Version: 2/6/2024

Introduction to Quantitative Analysis

DACSS 603

University of Massachusetts Amherst

Spring 2024

Course Time	**Tuesday & Thursday** 4:00 – 5:15 pm	**Multimodal Course Venue**	**University/Synch: Machmer W-13** **UWW/Async: Zoom**
Instructor:	Erico Yu(him/his)	**Class Assistant:**	**TBD** **Hours: TBD**
Office	257 Bartlett Hall	**Office Hours:**	Tuesday & Thursday 12:30 – 3:30 PM EST (Calendly), and by appointment
Course Website	Canvas Google Classroom (Backup)	**Online Participation**	Piazza

Resources:

Graduate Student Services | DACSS | Disability & Accessibility

[1. Course Description]

This course serves as a rigorous introduction to quantitative empirical research methods, designed for doctoral students in the social sciences and master's degree students with a data analytics or computational social science focus.

The course will start from basics of probability and hypothesis testing, spend a considerable amount of time on simple and multiple linear regression, and cover some more advanced topics like logistic regression and generalized linear model. At times, we'll take a step back and take a critical look at conventional ways of doing statistics and talk about the replication crisis, problems with p-values, limitations of null hypothesis testing and so on. Simulations and data analysis will be conducted in the R statistical environment.

[2. Learning Objectives]

Upon completion, you will be able to understand, evaluate, and criticize the use of common statistical methods for social science research. The course will also serve as a useful basis for more advanced research methods courses.

[3. Prerequisites]

Basic knowledge of algebra, sets, functions, and probability is assumed. More advanced mathematics will be introduced as needed for those who may not have encountered such material previously (and as review for others), but we will focus on conceptual understanding and enhancing our ability to read mathematical notation in papers. It is best to have had some exposure to R prior to this class, preferably at the level of DACSS 601 Introduction to Data Science, but it is possible to succeed without this background if you are willing to put in extra work towards the beginning of the semester.

[4. Textbook]

The main textbook is a free online book:

- *[EwR] Hanck, C., Arnold, M., Gerber, A. & Schmelzer, M. (2021) Introduction to Econometrics with R.*

Other books that we may use excerpts from:

- *[LSR] Navarro, Danielle. Learning Statistics with R.*
- *[ISLR2] James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An Introduction to Statistical Learning.*
- *[ALR] Weisberg, S. (2014). Applied Linear Regression*
- *[SMSS] Agresti, Alan. Statistical Methods for the Social Sciences. 5th Edition. Pearson, 2018. (pdf of relevant chapters in Google Classroom)*
- *[RaOS] Gelman, A., Hill, J., & Vehtari, A. Regression and Other Stories. Cambridge Univ. Press, 2020. (pdf of relevant chapters in Google Classroom)*

[5. Course Meetings, Website and Technology]

Course Meetings & Schedule:

- **Lecture & Recorded Video:** Our synchronous lectures will be held in person every Tuesday and Thursday from 4:00 PM to 5:15 PM at Machmer Hall room W-13. Additionally, for your convenience, we will also provide an online option for these lectures via Zoom.
- **Weekly Review Meeting for the UWW/Asynchronous Session:** TBD; Will be announced based on request.

Note: The weekly review meeting is primarily tailored to UWW/online students who primarily attend the course asynchronously (watching recorded class lectures) and provides them a time for a quick wrap-up on each week's lectures and interaction/Q&A with the instructors.

BUniversity/Synchronous students are also welcome to attend.

Weekly Feedback and Questions

Students use Google Form to provide feedback and ask questions about course material every week. The instructor will address these questions in the following week.

Course Website/LMS:

All classroom material will be posted on **Canvas**. For students who are not formally enrolled or do not have the access to Canvas at the moment, you can check out the course materials through **Google Classroom**. You will be submitting assignments and feedback and grades will be given via **Canvas**.

In the future weeks, we will also be using Piazza for after-class discussion and Q&A.

Technology/Software (Updated 9/6/2023):

R and RStudio: We will primarily use R and RStudio for this course. Both software applications are freely available online. You can find a comprehensive installation guide on this website.

Alternative platforms to local R and RStudio:

- **Posit Cloud: 25 hours compute time per month for Free Plan.**
- **Google Colab: not available to run Quarto for publishing files.**

If you do not have much prior knowledge or experience of using R, here are some useful resources and books to get you started and/or more your forward:

- The book we use in DACSS-601 for R introduction and practice: R4DataScience(2nd edition)
- Resources via UCLA: https://stats.idre.ucla.edu/r/
- I often find that my search for help with a particular task leads me to: Quick-R
- Many have found stack overflow invaluable: https://stackoverflow.com/questions/tagged/r

Online Platforms: In addition to R and RStudio, we will utilize several online platforms. All of these platforms are freely accessible online.

- Canvas
- Google Classroom: This platform will be the mirror of Canvas, storage tutorials and quizzes responses, and backup for course materials and announcements.
- Piazza: Piazza will serve as a discussion forum for course-related queries and discussions.
- GitHub: not required, but highly recommended to work on your final project.

