Introduction to Econometrics

The University of Arizona
Department of Economics
ECON 418-518.001

Instructor:	William Brasic	**TA:**	ENTER TA
Instructor Office:	McClelland Hall Room 401A	**TA Office:**	TA Office
Instructor Office Hours:	Mon/Wed 12:00 P.M. - 1:00 P.M.	**TA Office Hours:**	ENTER TIME
Class Day/Time:	Mon/Wed 2:00 P.M. - 3:15 P.M.	**Term:**	Fall 2024
Class Location:	McClelland Hall Room 130	**Credit Hours:**	3
Class Email:	arizonaecon418@gmail.com	**Slack:**	slack.com/ECON418-518

COURSE DESCRIPTION

Statistical methods in estimating and testing economic models; model identification; hypothesis testing of model parameters; assumptions of classical regression model, problems caused by violating them, and possible remedies; binary response models; core principles of machine learning; machine learning algorithms.

STUDENT LEARNING OUTCOMES

- Broad knowledge of regression analysis relevant for analyzing economic data
- Interpretation and critical evaluation of the outcomes of empirical analysis
- Elementary procedures for model validation in the single equation context
- Theoretical background for the standard methods used in empirical analyses, like properties of least squares estimators and the statistical testing of hypothesis
- Perform statistical tests to investigate whether the classical assumptions in regression analysis are satisfied
- Qualified user of econometric methods
- Familiarity with machine learning terminology
- Knowledgeable in foundational machine learning algorithms and beyond
- Learn the R programming language for data science, econometrics, and machine learning
- Apply the R programming language to solve empirical problems

PREREQUISITES

A major or minor in Economics (ECONBA) or Business Economics (BNECBSBA); ECON/AREC 339 or BNAN 276; ECON 300 or ECON 361. Students must have good knowledge of: (1) probability; (2) statistics; and (3) calculus before entering the class.

TEXTBOOKS

The required textbooks for this course are:

- *Introductory Econometrics: A Modern Approach* by Jeffrey M. Wooldridge; Cengage Learning, 7th Edition (2019); ISBN13: 978-1337618519. Make sure you buy the version with MindTap as we will be using this software for assignments.

- *An Introduction to Statistical Learning with Applications in R* by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani; Springer, 2nd Edition (June 2023); ISBN13: 978-1071614174. This book is freely available online at https://www.statlearning.com/.

REFERENCES

For students looking to pursue graduate study in economics, typical first year econometric textbooks are:

- *Econometrics* by Bruce Hansen; Priceton University Press, 1st Edition (2022); ISBN13: 978-0691235899
- *Statistical Inference* by George Casella and Roger L. Berger; Thomson Learning, 2nd Edition (2002); ISBN13: 978-0534243128

If you are looking to bolster your mathematical background for the course, here are some good books:

- *Fundamental Methods of Mathematical Economics* by Alpha C. Chiang and Kevin Wainwright; McGraw-Hill, 4th Edition (2004); ISBN13: 978-0070109100
- *Matrix Analysis for Statistics* by James R. Schott; Wiley, 3rd Edition (2016); ISBN13: 978-1119092483

For those looking for a reference on probability and statistics:

- *Mathematical Statistics with Applications* by Dennis Wackerly, William Mendenhall, Richard L. Scheaffer; Brooks/Cole, 7th Edition (2008); ISBN13: 978-0495110811
- *Probability & Statistics for Economists* by Bruce Hansen; Princeton University Press, 1st Edition (2022); ISBN13: 978-0691235943

We will cover machine learning in this course. Some good resources are (the first one is excellent):

- *Machine Learning with PyTorch and Scikit-Learn* by Sebastian Raschka, Yuxi (Hayden) Liu, Vahid Mirjalili; Pakt Publishling, 1st Edition (2022); ISBN13: 978-1801819312
- *The Elements of Statistical Learning: Data Mining, Inference, and Prediction* by Trevor Hastie, Robert Tibshirani, and Jerome Friedman; Springer, 1st Edition (2009); ISBN13: 978-0387848570

STATISTICAL SOFTWARE

We will use R in this course. R is a language and environment for statistical computing and graphics, available as a free open-source software. It is one of the most popular computing languages for data science and statistics. The software is free and can be easily downloaded from the web at https://posit.co/download/rstudio-desktop/. Upon clicking this link, you'll want to first download R and then download RStudio which is a nice interface for R.

You can use any programming language (e.g., Python) you like for this class, but since this is a course in econometrics and R is extremely popular among economists and statisticians that is what I encourage you to use as well. Becoming good at R to the point you feel comfortable putting it on a resume will serve you very well when you go on the job market so I highly encourage you to spend the time learning it. There is an immense amount of tutorials, books, videos, and free courses available online, so Google is your best friend here. Moreover, the first homework will serve as a self-guided tutorial on how to use R. In my own experience, the most effective way to learn R is by tinkering with R on one's own. Also, always remember that virtually any questions you will ever have about coding in R have already been asked by someone else and answered on numerous R-help forums. Just google it (or use ChatGPT)!

