



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 6520

APPLIED STATISTICAL ANALYSIS WITH MISSING DATA

AUTUMN 2023

Course overview

Instructor

Instructor: Dr. Elly Kaizar

Email address: kaizar.1@osu.edu

Phone number: 614-247-2585

Course website: <https://osu.instructure.com/courses/152186>

Office hours: Office Hours Mondays 4:10-5:05pm, Eastern time, and by appointment (please email with your availability). Zoom links will be provided individually as needed.

Office Location: 404B Cockins Hall

Prerequisites

STAT 6201, 6302 or 6802, and STAT 6450 or 6950, or PubHBio 6211, or permission of instructor.

Teaching Assistant

Yuxuan Xin will be helping grade this semester. She will not be holding office hours for this course.

Course description

This class will review statistical analysis for complete data and provide an introduction to the models and methods for the dataset with missing values. The course has a significant component of statistical computations dealing with missing data. It is intended for those who already have some experience with standard statistical methods for complete data and want to extend them to handle missing data in practice.

Course learning outcomes

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

- Describe the missing data mechanism and underlying assumptions and identify different patterns of missing data
- Describe the difference in statistical analysis between the missing data problem and complete data problem (including weighted methods)
- Perform simple missing data analysis; describe its weakness
- Implement likelihood-based analysis with ignorable missing response; implement the EM algorithm with some statistical package
- Describe the principle of Bayesian analysis with missing data; implement multiple imputation with some statistical package
- Describe and implement missing data models in contingency tables
- Describe modern statistical methods to deal with non-ignorable missing data
- Implement and interpret statistical methods for missing data in a practical scenario.

How this course works

Mode of delivery: This course is scheduled an in-person course, meeting on Mondays, Wednesdays and Fridays from 3:00-3:55pm. Students are expected to attend and participate during lecture, though I will not take attendance. Two synchronous class periods are planned to be replaced by asynchronous activities (as listed on the course schedule). Class may be held synchronously over Zoom or asynchronously via CarmenCanvas to prevent disruption of instruction due to illness or other unanticipated instructor absence or other in-person class cancellation.

Course materials

Required textbook

Statistical Analysis with Missing Data, Little and Rubin, 3rd edition, Wiley. The textbook is available via the Ohio State Library: <https://library.ohio-state.edu/record=b8643360>.

Optional references

- *Analysis of incomplete multivariate data*, Schafer, J.L. Chapman & Hall, London.
- *Applied Missing Data Analysis*, Enders, C.K. The Guilford Press.

Course technology

For help with your password, university e-mail, Carmen, or other university-related 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

Technology skills needed for this course

- Basic computer and web-browsing skills
- Navigating Carmen go.osu.edu/canvasstudent
- CarmenZoom virtual meetings go.osu.edu/zoom-meetings

Required equipment

- Computer with high-speed internet connection and browser for which Carmen is fully functional and R is fully functional (see below)
(https://support.sas.com/ondemand/caq_swe.html)
- Other: a mobile device (smartphone or tablet) to use for BuckeyePass authentication

Required 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. Students are able to access Word, Excel, PowerPoint, and other programs, depending on platform. Full instructions for downloading and installation can be found <https://ocio.osu.edu/kb04733>.

Carmen access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (go.osu.edu/add-device).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (go.osu.edu/install-duo) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357(HELP) and IT support staff will work out a solution with you.

Grading and faculty response

How your grade is calculated

Assignment or category	Percentage
Homework	35
Midterm Exam	30
Final Exam	35
Total	100

See course schedule, below, for due dates

All grades will be stored in Carmen. Students are responsible for regularly checking the grade entries in Carmen. Any grade disputes should be emailed to the instructor within 7 days of the grade assignment.

Descriptions of major course assignments

Homework

There will be approximately 7 graded homework assignments. These should be submitted electronically to the Carmen Dropbox. Unless otherwise indicated in the assignment, electronic submissions must be a single file in .pdf format. Your name should appear both in the file name and at the top of the first page.

I encourage you to work together in solving homework problems, but your submitted work must be your own, and should not make use of chatbots or similar tools. You may not copy any of your submission from another student, the text, or any other source (including websites or chatbot output) without proper attribution (citation). Remember that your grade will be based on your work that you submit, and so should reflect your own work. Feel free to ask the instructor for help after your first attempt at any homework problem.

Midterm and Final Exam

There will be two exams. The midterm exam will be an in-class exam. You may bring a calculator (not a cell phone or other communication device) to the exam. You may bring two 8.5x11 sheets of paper with your own notes on both sides. These sheets may be prepared any way you like, and will not be collected. The final exam will be a take-home exam that is open books and open notes. During both exams, you should not communicate (including in-person and by electronic means) about the exam or the exam contents with anyone other than the course instructor.