Technical Support: Please note that the instructional team cannot provide extensive support for software installation or general computing issues. We will offer limited hands-on debugging assistance during lab meetings and drop-in office hours. If you encounter any issues while installing R, we recommend creating a free RStudio Cloud account. This will allow you to continue your work while seeking assistance from experts to resolve installation problems.We also recommend that students work in small groups and support each other as much as possible during class.

[6. Course Assessment and Feedback]

Final grades will be based on:

- **Attendance and Participation (10%):**
  It is imperative that students actively and regularly participate in class discussion. Participation does not need to reflect expertise; rather, students should seek to both ask and answer questions regularly and in equal proportion. The main form of synchronous participation will happen both in class and on Zoom, where students ask and answer questions during lectures. Asynchronous participation will happen through Piazza, where students are expected to regularly ask and/or answer questions about R, statistics, lectures, readings and so on.

- **Quizzes (10%):**
  There will be a short take-home quiz most weeks to ensure key concepts from that week are understood. They will serve as feedback for you and for me. They will be auto-graded, mostly multiple choice questions. Quizzes can also include questions from that week's **tutorial**.
  There will be an R tutorial most weeks to help you with mastering the R functions and concepts necessary to complete the upcoming homework assignment. Tutorials are not themselves graded but questions from the tutorial will appear in the quiz. Completing the tutorials will make it a lot easier for you to complete the homework.

- **Homework (40%):**
  There will be a homework assignment approximately every two weeks. The assignments will be made up of exercises to help you better understand concepts and methods covered during class. Collaboration is acceptable, but please write up your own answers; do not hand in identical written responses. The assignments should be completed using R and rendered into websites using Quarto { a scientific and technical publishing system that allows for easily integrating narrative text, equations, figures, code, and output from code into a single document. Quarto not only renders qmd les, its native format, but is able to render most R Markdown (.rmd) and Jupyter notebook (.ipynb) files. Authoring

your documents in .qmd is recommended. For information on Quarto visit https://quarto.org/.

- **Final Project (40%):**

  The final project will be in the form of a poster presentation of a data analysis project. The poster should be accompanied by a replication folder that includes the code and data to create the figures and tables in the poster, ideally put together in a .qmd file.

  The final project may be done in groups of maximum two people. Students who want to work as a group should let the instructor know in the first few weeks of the semester by email. Those working as a group should clearly identify each person's contribution at each stage of the project.

  It is important that students make progress on the final project throughout the semester. To ensure that this is the case, students will submit their progress in two check-in assignments during the semester and use feedback from them to prepare the final poster.

Final letter grades are assigned using the University's Plus-Minus Grading Scale according to following rubric:
A (94-100%) A- (90-93%) B+ (86-89%) B (81-85%) B- (77-80%) C+ (74-76%) C (70-73%) F (Below 70%)

[7. Course Schedule]

The following course schedule may change to reflect our dynamic learning process.

Week	Date	Topics	Tutorial & Quizz	Suggested Readings
Week 1	Feb 1	Class Introduction		Syllabus
Week 2	Feb 6 & 8	Descriptive Statistics & Probability	• Tutorial#1&2 • Quiz#1	[EwR] Ch 2 [LSR] Ch 5, Ch 9 TBD [*RaOS*]
Homework 1 posted, due on Feb 22				
Week 3	Feb 13 & 15	Central Limit Theorem & Condence Intervals	• Tutorial#3&4 • Quiz#2	[EwR] Ch 3.1, 3.2, 3.4 [LSR] Ch 10
Week 4	Feb 20	Hypothesis Testing: One-sample T-test	• Tutorial#5 • Quiz#3	[EwR] Ch 3.3, 3.5-3.8 [LSR] Ch 11

	Feb 22	No Class. Follow Monday Schedule		
Final Project Instruction posted; Check-in#1 Assignment due on Mar 31				
Week 5	Feb 27	Two-sample T-test Final Project Check-in#1	• Tutorial#6 • Quiz#4	[LSR] Ch 14.1-14.3, Ch 12.2, 12.6 Additional Reading: Optional: [*RaOS*] Ch 4.3-4.7
	Feb 29	ANOVA & Chi-square		
Homework 2 posted, due on Mar 7				
Week 6	Mar 5 & 7	Regression Background and Simple Linear Regression	• Tutorial#7 • Quiz#5	[EwR] Ch 4, Ch 5.1, 5.2 [LSR] Ch 15.1, 15.2 [*RaOS*]Ch 1.1-1.3 (TBD) Optional: [*RaOS*] Ch 6
Week 7	Mar 12 & 14	Multiple Regression 1	• Tutorial#8 • Quiz#6	[EwR] Ch 6, Ch 5.3 Optional: [*RaOS*] Ch 7
Homework 3 posted, due on Mar 28				
Week 8	Mar 19 & 21	No Class: Spring Recess		
Week 9	Mar 26 & 28	Multiple Regression 2	• Tutorial#9 • Quiz#7	[EwR] Ch 7 Optional: [*RaOS*] Ch 10
Week 10	Apr 2 & 4	Transformations	• Tutorial#10 • Quiz#8	[EwR] Ch 8 Optional: [*RaOS*] Ch 12.4-12.5
Homework 4 posted, due on April 18				
Week 11	April 9 & 11	Assumptions, Diagnostics, and Model Evaluation	• Quiz#9	[RaOS] Ch 11 [SMSS] Ch 14.1 [ISLR2] Ch 2.2
Week 12	April 16 & 18	Regression with Binary and Ordinal Dependent Variable		[EwR] Ch 11 [SMSS] Ch 15.4 Optional: [*RaOS*] Ch 13 Ch 15.2-15.5
Homework 5 posted, due on May 2				

