STA 672: Modeling and Study Design
Fall 2024

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Bulletin Description

Introduction for graduate students to various methods of data analysis, forecasting, and building and use of computer simulation and optimization models for analysis and solution of environmental problems.

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Prerequisites

<u>Bulletin listed prerequisite</u>: basic course in statistics and admission to IES or permission of instructor.

<u>Contextual prerequisites</u>: familiarity with computers (file directories), an intro statistics course that covers two-sample inference (*i.e.*, the t-test) and the basics of linear regression (simple linear regression will suffice) are expected.

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Section and Instructor Information

STA 672 Instructor

- Instructor: **Tom Fisher**
- Email: *fishert4@miamioh.edu*
- Office hours: TBD
           (via Zoom or in person, schedule appointment)
- Home Page: https://tjfisher19.github.io/

Detailed Class Description

This is a second course in statistics designed for graduate students looking to improve their quantitative skills. Most of the semester is spent learning experimental design and analysis, and regression analysis. Near the end of the semester we will discuss some other modeling types and sample survey design and analysis.

What this class is	What this class is NOT
- Data Analysis! - This course is the application of statistics - We will be performing the analysis as is done in modern practice - on a computer! - Coding - typing commands into a computer - Modern statistical analysis is done on a computer - Coding provides reproducible results - Point & click software is useful but has limitations - Cost $$$, limited functionality, lacks customization - Statistical methods for those working in the sciences - Many contextual examples and analysis types covered - Discipline agnostic, but expect an environmental flare	- Stat Theory - Some mathematical/theoretical background will be provided but... - the focus of the course is on application - Programming - You will need to learn to code but we are not programming - We will be using software, not creating it - A computer science course - We will not be building data structures - We will not be mathematically analyzing algorithms - An advanced statistics/data science/analytics class - Do not expect to learn "machine learning" here - We will introduce the framework to learn those topics

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Class Topics

The class can essentially be decomposed into **four primary units** or modules.

Introduction to analysis in R and Experimental Design (~4 weeks)

- Review of Intro Stat methods, but in R using scripts and Quartro (replacement of RMarkdown)
- Analysis of Variance (ANOVA)
- Introduction to Experimental Design
  - One and two factor designs
  - Blocking
  - More complicated designs
- Random Effects models

Linear Regression Modeling (~5 weeks)

- Defining the multiple regression model
- Inference on regression
- Residual diagnostics
- Bridging ANOVA and regression
- Cross-validation and the ideas of *machine learning*

Generalized Linear Models (~3 weeks)

- Statistical odds and non-measured responses
- Logistic regression and other regression approaches
- Validation studies and forecasting

Survey topics & stochastic modeling (~2 weeks)

- Survey sampling ideas
- Using simulation to gain insight into a system
- Power Analysis

Caution / Advice:

- Concepts in this course build up over a semester and very much build off probability theory and statistical modeling. If you do not understand a concept early in the semester, then you will find you have a poor foundation for learning more complicated concepts.
- Keep current and do not fall behind.
  - If you find yourself struggling, seek help!

Connections to STA 363

STA 363 is an undergraduate course required for the BS in Data Science and Statistics and the BA in Data Analytics. The course is also required for the minor in Statistical Methods, which is very popular for students studying the biological and earth sciences. The overlap in curriculum between STA 363 and 672 is substantial. As such, we will be using some STA 363 materials as a supplement to our class materials.

Class Format

This class is taught in a way that essentially blends STA 401 and 463 type teaching. Some days will be note-heavy and fairly *mathy* while other days will be very applied and we will use the computer throughout. I will announce dedicated "lab" days in advance but we may use the computer on any given day to demonstrate a concept of theory discussed in that class.

