



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

STAT 6860: FOUNDATIONS OF THE LINEAR MODEL SPRING 2021

Course overview

Instructor

Xinyi Xu

Email address: xinyi@stat.osu.edu

Office hours: Virtual hours via CarmenZoom: Th 2:15-3:15pm EST, or by appointment

Teaching Assistant

Wei-En Lu

Email address:

Role: lu.1408@osu.edu

Office hours:

Grading homework assignments, monitoring the course discussion board and answering questions about homework
Virtual hours via CarmenZoom: M 11:30am-12:30pm EST

Course description

STAT 6860 is designed to get you ready for the second-year course on the linear models. While you have all seen linear algebra in undergraduate coursework, the typical course is taught with the goal of mathematics in mind. In Statistics, different parts of linear algebra are more important, and we will spend time on some of these areas. Particular examples include the emphasis in Statistics on covariance matrices (square, symmetric, non-negative definite), projections and successive projections as they relate to least squares fits of a model, and the ordering of matrices that is useful for optimal design. During the course, we will review basic concepts of linear algebra and we will build connections to formal statistical models and methods – in particular to the multivariate normal distribution and to the linear model, as well as to least squares and related techniques.

Prerequisites: Enrollment in the PhD program in Statistics or Biostatistics, or permission of the instructor.

Course learning outcomes

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

- Understand and use appropriate notation and terminology of matrices, vectors, column spaces, eigenvalues and eigenvectors, etc.;
- Understand geometric views of some matrix operations;
- Perform linear algebra operations such as matrix decompositions, projections, general inverses;
- Carry out analysis of linear models using the methods of (weighted) least squares, etc.

Course materials

Required: *Matrix Algebra from a Statistician's Perspective*, by D. A. Harville, Springer.

Download the eBook from

<https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/b98818>

This text is an excellent book, but it was not written with a course in mind. Instead, it has been written as a reference book and it contains a wealth of useful results. This text was chosen for the course because it is one you can read with only a standard undergraduate course on linear algebra as background and because it is a great book to have on your bookshelf.

Course delivery

The vast majority of the course can be completed asynchronously, meaning that you will be able to study materials and work on assessments according to your own schedule. Each week several instructional videos, covering approximately 220 minutes of content, will be posted on the course website. You are responsible for watching the videos and studying the material that is assigned each week. In addition to the lecture videos, weekly assignments will be posted on the class website. You will be given ample time to complete the assignments.

The instructor may elect to deliver live CarmenZoom lectures in place of videos for certain topics. In this case, the lecture will be recorded and posted on the class website soon after.

Please check the course webpage regularly for important announcements, homework assignments and solutions. The instructor and teaching assistant will also manage active discussion boards via Carmen and will hold virtual office hours.

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; the following website may help you if you encounter difficulties with Carmen: <https://resourcecenter.odee.osu.edu/canvas/> .

Technology skills necessary for this specific course

- CarmenZoom

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

Grading and faculty response

Homework and exams

Assignment or category	Percentage
Homework	30
Midterm	30
Comprehensive Final	40
Total	100

Homework:

Homework will be collected approximately weekly. Allow sufficient time to complete these assignments so that you can get help if you need it. You are encouraged to use the Carmen discussion board to post questions about homework assignments and to answer questions from your peers. This will provide you with opportunities to interact with each other. However, do not copy any part of other's homework. Each student must produce his/her own homework to be handed in.

When you put together your homework solutions, make sure that you put the homework assignment number on the first page and arrange the problems in order. All homework must be **submitted online as a PDF file through the course website**, following the instructions on <https://community.canvaslms.com/docs/DOC-9539-421241972>.

NO late homework will be accepted. We automatically drop your lowest homework assignment grade. If you miss a homework assignment deadline, we will automatically take your first missed homework assignment to be your lowest grades (in that you will receive 0 for not completing the assignments), no matter what the reason for missing these assignments is, so please do not ask to make up the assignment. We allow for the assignment grades to be dropped because we recognize that sometimes, unavoidable things happen that might affect your ability to complete your work and we do not want you to worry about having to make up work in these situations.

Exams:

There will be one midterm exam and one comprehensive final exam.

Midterm (tentative): February 9, Tuesday, 12:40-1:40 pm EST

Final (Comprehensive): March 4, Thursday, 12:40-2:25 pm EST

- If you cannot be available at these times for unavoidable reasons, you must speak with the course instructor immediately. **If you fail to take an exam during the time when it is available without any communication with us to explain, we will not allow you to make up the exam unless there is an emergency situation that you can document.**
- The midterm will cover the materials from Chapters 1-8 and Chapters 10-12, as well as the materials from the lectures. The final exam will be comprehensive, with more weight on post-midterm materials.
- Both exams will be **close-book/closed-notes**. We take academic honesty very seriously in this course. You may communicate with only the instructor if you have any questions during the exam periods.

You have until one week after receiving your grades on the exams to dispute the grade; the same applies to any homework grade. Note that when asking for a question to be re-graded, the entire assignment/exam may be re-graded, and so you run the risk of losing more points than you gain back.

Faculty feedback and response time

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

Preferred contact method

- If you have questions about the lectures or notice any typos in the materials, please email the instructor. I will reply to e-mails within **24 hours on school days**.
- **If you have questions about the grading of homework assignments, please email the teaching assistant directly** – do NOT use the discussion board.

Discussion board

The teaching assistant and instructor will regularly monitor and reply to messages in the discussion boards as appropriate.

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*.

- **Office hours and live sessions: OPTIONAL OR FLEXIBLE**

All live events for the course, including office hours, are optional. For live presentations, I will provide a recording that you can watch later. 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 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 Coronavirus Outbreak site (<https://wexnermedical.osu.edu/features/coronavirus>) includes the latest information about COVID-19 as well as guidance for students, faculty and staff.

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 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 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 (Recommended)

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 Younklin 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
1	Jan. 12, 14	Matrices, vectors and column spaces
2	Jan. 19, 21	Spans, bases, ranks, and geometric views of matrix operations
3	Jan. 26, 28	Matrix decomposition and multivariate normal distribution
4	Feb. 2, 4	Idempotent matrices, systems of linear equations and projections
*	Feb. 9	Midterm Exam
5	Feb. 11	Least squares estimation and successive projections
6	Feb. 16, 18	Generalized inverses and weighted or generalized least squares
*	Feb. 23	Instructional break day
7	Feb. 25	Eigenvalues and eigenvectors, spectral decomposition
8	Mar. 2	Other matrix decompositions
*	Mar. 4	Comprehensive Final Exam