



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 5301

INTERMEDIATE DATA ANALYSIS 1

SUMMER 2025

ONLINE

Course overview

Instructor

Instructor: Dr. Jillian Morrison

Credential: PhD in Statistical Science

Email address: morrison.1043@osu.edu

Office hours: VIRTUAL - Tuesdays 11-12am or **by appointment**. Appointments for office hours must be requested via email by 10am on the date of the requested appointment.

Office Location: CH 329

Grader or Teaching Assistant

Graduate Teaching Assistant: Rezoanoor Rahman

Email: rahman.282@buckeyemail.osu.edu

The grader's office hours will be posted on Carmen.

Course description

Statistics 5301 is a first course in a two-semester non-calculus sequence in data analysis covering descriptive statistics, design of experiments, probability, statistical inference, one sample t, goodness of fit, the two-sample problem, and one-way ANOVA

Prerequisites: The sequence is intended for students with “limited” formal mathematics background (a solid grounding in high school algebra is beneficial). However, in terms of data analysis and interpretation, the conceptual level of the course is high. While many of the students in the course are graduate students (it is a required course in many programs), it is certainly an appropriate sequence for junior and senior level undergraduates.

Course learning outcomes

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

- deal with problems of data-gathering, presentation, and interpretation.
- create graphical and numerical summaries of data
- develop an understanding of problems of measurement
- gain an understanding of the impact of statistical ideas in daily life and specific areas of study

- recognize the uses and misuses of statistics and related quantitative arguments
- understand fundamental concepts of probability and statistics
- utilize the use of computer programs in problems involving data analysis
- summarize data using summary measures and graphical techniques.
- identify an appropriate analysis for data collected in a study
- carry out such an analysis
- examine whether the assumptions behind the analysis are reasonable
- recognize the strengths or weaknesses of the study based on how the data was collected
- understand how the design of a study affects the conclusions that can be made
- write and discuss what conclusions can be drawn from statistical analyses

This course satisfies the **General Education foundation requirement in Mathematical and Quantitative Reasoning or Data Analysis** which has the following goals and expected learning outcomes:

Goals: Successful students will be able to apply quantitative or logical reasoning and/or mathematical/ statistical methods to understand and solve problems and will be able to communicate their results.

Expected Learning Outcomes (ELOs): *Successful students are able to:*

1. *Use logical, mathematical and/or statistical concepts and methods to represent real world situations.*
2. *Use diverse logical, mathematical and/or statistical approaches, technologies and tools to communicate about data symbolically, visually, numerically and verbally.*
3. *Draw appropriate inferences from data based on quantitative analysis and/or logical reasoning.*
4. *Make and evaluate important assumptions in estimation, modeling, logical argumentation and/or data analysis.*
5. *Evaluate social and ethical implications in mathematical and quantitative reasoning.*

The course objectives address the **GE learning outcomes** as follows:

Students in Statistics 5301 are expected to be able to identify an appropriate analysis for data collected in a study, carry out such an analysis, examine whether the assumptions behind the analysis are reasonable, and recognize the strengths or weaknesses of the study based on how the data were collected. Doing so requires understanding basic concepts in statistics and probability; the ability to create graphical and numerical summaries of data; understanding how the design of a study affects the conclusions that can be made; and the ability to carry out basic statistical analyses (by hand or using statistical software). Students will conduct analyses of data, including a discussion (in plain English) of what conclusions can be drawn. The goal of statistics is not calculation but gaining understanding from numbers. This means that the correct numerical answer will only receive partial credit. The remainder of the credit will be available for choosing the best method of solution and explaining why the method is appropriate. You will also need to interpret your answers in the light of the practical problem.

This course also satisfies the **Legacy General Education requirement in Data Analysis** which has the following goals and expected learning outcomes:

Goals: Students develop skills in drawing conclusions and critically evaluating results based on data.

Expected Learning Outcomes (ELOs):

1. Students understand basic concepts of statistics and probability.

2. Students comprehend methods needed to analyze and critically evaluate statistical arguments.
3. Students recognize the importance of statistical ideas

Course materials

Main References:

1. **[SS] The Statistical Sleuth: A Course in Methods of Data Analysis by Ramsey F. and Schafer D. (2012), 3rd Edition, Cengage Learning, ISBN-13:978-1-133-49067-8**
 - This text is required for the second half of the course and is also used in STAT 5302, the second course in the Intermediate Data Analysis sequence. STAT 5301 will cover Chapters 1-6 of the book.
2. **[IPS] Introduction to the Practice of Statistics (5th Edition onwards) by D.S. Moore and G.P. McCabe**
 - This book is not required but may be useful as a reference for the first half of the course. We will only cover Chapters 1-9 of this book.