In-class activities, Quizzes and Small Group Activities

This class is interactive and most days we will be using the computer to perform analysis. Expect regular in-class or "lab" assignments in this course (I'd expect about half of our class meetings will have an assignment). Some may be graded for completion while others for accuracy. Most in-class assignments will be in the form of a statistical analysis and answering questions about it. But we may also have other assignment types such as mini homeworks and short quizzes. These assignments are to assess the class's learning and adjust the curriculum, or its pace, if necessary. Each individual assignment is low stakes, but the accumulation of assignments will have a meaningful impact on your grade. In some of these activities/assignments you may be encouraged to work together in groups as, not only will it help you learn from each other, it is reminiscent of how modern analytics is performed in industry.

Homeworks

Homeworks will be assigned throughout the semester (anticipating *upwards of 7* assignments) to assess your overall comprehension of the material (coding and analysis). The first assignment will be given in the first few days and there is an ungraded Homework #0. Graded homework will be due about every week to two weeks. Late homework will **not** be accepted unless granted **prior** permission from the instructor.

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Data Analysis Project

In lieu of a final exam, each student will complete a data analysis project. The details will be determined at a later time. There may be several milestones/grades comprising this project and before the final product is submitted during final exam week.

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Mid Semester & Final Evaluations

There will be two mid-semester exams in this class, one roughly covering experimental design and basic regression (Modules 1-4) on Wednesday, September 29, and one at the conclusion of the regression material (Modules 5-8) on Monday, November 15. There will be no final exam.

This course is meant to cover both the statistical methods and their application, so the format should be expected to be a mix of traditional exam with a take-home portion. You can bring one formula sheet (front and back) for each exam. If extenuating circumstances require you to miss an exam, let me know at least a week in advance and we will work something out.

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Class Materials

We will be using the computer in every class. You will need access to a computer to complete this course. Any of the major operating systems (Windows, Mac or Linux) is acceptable. A small notebook may be useful to take notes in class. Please complete Homework #0 as soon as possible.

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Course Textbook

There is **no required textbook** for this course but we will be using material from several sources.

[Forecasting: Principles and Practice](#) by Hyndman and Athanasopoulos (online text)

Time Series Analysis: With Applications in R by Cryer and Chan (book)

Introductory Time Series with R by Cowpertwait and Metcalfe (book)

Note about textbooks: the application of time series analysis has evolved greatly since I was a student so many printed books connected to specific software (e.g., those with "in R" or "in SAS" or "in Python") quickly become outdated. However, the theory of time series (specifically what is covered in this course) has not changed drastically in the last 30 years, so pretty much any textbook would be helpful in understanding the theoretical foundations of the course.

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Backup

No allowance will be made for computer or network failures. Be sure to back up your work frequently, and do not wait until the last minute to complete the assignment. To back up a file, save it first to one computer drive such as your UDS / M drive or the hard drive of your home computer, and then save it again to a portable drive. Do not trust that a thumb drive is sufficient. Email to yourself is a simple option. Use Google Drive, campus drives or github.

Software

In this course we will be utilizing R and RStudio. You can download both pieces of software for free from:

- http://cran.r-project.org/   [R language - select local download mirror]

- http://www.rstudio.com/   [Integrated Development Environment - great choice for using R!]

Countless resources are available for help in using R - Google "R Tutorial" and check out Youtube for examples.

Please complete Homework #0 as soon as possible.

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Discussion Boards

The discussion boards on Canvas are available for you to post questions, discussions and to help your fellow classmates. Please note that the posting of solutions is in violation of the academic integrity code. Those postings will be deleted and students may be prosecuted for a violation of academic integrity standards. The boards are activated as a way to communicate with your classmates.

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Notable Dates on Calendar

Date(s)	Topic
Mon, Aug 26	Classes begin
Mon, Sep 02	Labor Day -- **no class**
Fri, Sep 13	Last day to drop without a "W"
Sep 27 (TBD)	Approximate date for Midterm Exam #1
Mon, Oct 07	Midterm Grades due

	Deadline to register to vote in Ohio
Fri, Oct 11	Fall Break – **no class**
Mon, Oct 28	Last day to drop with a "W"
Thu, Oct 31	**Last day to apply for May Graduation**
Tue, Nov 05	General Election
Mid November	Midterm Exam #2
Wed, Nov 27	Start of Thanksgiving Break -- **no class**
Thu-Fri, Nov 28-29	University closed -- **no class**
Fri, Dec 06	Last Day of Classes
Dec 09– 13	Final Exam week (Assessment TBD)

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Attendance policy

Students are expected to attend class every day. The format of the class is such that lectures are interactive (students will actively code, following along with the instructor). Further, there will be upwards of fifteen "in-class" assignments, quizzes and activities. Missing class regularly does not bode well for success in this class.