STUDYING TIPS

To do well in the course, you need to study outside the classroom. First of all, read the lecture notes/materials and the textbook with a pencil in hand. Second, work through the examples contained in each chapter as well as the end-of-chapter problems. More generally, I urge you to study on a continuing basis.

The required textbooks listed on the front page of this syllabus should be read before each class period. You do not need to understand everything you have read, but you need to read the chapter before class so you have a base to work with. Note, there are things in the book that we will not cover or that the book

handles in a different way. It is always best to focus on what we cover in class when there are conflicts, but the book still offers a great base to what we will cover

COURSE GROUP CHAT (SLACK)

We will have a group chat for the course which will be through Slack. Slack is an app that be downloaded on your phone or accessed on your computer. It is a convenient way to communicate with people you are working with as it allows you submit files which can be read by everyone in the chat. You can also send direct messages to people. I will be actively on Slack each business day so please do take advantage of it. I encourage you to ask me questions via the Slack group chat rather than by email that way my responses can be seen by everyone. Also, this will be an avenue for you to discuss problems with your classmates. To join the Slack group chat, please click here or see the link on the first page of this syllabus. Upon joining, please use your first and last name as well as registering with your university email address.

GRADING POLICY

Item	Weight	Points
MindTap Assignments	30%	300
Homeworks	30%	300
Exams	40%	400

- There are 1,000 total points available for the class, excluding potential extra credit.
- Homeworks account for 30% (300 points) of your final grade. Homeworks will be due every few weeks. The due dates and those homeworks can be accessed via D2L. They are meant to get you to practice and review what is being covered in class. Homeworks not submitted or submitted after the due date will receive a 0.00%. These can be completed individually or with your classmates, but everyone must submit their own homework.
- MindTap assignments account for 30% (300 points) of your final grade. MindTap assignments will be due roughly every week. The due dates and those assignments can be accessed via D2L. MindTap assignments not submitted or submitted after the due date will receive a 0.00%. These can completed individually or with your classmates, but everyone must submit their own MindTap assignment.
- Exams account for 40% (400 points) of your final grade and each exam has roughly equal weight. There will be three total exams: exams one and two are worth 133 points each while exam three is worth 134 points. Each exam must be taken in-person and you are allowed to use a 8.5 x 11 inch sheet of paper (front and back) for the exam, but no electronic devices are allowed. Exams are to be completed individually during the designated class period. There are no make-up exams and you cannot take an exam early. If you arrive late to an exam and the first student has turned in their exam, you will not be allowed to take the exam. If you experience a prolonged illness that will cause you to miss multiple exams, you need to contact the course email account as soon as possible, as this could have an adverse effect on your final course grade without proper documentation.
- There will likely be extra credit given throughout the term. Extra credit may be given during class time or as out-of-class assignments. Any extra credit options will be offered to all students; there are no individual-specific sources of extra credit.
- Grading scale: 90.00% - 100.00% receives an A; 80.00% - 89.9$\bar{9}$% receives a B; 70.00% - 79.9$\bar{9}$% receives a C; 60.00% - 69.9$\bar{9}$% receives a D; 0.00% - 59.9$\bar{9}$% receives an E.

COURSE OUTLINE

In the course outline below,

- (E) refers to *Introductory Econometrics: A Modern Approach* by Jeffrey M. Wooldridge
- (ISL) refers to *An Introduction to Statistical Learning with Applications in R* by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani

Week	Day	Topic	Reading
1	26 August	Introduction to Econometrics	Chapter 1 (E)
	28 August	Math Review	Appendices A, B, C (E)
2	2 September	NO CLASS	
	4 September	Simple Linear Regression	Chapter 2 (E)
3	9 September	Simple Linear Regression	Chapter 2 (E)
	11 September	Linear Algebra	Appendix D, E (W)
4	16 September	Multiple Linear Regression	Chapter 3 (E)
	18 September	Multiple Linear Regression	Chapter 3 (E)
5	23 September	Inference	Chapter 4 (E)
	25 September	Inference	Chapter 4 (E)
6	30 September	Asymptotic Properties	Chapter 5 (E)
	2 October	Review/Catch Up	
7	7 October	EXAM 1	
	9 October	Multiple Linear Regression Model Selection	Chapter 6 (E)
8	14 October	Indicator Variables	Chapter 7 (E)
	16 October	Heteroskedasticity	Chapter 8 (E)
9	21 October	Failure of OLS Assumptions	Chapter 9 (E)
	23 October	Binary Response Models	Chapter 7.5, 17 (E)
10	28 October	Binary Response Models	Chapter 7.5, 17 (E)
	30 October	Review/Catch Up	
11	4 November	EXAM 2	
	6 November	Introduction to Machine Learning	Chapter 1,2 (ISL)
12	11 November	Introduction to Machine Learning	Chapter 1,2 (ISL)
	13 November	Resampling Methods	Chapter 5 (ISL)
13	18 November	Shrinkage Estimators	Chapter 6 (ISL)
	20 November	Classification	Chapter 4 (ISL)
14	25 November	Trees and Forests	Chapter 8 (ISL)
	27 November	Ensemble Learning	Chapter 8 (ISL)
15	2 December	Support Vector Machines	Chapter 9 (ISL)
	4 December	Unsupervised Learning	Chapter 12 (ISL)
16	9 December	Deep Learning or Treatment Effects	Chapter 10 (ISL)
	11 December	Deep Learning or Double ML	Chapter 10 (ISL)
17	TBD	EXAM 3	

DISPUTE OF GRADE POLICY

Disputes of grades received on homeworks, MindTap assignments, and exams must be submitted in written format with supporting documentation on why the grade in question should be changed. Any dispute must be submitted within 48 hours of when the marked grade was made available. The instructor will review the entire assignment, so it is possible that the grade will be changed positively, negatively, or not at all.