Access this eBook through the **CARMENBOOKS reader link** in the course navigation of your Carmen course for this class.

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

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/>) to illustrate certain aspects. Here is the information for obtaining R.
 - 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 <https://posit.co>. **Note that RStudio requires R to be installed.**
- It may be helpful to become familiar with the (free) R Markdown authoring framework as you take this class; its use is required in future courses in this sequence. An online guide with overview information can be found at <https://rmarkdown.rstudio.com>.
- **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 Website: Important announcements, course materials, homework problems, computing references, and other information about the class are posted on Carmen (carmen.osu.edu, login with your web ID)

Course Schedule

Plan for STAT 5301 Summer 2025 (updated May 05, 2025)

*tentative - subject to change

Week	Date	Topic to be covered*	Recommended Textbook Reading	Assignments
Part 1: Exploratory data summary tools and probability				
1	May 6-9	1. Exploratory data analysis (1): graphical summary tools; R basics (1)	IPS 1.1-1.2	
		2. Exploratory data analysis (2): numerical summary tools; R basics (2)	IPS 1.3-1.4	
2	May 12-16	3. Simple linear regression	IPS 2.1-2.5, 2.7	HW 1 due (Friday at 11:59pm)
		4. Data collection: sampling and experimental design	IPS 3.2-3.4	
3	May 19-23	5. Probability (1): basic concepts and rules; conditional probability	IPS 4.1-4.2, first 2 topics of 4.5	
		6. Probability (2): random variables (types, distributions); expectation; variance	IPS 4.3-4.4	
4	May 26-30	7. Probability (3): sampling distributions; large sample distribution; CLT	IPS 5.1-5.2	HW 2 due (Friday at 11:59pm)
	Friday, May 30th	Midterm 1 - Proctored Online using Honorlock on Carmen (1 hour 45 minutes)		Available 8am - 8pm
Part 2: One and two sample inferences				
5	June 2-6	8. Confidence interval; concepts and interpretation	IPS 6.1, first part of 7.1, first part of 8.1	
		9. One sample Z test; concepts and steps; approx. Z test; use CI to test	IPS 6.2, 7.1, 8.1	
6	June 9-13	10. One sample t-test; power; abuse of tests; Bonferroni correction	IPS 6.3, 6.4, 7.1	HW 3 Due (Friday at 11:59pm)
		11. Two independent sample Z and t-tests (pooled);	IPS 7.2	
7	June 16-20	12. Unequal population variances: non-pooled t-test; F test	IPS 7.3	
		13. Robustness of the t-procedure; assumption assessment; data transformation	SS 3.2-3.3, 3.5	
8	June 23-27	14. Inference for proportions: two sample tests and CI; power calculation	SS 8.1-8.2	HW 4 due (Friday at 11:59pm)
	Friday, June 27th	Midterm 2 - Proctored Online using Honorlock on Carmen (1 hour 45 minutes)		Available 8am - 8pm
9	May 30- July 4	15. Nonparametric tests (one sample): sign/signed rank/permutation tests	IPS 15.2	
		16. Nonparametric tests (two sample): Wilcoxon rank sum/permutation tests	IPS 15.1 (and supplemental links)	
10	July 7-11	17. Pearson's χ^2 test for goodness-of-fit; contingency table	IPS 9.1-9.2	HW 5 due (Friday at 11:59pm)

Part 3: Multiple Comparisons				
11	July 14-18	18. Separate population mean model; one-way ANOVA	IPS 12.1	
		19. Multiple comparison: Bonferroni; Tukey-Kramer; Contrasts; Scheffe	IPS 12.2, SS 6.4	
12	July 21-25	20. Two-way ANOVA; interaction effect	IPS 13	HW 6 due (Friday at 11:59pm)
		21. General model comparison; summary of one-way multiple comparison	SS 5.3-5.4, 10.3	
	Monday, July 28, 2025	Final Exam - Proctored Online using Honorlock on Carmen (1 hour 45 minutes)		Available 8am - 8pm

Course Delivery

The course will consist of online lectures. In addition, there will be homework assignments, weekly discussions and exams. Lecture material, homework assignments and exams will be made available on Carmen. You will be responsible for studying the material that is assigned and reviewed in lecture. Sufficient time will be allotted to complete homework assignments. R statistical software will be used to complete aspects of the assignments. Knowledge of course content and its application will be assessed via two midterms and a final exam. Your knowledge of R will not be assessed on exams. However, you will be expected to be familiar with and know how to interpret R output reviewed in class and in lecture notes. The instructor will hold weekly office hours via according to the schedule provided.