Miami University recognizes that students may have religious observances that conflict with class sessions. Students need to provide written notification of class session(s) that will be missed due to these observances. Notification must be at least one week prior to the

holiday date when class will be missed. Please see the [University Class Attendance policy website](#) for the detailed policy and the current [list of major religious holidays and celebrations](#). Additional information may be found on the [Student Life website](#).

In accordance with the [Miami University Class Attendance policy](#), students who are absent from class to such an extent as to make the student's work inefficient or to impair the morale of the class will be dropped from the course.

Reasonable accommodations may be made when a student is absent and the instructor is provided advanced notice.

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Student & Instructor Expectations:

You, as a student, should try your best to:

- Attend every class.

- Check the Canvas class site at least once per day during the workweek.

- Check your Miami email every 24 hours (more often if you have sent an email to the instructor or a classmate)

- Read Announcements that are sent via Canvas. Check Announcements on Canvas before emailing your instructor, as the information may have already been posted.

- Post questions you have about the course in the Discussion Forums. If you can answer another student's question, without violating the academic integrity policy, please feel free to do so.

- Actively participate in all class sessions, discussions, assignments, and other activities required in this course.

- Post your ideas and assignments; react to others' ideas, and exchange thoughts with fellow students and the instructor.

- Complete any readings in a timely manner so you can get help if needed.

- Submit assignments at the very least by their due date/time.

- Spend at least 6-9 hours a week outside class, studying, reading from supplemental sources, and completing assignments.

- Submit work that demonstrates a clear understanding of the material.

- Ask questions if you don't understand!

- Keep an open mind regarding the material and the opinions of others.

- Notify the instructor, in a timely manner (within 24 hours), if you have any problems.

The instructor will try his/her best to:

- Check the Canvas class site every day to monitor progress.

- Check email at least twice a day, Monday through Friday.

- Respond to all emails within 24 hours (except on weekends).

- Post all grades within 7 days of assignment due dates, except for homeworks which may require up to 2 weeks.

- Make every effort to meet with students who request a meeting.

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Academic Integrity

Academic Integrity is at the heart of the mission and values of Miami University and is an expectation of all students. Maintaining academic integrity is a reflection of your character and underpins your learning and understanding of the course material.

According to the Miami University Student Handbook, "Academic dishonesty is defined as any activity that compromises the academic integrity of the institution or subverts the educational process."

Examples of academic dishonesty include but are not limited to:

- Referencing outside sources or course notes while taking an exam.

- Referencing non-permitted websites while taking a quiz

- Collaborating with another person in any way while taking a quiz or exam

- Copying someone else's solutions to a problem and submitting it as your own work

- Posting class material and assignments to sites not affiliated with Miami University

- Plagiarism - Using another's ideas without citation and calling them your own

- Using Artificial Intelligence to complete an assignment when not permitted

All Miami University policies concerning academic integrity apply to this course. See the Student Guide to Academic Integrity for details.

Suspected Dishonesty: Any suspected instances of academic dishonesty will be handled under Miami University's Academic Integrity policy. It is a student's responsibility to read this policy. Lack of knowledge or understanding of the appropriate academic conduct is not an excuse for committing academic dishonesty.
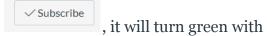
Students who are found responsible for committing academic dishonesty will receive a sanction that ranges from a zero on the assignment to an F in the course, which could contain the AD transcript notation. Students who are found responsible for committing two acts of dishonesty (academic or Code of Student Conduct section 102 (Dishonesty)) automatically will be suspended from Miami University.

