THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 6450
APPLIED REGRESSION ANALYSIS
AUTUMN 2020

Course overview

Instructor

Instructor: Subhadeep Paul
Email address: paul.963@osu.edu
Lectures: On CarmenZoom, Tuesday and Thursdays, 9:05–10:55 am
Office hours: Virtual Hours via Carmen Zoom (Tuesday 11:30-12:30, Thursday 11:30-12:30)

Grader or Teaching Assistant

To be announced.

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 and their remedies

Multiple Linear Regression (MLR) model

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

Generalized Linear Models (GLMs)

- Logistic regression
- Additional topics as time permits (may include high dimensional regression, 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

Course materials

Required

The required textbook for this course is:

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

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

The course will be primarily delivered synchronously with some occasional asynchronous content. Synchronous content will be presented live over CarmenZoom during the lecture times (see above), and asynchronous content (if any) will be delivered by recorded lectures posted on the class website in carmen.

Each week we will cover approximately 220 minutes of content in total. You will be responsible for attending live virtual classes and any recorded videos as well as studying the material that is assigned. In addition to the lecture videos, assignments will be posted on the class website. You will be given ample time to complete the assignments.

The instructor will hold weekly office hours via CarmenZoom. The times are given above.

Grading and faculty response

Grades

Assignment or category	Percentage
Homework	35
Midterm Exam	20
Final Exam	25
Final Project	20
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. You are encouraged to work together on the problems, but each student must hand in their own work, written in their own words. Do not copy any part of another student's homework including computer output. Use of homework solutions distributed in previous offerings of the course or available on the web constitutes academic misconduct and will be handled according to university rules. **All homework must be submitted online as a PDF file through the class website (carmen).** Please be sure that the questions are clearly labeled, all supporting work (including computer code) can be easily identified, and that all figures/tables are referenced and interpreted in the text.

Please note late submission of assignments will not be accepted unless prior exception has been sought. if you are unable to complete an assignment on time, please get in touch with me as soon as possible so we can discuss your situation

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 through carmen and proctored online through CarmenZoom. Further details will be given in advance of each exam.

Tentative Date for midterm exam: Tuesday, October 13, 2020 during class time.
Final Exam Date (University scheduled): Monday Dec 7 8:00am-9:45am

Statistical tables will be provided as needed. Calculators may be used, but no communication devices are allowed (e.g. mobile phones). Makeup exams require a valid excuse and official proof if I am notified in advance or as soon as possible.

Project: A data-analysis group class project will consist of an oral presentation of results obtained from analyzing a dataset, and will require use of the R software. The students are expected to work in groups of 3-5 and each group can select a dataset of their choice to analyze (preferably from the research/educational domain of the students to bring more diversity of topics). No written report is required. **The groups will present their results to the class on Dec 3 during the usual class time.**

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

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**.

E-mail

I will reply to e-mails within **24 hours on school days**.

Attendance, participation, and discussions

Students may miss class, for a variety of reasons related to COVID-19. As much as possible,

please stay in contact with the instructor so that we can discuss accommodations should they be needed.

Student participation requirements

Because this is a distance-education course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- **Logging in**: **AT LEAST ONCE PER WEEK**
  Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible.*
- **In live lectures:** Students will be expected to participate, discuss, and answer questions in online live lectures.
- **Office hours**: **OPTIONAL OR FLEXIBLE**
  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, Kellie Brennan, at titleix@osu.edu

Accessibility accommodations for students with disabilities

The University strives to make all learning experiences as accessible as possible. 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; 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 25,27	Introduction, background materials, R programming basics
2	Sep 1, 3	Simple Linear Regression (SLR) – parameter estimation and inference
3	Sep 8, 10	SLR – inference on model and ANOVA, visual diagnostics
4	Sep 15, 17	SLR- diagnostic tools, remedies, transformations, simultaneous inference
5	Sep 22, 24	Recap of linear algebra and SLR in matrix form
6	Sep 29, Oct 1	Multiple Linear Regression (MLR) –introduction and estimation, models with interactions
7	Oct 6, 8	MLR – inference, diagnostics and remedy, general linear test
8	Oct 13, 15	Midterm Exam, Weighted least squares, indicator (dummy) and qualitative predictors
9	Oct 20, 22	Piecewise linear models, polynomial regression
10	Oct 27, 29	Variable Selection and Model building (stepwise regression)
11	Nov 3, 5	Bias variance tradeoff, cross validation, lasso, ridge
12	Nov 10, 12	Data Analysis with MLR
13	Nov 17, 19	Generalized Linear Models (GLM) – logistic regression estimation, inference, residuals, diagnostics
14	Nov 24,	Logistic regression –model selection, prediction, Data Analysis
15	Dec 1, 3	Poisson regression, project presentation