Additional Contact Information

Email: Please begin subject with “STAT 5301”; use my OSU email morrison.1043@osu.edu and avoid using the Carmen email tool. In order to protect your privacy, all course email correspondence must be conducted using your valid OSU name.# email account: any email from a non-OSU account will not be answered. I will attempt to answer emails within 48 hours, however, due to the large volume of emails this may not always be possible. Before writing an email, check whether the question has already been answered in the syllabus, the notes, or the textbook. I will sometimes receive questions via email regarding homework problems or clarifications: if your question may be helpful to other students, I will anonymously but verbatim along with my answer in the Discussions section on the class Carmen page.

Extra help: The hours during which the GTA for our course will hold office hours can be found at the top of the syllabus. You can meet with the GTA for our course during his or her office hours to discuss questions you have about the course material, homework assignments, R, etc.

Grading

Assignment or category	Percentage
Discussion	10
Homework	20
Midterm 1	20
Midterm 2	20
Final Exam	30
Total	100

Assignment information

Homework:

There will be regular homework assignments (6). Homework must be uploaded to Carmen by the posted deadline on the day it is due (typically the beginning of class). Homework is not accepted by email. Late homework is NOT accepted, but the lowest homework score will be dropped. You are encouraged to work together on the homework, but do not copy any part of a homework. Each student must produce his/her own homework to be handed in.

Feel free to ask me for help after you have attempted the questions. The grader for the course does not have the time to provide detailed explanations on each question. To make up for this, I will try to prepare homework solutions detailed enough to allow you to understand how the question could be approached. Homework solutions will be available on the class web site.

Homework preparation rules: Homework should be uploaded to Carmen in PDF format. PDF scans of handwritten pages are acceptable. Put your name and the homework assignment number at the top of the first page. Number all pages consecutively. Submit the problems in order, making sure that the computer output and discussion are placed together (do not put the computer output at the end of the homework). Include both R code and output in your homework and make it clear what parts of the output are relevant and show how they answer the questions posed in the homework.

Academic Integrity and Collaboration for Homework: You are encouraged to work with other Stat 5301 students on homework and you may consult references both internal and external to the course material. **Each student must produce their own assignment to be handed in. Do not copy any part of another student's homework. You must list at the top of your homework your collaborators and any references (texts or other online materials) that you consulted. 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.**

Weekly Discussions:

There will be weekly discussions where you respond to a prompt based on the topics being covered that week. These are due at the end of the week.

Exams:

There will be two midterms and one final exam. Please see Course Schedule for the corresponding dates.

All exams are **closed book/closed notes** (except for the sheet of notes described next) – there are no make-up exams. You may use the number of 8.5x11 inch sheet of paper (both sides), with whatever facts, formulas, or explanations you find helpful, for each exam. Further details will be given in advance of each exam. A basic calculator is allowed – tablets, laptops, cellphones, and other communication devices are not. Statistical tables will be provided as needed.

Late assignments

Generally late assignments are not accepted. 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.

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 **7-10 days**.

E-mail

I will typically reply to e-mails within **48 hours on school days**. If you do not get a response within that timeframe, feel free to email again.

Attendance, participation, and discussions

Student participation requirements

- **Regular participation is required.** Please ensure that you are following along with the weekly lectures and completing assignments on time.
- **Checking for course emails and announcements: DAILY**
 - Important announcements will be sent through Carmen (using Announcements or email) so please make sure that you see those regularly -- e.g., that you check emails that are sent through Carmen and that you receive notification of announcements. You can look at your Settings in Carmen to verify that you receive appropriate notifications.
- **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: OPTIONAL, BUT STRONGLY ENCOURAGED**
 Attending my office hours is optional, but is a good way to stay connected to the course and ask questions.