Students should act honestly in the completion of all course assignments, and ask the instructor for clarification on any assignment guidelines that are not clear.

Communication Guidelines & Netiquette

Announcements: Please subscribe to the Course Announcements so you can be automatically notified about important information through your email. To subscribe for auto-email notifications, click on the subscribe button. ✓ Subscribe , it will turn green with "subscribed", ✓ Subscribed .

Discussion Forum: This is the place to ask questions about course content, homework, and "in-class" assignments. General questions about the course should also be asked here so that all students may benefit from the answers. Check here for answers to your questions before sending an email to the instructor or graduate assistants. Questions you do not wish to share with the class should be sent directly to your instructor.

Contacting Your Instructor: Email is the best way to reach your instructor. However, if you would prefer to have a conversation, you may speak to your instructor during office hours or send your instructor an email to set up a time to meet. Given today's ease of communication, it is your responsibility to contact your instructor within 24 hours if you are having any problems. While instructors will attempt to answer emails quickly, it may take up to 24 hours (or longer on weekends) for you to receive a response. Many faculty receive over 50 emails a day. We ask that you put "STA 483: *summary of your email*" in the subject line of your email to help sort; we will try to do the same with announcements and emails.

Communication Guidelines: Email is the official mode of communication for the University. You are responsible for any communication that is sent to your Miami email account, so please be sure to check your account frequently. If you have your email forwarded to your preferred account, please be sure you have enough server space for your Miami emails and please check to see that your server will accept Miami emails.

You will be asked to communicate with other students in this class via email. You may access email tools on the Canvas class site. All group members are responsible for initiating contact with one another as soon as the assignment is opened. Failing to make contact with your group members is not an excuse to miss completing an assignment.

Netiquette:* Diversity has many manifestations, including diversity of thought, opinion, and values. We encourage **all learners to be** polite and **respectful** of that diversity and to refrain from inappropriate or offensive commentary. If inappropriate or offensive content is either emailed or posted on the class site, we may recommend college disciplinary action. Students guilty of academic

misconduct, either directly or indirectly through participation or assistance, are subject to disciplinary action through the regular procedures of Miami University. Learners as well as faculty should be guided by common sense and basic etiquette. Criticism should be presented in a positive light. The following are good guidelines to follow:

- Be professional in your correspondence with the instructors and with other students.

- Never post harassing, threatening, or embarrassing comments.

- Never post content that is harmful, abusive; racially, ethnically, or religiously offensive; vulgar; sexually explicit; or otherwise potentially offensive.

- Never post, transmit, promote, or distribute content that is known to be illegal.

- If you disagree with someone, respectfully respond to the subject, not the person.

- Treat others as you would like to be treated.

- It can be difficult to communicate emotion in email, so use emoticons such as 🙂 or ;-) when appropriate.

- Be timely in your communication with others.

- Be as brief and succinct as possible.

- Include a descriptive subject line in all emails.

- Use proper spelling and grammar.

- Cite sources appropriately including URLs of sites you use for code inspiration.

Remember that "tone" can usually be detected accurately in verbal communication, but often can be misunderstood in electronic communication. Because of this phenomenon, we encourage you to err on the side of politeness.

*adapted from Regents Online Campus Collaborative

For more information on netiquette check [Netiquette Rules for Electronic Communications](#).

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ADA & Students with Disabilities

Miami University is committed to ensuring equal access to students with disabilities. Miami's Office of Student Disability Services (SDS) assists students with determining eligibility for services and accommodation planning. Miami's AccessMU provides resources and guidance toward equal opportunity for all individuals. Refer to Miami University's [Accessible Technology Policy](#) for definitions and additional information.

Students who are entitled to disability-related academic adjustments, auxiliary aids, etc., must register with SDS to receive accommodations in university courses. Please understand that formal communication from SDS must be presented prior to the coordination of accommodations for this course. For more information, see [Student Disability Services](#) and/or [the Rinella Learning Center](#). Students may also contact SDS at (513) 529-1541 or via email at sds@miamioh.edu.

