Bias-variance tradeoff and cross validation

Generalized Linear Models (GLMs) (if time permits)

- Logistic regression – methodology for fitting, statistical inference, diagnostics, model selection, prediction, ROC curves.
- Poisson regression

Prerequisite or corequisite:

Statistics 6201 or equivalent.

Course learning outcomes

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

- Understand the motivation of regression analysis
- Understand the theoretical assumptions behind the linear model and their importance in properly conducting a regression analysis
- Know how to estimate the parameters in regression models
- Be able to validate the modeling assumptions with formal tests and visual diagnostic tools
- Know how to make inferences regarding the linear model
- Be able to build and validate regression models in a principled manner
- Be able to apply the above knowledge and techniques in on your own data or problems

This course focuses on the application of linear regression models

Course materials

Required

The required textbook for this course is:

Applied Linear Regression Models, 4th edition, by Kutner, Nachtsheim, and Neter. (ecopy available)

I will highlight other useful references as the course progresses.

Optional materials

A related text book (not required)

Applied Regression Analysis, Wiley. Normal Draper and Harry Smith (1998). (print)

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

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

Technology skills necessary for this specific course

- CarmenZoom
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video

Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 10+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

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.
- An easier 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 http://rstudio.org. **Note that RStudio requires R to be installed.**
- Microsoft Office 365 ProPlus All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad® and Android™) and five phones.
    - Students are able to access Word, Excel, PowerPoint, Outlook and other programs, depending on platform. Users will also receive 1 TB of OneDrive for Business storage.
    - Office 365 is installed within your BuckeyeMail account. Full instructions for downloading and installation can be found https://ocio.osu.edu/kb04733.

Course delivery

For the Fall 2023 offering, the course will be taught in-person on 9:10 am - 11:00 am on Tuesday and Thursday at Jennings Hall 0040. Course materials, including slides, notes, and in-class codes, will be posted on the course website. You will be responsible for attending classes in person, studying the course material, working through statistical theories and R coding examples presented in the class.

Also, quizzes, homework assignments, and readings will be posted on the class website. You will be given ample time to complete the quizzes and assignments.

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

Grading and faculty response

Grades

Assignment or category	Percentage
Homework	**25**
In-class attendance (no grading)	**10**
Midterm Exam	**30**
Final Exam	**35**
Total	**100**

Assignment information

Homework: Homework will be assigned regularly (a total of 5 homework assignments). It will consist of both written problems and computer programming/data analysis problems.

All homework must be submitted online as a PDF file through the class website (carmen). 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 (including computer code), result (including figures and tables) 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.

Please note late submission of assignments will not 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 problems, but each student must hand in their own work, written in their own words. Feel free to ask help to instructor and teaching assistant after you have made an attempt of the questions.

Participation: Participation is measured by in-class tests. We permit a maximum of two missed tests. If special circumstances will cause you to miss an entire week of lectures or more than two tests, please contact me at least 24 hours beforehand.

Exams: There will be two exams --**one midterm exam and a final exam**. Coverage includes lecture material, assigned reading, and homework. All exams are closed book/closed notes and will be delivered in class at the lecture time. Further details will be given in advance of each exam.

Date for midterm exam (tentative): Tuesday Oct 10, 2023 during class time.
Date for final exam (scheduled by the University): Friday Dec 8, 2023 8:00 – 9:45 am

If you cannot be available at these times for unavoidable reasons, you must speak with the course instructor immediately with at-lease 5 business days in advance. If you fail to take an exam during the time when it is available without any communication, no make-up of exam will be allowed. Statistical tables will be provided as needed. Calculators may be used, but no communication devices are allowed (e.g. mobile phones).

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 large weekly assignments, you can generally expect feedback within **14 days**. If you have questions about the grading of homework assignments, please email the teaching assistant directly.

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.

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 good grammar, spelling, and punctuation. Informality (including an occasional emoticon) 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.
- **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.

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 were published on July 1 on the Safe and Healthy website (https://safeandhealthy.osu.edu).

Potential disruptions to instruction

- As much as is possible, students will have access to material online if they are unable to attend class because of positive diagnosis, symptoms, or quarantine required following contact tracing.
- If the instructor is unable to be present in person because of positive diagnosis, symptoms, or quarantine following contact tracing a new instructor will be assigned to the course. Details will be given on the course website

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 online course

- **Exams**: You must complete the midterm and final exams yourself, without any external help or communication.
- **Written assignments**: Your written assignments, including discussion posts, 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 includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on assignments is

not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

- **Group projects**: This course includes group projects, which can be stressful for students when it comes to dividing work, taking credit, and receiving grades and feedback. I will make the guidelines for group work as clear as possible for each activity and assignment, but please let me know if you have any questions.

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 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/.

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

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.

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 fairly reliable guide for the course content. However, you cannot claim any rights from it and in particular we 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, Readings, Assignments, Deadlines
1	Aug 22, 24	Introduction, background materials, data sources
2	Aug 29, 31	Simple Linear Regression (SLR) – parameter estimation and inference
3	Sep 5, 7	SLR – inference on model and ANOVA
4	Sep 12, 14	Visual diagnostics, lack of fit test, data analysis
5	Sep 19, 21	SLR- diagnostic tools, remedies, transformations, simultaneous inference, data analysis
6	Sep 26, 28	Recap of Linear Algebra, SLR in matrix form
7	Oct 3, 5	Multiple Linear Regression (MLR) –introduction and estimation
8	Oct 10	Midterm Exam (Oct 10) and Autumn break
9	Oct 17, 19	MLR – inference, diagnostics and remedy, general linear test
10	Oct 24, 26	MLR – polynomial regression, interaction regression
11	Oct 31, Nov 2	MLR – Variable Selection and Model building Bias variance tradeoff, cross validation, lasso, ridge
12	Nov 7, 9	Data Analysis with MLR
13	Nov 14, 16	Generalized Linear Models (GLM) – logistic regression estimation, inference, residuals, diagnostics
14	Nov 21	Logistic regression –model selection, prediction, Data Analysis
15	Nov 28, 30	Poisson regression
16	Dec 5, 7	Final Review