Late assignments

Assignments are provided in advance of the due date. Students should plan ahead, pay attention to planned outages, prepare for internet slowness, and be sure to leave extra time to upload files. Grades for assignments submitted late will be automatically deducted 5% per hour they are late, with a minimum grade of 0%. If you experience an emergency or other unplanned circumstance that prevents your submitting an assignment on time, please contact the instructor as soon as possible.

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-HELP** at any time if you have a technical problem.)

Grading and feedback

For homework assignments, you can generally expect feedback within **9 days**.

E-mail and discussion boards

I plan to reply to e-mails and/or discussion posts within **48 hours on days when class is in session at the university**. Please do not try to contact me via Carmen messaging. Instead, please use my University email: kaizar.1@osu.edu.

Other course policies

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.

Academic integrity policy

Policies for this online course

- **Quizzes:** You must complete the quizzes yourself, without any external help or communication. You may refer to course materials (e.g., textbook and video) during the quiz.
- **Written assignments:** Your written assignments should be your own original work. In formal assignments, you should follow a standard reference style (e.g. APA or Chicago) to cite the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in--but no one else should revise or rewrite your 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 any other part of your research look more successful than it was.
- **Collaboration and informal peer-review:** The course includes many opportunities for collaboration with your classmates. While I encourage participation in study groups and peer-review of written homework, remember that comparing answers on an exam 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 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.

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

Commitment to a diverse and inclusive learning environment

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.

Land Acknowledgement

We would like to acknowledge the land that The Ohio State University occupies is the ancestral and contemporary territory of the Shawnee, Potawatomi, Delaware, Miami, Peoria, Seneca, Wyandotte, Ojibwe and Cherokee peoples. Specifically, the university resides on land ceded in the 1795 Treaty of Greeneville and the forced removal of tribes through the Indian Removal Act of 1830. I/We want to honor the resiliency of these tribal nations and recognize the historical contexts that has and continues to affect the Indigenous peoples of this land.

More information on OSU's land acknowledgement can be found here:

<https://mcc.osu.edu/about-us/land-acknowledgement>

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. 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 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

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. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

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 with your instructor.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)
- Collaborative course tools

Disclaimers

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 I 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.

Video and audio recordings of class lectures including student participation may be part of the classroom activity. The video and audio recording may be used for educational use/purposes and may be made available to all students presently enrolled in the course.

Course schedule (tentative)

See Carmen for updates and details on assignments.

Week	Dates	Topics, Readings	Readings
1	8/21-8/27	Review of Statistical Inference	Text 6.1.1, 6.1.2, 6.1.4, 6.1.5
2	8/28-9/3	Review, cont. and Intro to Missing Data	Casella and George, 1992 (doi:10.2307/2685208); Text 1.1-1.3
	9/6, 3:00pm	Homework 1 Due	
3	9/4-9/10 (M 9/4 Labor Day)	Intro to Missing Data, cont.	Text 1.1-1.4; Tierney and Cook, 2023 (doi.org/10.18637/jss.v105.i07)
4	9/11-9/17 (9/15 – Distance Learning or guest lecture TBA)	Bayesian Inference and Multiple Imputation	Text 10.1, 10.2, 6.1.3, 5.4
	9/20, 3:00pm	Homework 2 Due	
5	9/18-9/24	Multiple Imputation, cont.	Text 10.1, 10.2, 6.1.3, 5.4
6	9/25-10/1	Congentiality and MI Shortcuts	Text 5.4, 6.1.3, 10.2
	10/4, 3:00pm	Homework 3 Due	
7	10/2-10/8	MI Shortcuts, cont.	Text Sections 5.4, 6.1.3, 10.2, White, et al (2011) Andridge and Little (2010)
8	10/9-10/15 (R-F 10/12-13 Autumn Break)	Single Imputation	Text Chapter 4
	10/11, 3:00pm	Homework 4 Due	
9	10/16-10/22	Single Imputation, cont.	Text Chapter 5
10	10/23-10/29	Likelihood-Based Inference	Text 6.2-6.3, 7.1-7.4, 9.1
	10/25, 3:00pm	Homework 5 Due	
11	10/30-11/5	Likelihood-Based Inference, cont.	Text 8.1-8.4 (skim 9.2), 13.1-13.3

Week	Dates	Topics, Readings	Readings
	11/1, 3:00pm	Midterm Exam	
12	11/6-11/12 (R 11/10 Veterans Day)	Complete Case, Available Case and Weighting	Text Chapter 3
	11/8, 3:00pm	Homework 6 Due	
13	11/13-11/19 (11/17 – Distance Learning or guest lecture TBA)	Weighting, cont.	Text Chapter 3
14	11/20-11/26 (WRF Various Breaks)	Nonignorable Missing Data	Text 15.1, 15.2
	11/27, 3:00pm	Homework 7 Due	
15	11/27-12/3	Nonignorable Missing Data, cont.	Text 15.3, 15.4
16	12/3-12/6	Sensitivity Analyses	Text 15.1-15.4 and TBD
	12/8, 3:00pm	Final Exam Due	

Edited 8/28 to update office hours.