If you have a disability, please contact me, and I will be glad to make any necessary accommodations.

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Diversity & Discrimination

All Miami University policies concerning diversity and equal opportunity will be upheld in this class.

> Miami University is a community dedicated to intellectual engagement. Our campuses consist of students, faculty, and staff from a variety of backgrounds and cultures. By living, working, studying, and teaching, we bring our unique viewpoints and life experiences together for the benefit of all. This inclusive learning environment, based upon an atmosphere of mutual respect and positive engagement, invites all campus citizens to explore how they think about knowledge, about themselves, and about how they see themselves in relation to others. Our intellectual and social development and daily educational interactions, whether co-curricular or classroom related, are greatly enriched by our acceptance of one another as members of the Miami University community. Through valuing our own diversity, and the diversity of others, we seek to learn from one another, foster a sense of shared experience, and commit to making the university the intellectual home for us all.

Please see the [General Bulletin](#) for more information.

Miami University is committed to providing equal opportunity and an educational and work environment free from discrimination on the basis of sex, race, color, religion, national origin, disability, age, sexual orientation, gender identity, military status, or veteran status. Miami shall adhere to all applicable state and federal equal opportunity/affirmative action statutes and regulations.

Please see the Miami University policies regarding discrimination and harassment for more information.

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Resources and Support for Students

As an instructor, I have a duty to report. This means I am required to promptly report to the Deputy Title IX Coordinator (titleix@miamioh.edu or 513-529-1870) any information a student shares with me regarding harassment, discrimination, sexual misconduct and interpersonal violence, or retaliation. A report does not initiate an investigation. It engages a discussion of your resources, supportive measures, and options available. If students want to speak with someone confidentially, they can speak with Student Counseling Services, Student Health Services, and an advocate with Women Helping Women.

Speaking with a confidential resource person does not preclude students from making a formal report to the University if and when they are ready.

https://miamioh.edu/diversity-inclusion/programs-resources/report-incident/index.html

For more information, please visit https://miamioh.edu/campus-safety/sexual-assault/ and https://www.miamioh.edu/diversity-inclusion/oeeo/index.html.

COVID-19 Policies and Illness Considerations

Students, faculty or staff should **not come to campus when ill** or under orders from the Butler County General Health District to isolate because of a diagnosis or quarantine because of close contact with someone who tested positive for COVID-19. However, students are ultimately responsible for material covered in class, regardless of whether the student is absent or present. Instructors are not expected to create a facsimile of in-class instruction, but should identify reasonable ways to accommodate the absence and may wish to make some or all of their office hours remotely accessible to assist in this accommodation. If your absence is of significant duration or

severity, as your instructor I will advise you about other options that might be available including assigning an incomplete grade or requesting a medical withdrawal.

Currently, there is no universal mask requirement on campus at this time. The University asks members of the community to honor an individual's request to wear a mask in their space. Face masks have been shown to be an effective means of limiting the spread of COVID-19 and other airborne viruses.

Final Grade Calculation

At the conclusion of the semester, final grades will be compiled using the following point distribution:

Item	Contribution to Final Grade
Labs, in-class Assignments & quizzes • Expect regularly (at least once a week but likely more) • Quizzes would be short • In-class assignment may be interactive with peers • In-class assignments may extend to short-term homework	20%
Homework • More in-depth application of covered material • Some may be challenging	30%
Mid Semester Exam #1 • In class portion (assess understand of analysis) • Take home portion (assesses coding)	15%
Mid Semester Exam #2	15%
Data Analysis Project (in lieu of Final Exam)	20%

Grading Scale

A+ = [97, 100]   A = [92, 97)   A- = [90, 92)

B+ = [87, 90)   B = [82, 87)   B- = [80, 82)

C+ = [77, 80)   C = [72, 77)   C- = [70, 72)

D+ = [67, 70)   D = [62, 67)   D- = [60, 62)

F = [0, 60)