Week 13	April 23 & 25	Regression with Count and Categorical Dependent Variable		[ALR] Ch 12 [SMSS] Ch 15.5-6
Final Project Check-in#2 Assignment due on April 28				
Week 14	April 30 & May 2	Missing-data Imputation Or Intro to Multilevel Modeling (TBD)		[*RaOS*] Ch 17.3-17.5 (TBD) Or [*RaOS*] Ch 22.5 (TBD)
Week 15	May 7 & 9	Review & Wrapping Up for Poster Session or Additional Office Hours (TBD)		
Final Project Due Date: TBD				

[8. Course Policies]

Office Hours & Emails

My office hours are held either in person or via Zoom. If you know that you would like to come see me, I encourage you to sign up for a 30-minute slot through Calendly (you should be able to see my schedule and appointments).

You can always reach out to me by email. I try to respond to all email and phone messages within 48 hours during weekdays, but generally do not check and respond to email between 4pm on Friday and 10am on Monday. Also, please expect delay in responding to evening emails after 6pm.

Incomplete and Retake

Special note for those who retake the course this semester: the previous incomplete-and-retake policy applied between Summer 2021 and Spring 2023 is discontinued. You will need to pass DACSS-601 before you can effectively take other DACSS courses. In special circumstances where an incomplete is needed, a student needs to have completed 60% of their work for the term.

More information can be found on page 28 of the following document: https://www.umass.edu/registrar/sites/default/files/academicregs.pdf).

Pronoun & Communication

I take seriously my responsibility as a member of the UMass community. As a way to promote an inclusive environment for all of my students, I will refer to everyone using "they" as a gender-neutral singular pronoun in general situations. In the meantime, I will also accommodate you with your preferred pronoun.

Collaboration and Academic Integrity

I support collaboration and encourage you to work together with your peers in offering feedback on assignments. You are also encouraged to cite class discussions, conversations with peers, posted notes and any other material prepared by your classmates**. But all written work must be your own. Make sure to clarify and acknowledge collaboration with your peers, accurately represent your own contributions, and properly cite all sources.** Any suspected misrepresentation of your own original contributions—even if the result of carelessness—will be brought to the attention of me, DACSS, or the Academic Honesty Office and may result in a failing grade for the course.

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst.

Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. The procedures outlined below are intended to provide an efficient and orderly process by which action may be taken if it appears that academic dishonesty has occurred and by which students may appeal such actions.

Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent.

For more information about what constitutes academic dishonesty, please see the Dean of Students' website: http://umass.edu/dean_students/codeofconduct/acadhonesty/.

Late Submission & Extension Policy: Our late assignment submission policy allows for flexibility while maintaining accountability. Among the five homework assignments and 2 final project check-in assignments, students are permitted to submit three late assignments without prior notification or explanation. Any late submissions beyond the initial three, a deduction of 10% on that assignment will occur for every 24-hour period. Additionally, students have the opportunity to resubmit any three assignments for improvement and regrading.

[9. Additional Resources and Accommodations]

Statement on Disabilities

The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier free campus.

If you are in need of accommodation for a documented disability, register with Disability Services to have an accommodation letter sent to your faculty. It is your responsibility to initiate these services and to communicate with faculty ahead of time to manage accommodations in a timely manner. For more information, consult the Disability Services website.

Taking Care of Yourself

Grad school is difficult, pandemic or not, and I want you to pay attention to your physical and mental health. I encourage you to reach out to University Health Services at (413) 577-5000 if you would like help with anxiety, depression, or mental health issues. The emergency counseling line is (413) 545-2337. Reach out to the UMass Police Department if you are having problems with your basic security. Contact your department or program to assist with academic difficulties as a result of sexual assault or violence, as well as contacting faculty on behalf of the student.

Title IX Statement

In accordance with Title IX of the Education Amendments of 1972 that prohibits gender-based discrimination in educational settings that receive federal funds, the University of Massachusetts Amherst is committed to providing a safe learning environment for all students, free from all forms of discrimination, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and retaliation. This includes interactions in person or online through digital platforms and social media. Title IX also protects against discrimination on the basis of pregnancy, childbirth, false pregnancy, miscarriage, abortion, or related conditions, including recovery. There are resources here on campus to support you. A summary of the available Title IX resources (confidential and non-confidential) can be found at the following link: https://www.umass.edu/titleix/resources. You do not need to make a formal report to access them. If you need immediate support, you are not alone. Free and confidential support is available 24 hours a day / 7 days a week / 365 days a year at the SASA Hotline 413-545-0800.