THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

STAT 6550: THE STATISTICAL ANALYSIS OF TIME SERIES SPRING 2021

Course overview

Instructor Xinyi Xu

Email address: xinyi@stat.osu.edu

Office hours: Virtual hours via CarmenZoom: F 1-2pm EST, or by appointment

Teaching Assistant Qiuyu Gu

Email address: gu.675@osu.edu

Role: Grading homework assignments, monitoring the course discussion board and answering questions about homework

Office hours: Virtual hours via CarmenZoom: Tu 1:30-2:30pm EST, or by appointment

Course description

STAT 6550 aims to develop a working knowledge of time series analysis and forecasting methods. The emphasis is on modeling methodology (identification, estimation, diagnostics, and updating) and forecasting. Experience is gained in the statistical theory so as to be able to analyze time series data in practice.

Prerequisites: Stat 6201 or Stat 6302 or Stat 6802; Stat 6450 or Stat 6950; or permission of instructor.

Course learning outcomes

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

- Understand and use appropriate statistical tools to analyze time series data;
- Examine whether the assumptions for the analysis are reasonable;
- Recognize the strengths or weaknesses of various time series tools.

Course materials

Required: ***Brockwell and Davis, Introduction to Time Series and Forecasting (2nd or 3rd Edition), New York: Springer.***

Both the 2nd and 3rd edition of the textbook are freely available online via your OSU account:

- 2nd edition: http://link.springer.com.proxy.lib.ohio-state.edu/book/10.1007%2Fb97391
- 3rd edition: https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007/978-3-319-29854-2

Course delivery

The course will be a mix of synchronous and asynchronous content. Synchronous content will be presented live over CarmenZoom, and asynchronous content will be delivered by recorded lectures posted on Carmen. Details of the weekly schedule will be announced at the start of each week.

Each week we will cover approximately 110 minutes of content in total. You will responsible for watching any live content or recorded videos and studying the material that is assigned. In addition to the lecture videos, every week quizzes or homework assignments will be posted on Carmen.

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

Necessary software

- In this course, you will be required to do some basic statistical analyses on the computer using the statistical software package 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.**

Grading and faculty response

Homework and exams

Assignment or category	Percentage
Homework	25
Quizzes	10
Midterm	25
Comprehensive Final	40
Total	100

Homework and quizzes:

Weekly short quizzes and homework will be assigned on Carmen. 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. Make sure that the

computer output and discussion is placed together (do not put the computer output at the end of homework). Computer output alone without proper interpretation of the result would not be considered a complete answer either and you may lose points. You don't need to include R script itself in your homework unless it is necessary to justify your answer. 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): March 9, Tuesday, 11:30am-12:25pm EST
Final (Comprehensive): April 30, Friday, 10:00-11:45am 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.**
- Both exams are **closed book/closed notes** (except for the sheet of notes described next) and will be **proctored via CarmenZoom**. You may use one 8.5x11 inch sheet of paper (both sides), with whatever facts, formulas, or explanations you find helpful, for each exam. A basic calculator is allowed – tablets, laptops, cellphones, and other communication devices are not. Statistical tables will be provided as needed. 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, 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:

- **In live lectures:**

  Students will be expected to participate and answer questions in online live lectures.

- **Logging in**: **AT LEAST TWICE 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 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

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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
1	Jan. 12, 14	Introduction to time series models
2	Jan. 19, 21	Stationary processes
3	Jan. 26, 28	Estimating mean, autocovariance, and autocorrelation functions
4	Feb. 2, 4	Methods for estimating and eliminating trend and seasonality
5	Feb. 9, 11	Statistical properties of stationary and linear processes
6	Feb. 16, 18	MA and AR processes
*	Feb. 23	Instructional break day (no class)
7	Feb. 25	ACF and PACF, forecasting stationary time series
8	Mar. 2, 4	Forecasting stationary time series
*	Mar. 9	**Midterm**
9	Mar. 11	ARMA processes
10	Mar. 16, 18	Estimation and prediction of ARMA processes
11	Mar. 23, 25	Assessing fit / comparing different time series models
12	Mar. 30	Case study
*	Apr. 1	Instructional break day (no class)
13	Apr. 6, 8	ARIMA and SARIMA processes
14	Apr. 13, 15	Linear regression with stationary time series errors
15	Apr. 20, 22	Nonlinear processes
*	Apr. 30	**Comprehensive final exam**