ABSENCE AND CLASS PARTICIPATION POLICY

Regular attendance is essential if you plan on doing well in this course. Students are responsible for all material presented in class and are expected to be present and participate in class discussion and activities. If for some reason you are absent, you are responsible for acquiring any notes and information you have missed. If you have questions, please come to office hours.

The UA's policy concerning Class Attendance and Participation is available at https://catalog.arizona.edu/policy/courses-credit/courses/class-attendance-participation.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. The student will receive attendance credit for that class period. Students on military deployment leave will also receive credit. See https://deanofstudents.arizona.edu/policies/attendance-policies-and-practices.

Compliance with University health protocols is expected. Students following University protocol for isolation will receive attendance credit for missed class periods. For COVID-19, student protocol can be found at https://covid19.arizona.edu/positive-case-protocol-students.

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable: http://policy.arizona.edu/human-resources/religious-accommodation-policy

If you anticipate being absent, are unexpectedly absent, or are unable to participate in class online activities, please contact the instructor as soon as possible. To request a disability-related accommodation to this attendance policy, please contact the Disability Resource Center. Their webpage can be found at https://drc.arizona.edu/.

UNIVERSITY POLICIES

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies.

CLASSROOM BEHAVIOR POLICY

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.). Any electronic devices should be used only for class-related activities.

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue disruption will be asked to leave class and may be reported to the Dean of Students.

THREATENING BEHAVIOR POLICY AND SAFETY

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

For a list of emergency procedures for all types of incidents, please visit the website of the Critical Incident Response Team (CIRT): https://cirt.arizona.edu/case-emergency/overview.

Also, watch the video available at https://arizona.sabacloud.com/Saba/Web_spf/NA7P1PRD161/common/learningeventdetail/crtfy000000000003560.

NONDISCRIMINATION AND ANTI-HARASSMENT POLICY

The University of Arizona is committed to creating and maintaining an environment free of discrimination. In support of this commitment, the University prohibits discrimination, including harassment and retaliation, based on a protected classification, including race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information. For more information, including how to report a concern, please see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy.

ACCESSIBILITY AND ACCOMMODATIONS

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (https://drc.arizona.edu/) to establish reasonable accommodations. All accommodations must be arranged through the Disability Resource Center.

NAMES AND PRONOUNS

Course staff will endeavor to use each student's preferred name and pronouns, as defined in UAccess. Assignments may be submitted using either official legal name or preferred name. information on updating preferred name and pronouns is available on the Office of the Registrar site at https://www.registrar.arizona.edu/.

OTHER CAMPUS RESOURCES

Campus health provides medical and mental health services through virtual and in-person care at https://www.health.arizona.edu/. Counseling and Psych Services can be reached directly at 520.621.3334. The Survivor Advocacy program, accessible at https://survivoradvocacy.arizona.edu/, provides confidential support and advocacy services to survivors of sexual and gender-based violence.

The Dean of Students office has an assistance program to help manage crises, life traumas, and other barriers, accessible at https://deanofstudents.arizona.edu/support/student-assistance. The Campus Pantry is open for supplemental food; see https://campuspantry.arizona.edu/ for hours and access.

GRADING POLICIES

Grades and student course work are considered education records under FERPA and are protected. Course staff will not release assignments and grades to people other than the student without written consent of the student. All email communication about grades should occur through official University email. For more information, see https://www.registrar.arizona.edu/ferpa.

INCOMPLETE (I) OR WITHDRAWAL (W)

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at https://catalog.arizona.edu/policy/registration-tuition-fees/registration-enrollment/change-schedule.

CODE AND ACADEMIC INTEGRITY

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: https://deanofstudents.arizona.edu/policies/code-academic-integrity.

All lecture notes, lectures, study guides, and other course materials disseminated by course staff to students, whether in class or online, are original materials and reflect intellectual property of the instructor or author of those works. Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

Academic integrity violations on case assignments or exams, such as plagiarism, copying, or cheating, will result in point deduction, potentially to a grade of 0 for the assignment. This includes providing unauthorized assistance. A violation may include a report to the Dean of Students Office.

ACADEMIC ADVISING

If you have questions about your academic progress this semester, please reach out to your academic advisor (https://ua-trellis.my.site.com/Public/s/advisors-by-major). Contact the Advising Resource Center (https://advising.arizona.edu/) for all general advising questions and referral assistance.

SUBJECT TO CHANGE STATEMENT

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.