Gen AI use



*In this course, students are welcome to explore innovative tools and technologies, including generative artificial intelligence (GenAI). Students are permitted to use GenAI tools for most course assignments, **except for exams**. Your written assignments, including homework, should be your own original work.*

GenAI can be a helpful resource for drafting creative content, brainstorming ideas, creating a “reverse outline” from a rough draft, and enhancing productivity. Yet it is essential to approach its use thoughtfully and ethically. If you use GenAI in any of your assignments, please include the following statement with each assignment:

- 1. Application Used: Specify the GenAI application or tool you used (e.g., Copilot, ChatGPT, Claude AI, Gemini).*
- 2. Intended Purpose: Describe the purpose for which you used GenAI (e.g., idea generation, content creation).*
- 3. Quality of Initial GenAI Output: Evaluate the initial output generated by GenAI. For example, was it accurate, biased, coherent, and/or relevant?*
- 4. Iteration and Refinement: Explain how you revised prompts or adjusted parameters to refine the GenAI output. Did you experiment with different input prompts to improve the output?*
- 5. Incorporation in Completed Assignment: Reflect on how you incorporated the GenAI-generated content into your assignment. How did you edit, adapt, or combine it with other ideas?*

While GenAI can be a valuable tool, remember that academic integrity remains paramount. You are responsible for developing and articulating your own ideas, so addressing how GenAI contributed to those ideas (as you would for any sources you use) is centrally important to your learning. Attribute GenAI-generated content with proper citations and avoid plagiarism. Additionally, consider the accuracy of information incorporated in your assignment and the ethical implications of using GenAI in educational contexts. You are responsible for ensuring that the information you submit based on a GenAI query does not contain misinformation, unethical content, or violate intellectual property laws. Submission of GenAI-generated content as your own work is considered a violation of Ohio State’s [Academic Integrity](#) policy and [Code of Student Conduct](#) because the work is not your own. The use of unauthorized GenAI tools will result in referral to the [Committee on Academic Misconduct](#). If I suspect that you have used GenAI inappropriately on an assignment for this course, I will ask you to communicate with me to explain your process for completing the assignment in question.

Privacy Considerations: Students should familiarize themselves with the Terms of Use for the GenAI service they use, as well as the service’s expectations around data privacy and use. Students should not share private or sensitive information about themselves or others with GenAI services. As indicated in Ohio State’s February 2024 Security and Privacy Statement on Artificial Intelligence, “[u]niversity community members should not enter any institutional data that is categorized above the S1 (public) level into generative AI tools, except when using the protected environment of Copilot, meaning that you logged in with your university credentials and see the green ‘Protected’ button in the upper right-hand corner. Even when using the protected version of Copilot, it is best practice to put only S1 or S2 (internal) institutional data into the tool. S3 (private) and S4 (restricted) data should not be entered into any AI platform.”

Please contact me if you have questions regarding this course policy.

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.

- **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.)

Academic integrity policy

Academic integrity is a shared responsibility. We want to have a supportive and fair learning environment for all students. If you find yourself struggling with the course material as the semester proceeds, reach out to me or to the other teaching staff for extra assistance. Attend office hours. If you are struggling on homework assignments or quizzes, reach out to me or to other students for help. Violations of academic integrity standards on the part of even a single student can have negative repercussions for all students. For example, if we detect evidence of cheating on exams, not only will the procedures for investigation of academic misconduct be pursued for any involved students, but it may also result in more stringent administration of subsequent exams. **Please help us to maintain a positive and fair learning environment for all students by adhering to these policies for academic integrity.**

Policies specific to Homework, quizzes, and exams are detailed in the **Assignment Information** section.

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 3335-5-48.7 (B)**). For additional information, see the **Code of Student Conduct**.

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.

I expect that you will read and follow the guidelines and requirements for campus safety, which are available at <https://safeandhealthy.osu.edu>.

If you are unable to attend or participate in class for an extended period of time due to illness or quarantine, please let me know as soon as possible and we will make arrangements.

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>.

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

Accessibility accommodations for students with disabilities

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 ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness

interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

Religious Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the [Office of Institutional Equity](#). (Policy: [Religious Holidays, Holy Days and Observances](#))

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](tel: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](tel:614-292-5766) and 24 hour emergency help is also available 24/7 **by dialing 988 to reach the Suicide and Crisis Lifeline**.

Disclaimer

This syllabus should be taken as a 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.