

Syllabus

MFE 402: Econometrics

Fall 2024

Course Meeting Times and Location

| | |
|---------------|------------------------------------------------------------------------------------|
| Section 1: | Tuesdays 1:00pm – 3:50pm in D-313 |
| Section 2: | Tuesdays 8:30am – 11:20am in D-313 |
| Thanksgiving: | No class Tues 11/26, makeup Fri 11/22 from 1:00-3:50p (Sec1&2) in Crown Auditorium |
| Midterm: | Wed Nov 6 1:00pm – 2:30pm, class afterwards 2:50-3:50p in B313 |
| Final Exam: | Tues Dec 10 from 11:30am – 2:30pm |
| Course Site: | BruinLearn Section 1 BruinLearn Section 2 |

Instructor

| | |
|--------------------|------------------------------------------------------------------------------------|
| Faculty of Record: | Dan Yavorsky |
| Email: | dan.yavorsky@anderson.ucla.edu |
| Cell: | 951-201-0927 |
| Office Location: | D-419 Tuesdays |
| Personal Website: | www.danyavorsky.com |

Teaching Assistants

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|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Teaching Assistants: | Zechen Liu and Arpan Indora |
| Contact: | zechen.liu.2024@anderson.ucla.edu and arpanindora96@ucla.edu |
| TA Sessions: | Select Mondays (10/7, 10/21, 11/4, 11/18, 12/2) from 5-6pm in C303 |

Please email the professor and cc the TAs (or vice-versa).
Do not email us separately; do not contact us through Bruinlearn “conversations”.

Course Description

This course provides a broad foundation in the application of statistical theory, methodology, and computation for economic and financial topics. We will explore parametric, semi-parametric, and possibly non-parametric regression models, and estimate them with analog and method-of-moments estimators, maximum likelihood estimation, and via a Bayesian approach. My goal is to sufficiently introduce these ideas such that you are empowered to dive deeper into specialized areas covered during the MFE curriculum or of your own personal interest.

Prerequisite topics for the course include probability, introductory statistics, basic linear algebra, and R programming.

Course Objectives

At the end of the course, students will be able to:

1. Understand key classes of statistical methods to estimate common econometric models.
2. Know how and when to appropriately assume, fit, interpret, test, and predict from a regression model.
3. Compute all common regression output from statistical software packages.
4. Advance into additional econometric topics (times series, panel data, causality, simultaneous equations, limited dependent variable, hierarchical, etc.).

Evaluation and Grading

This course will be graded using the following weighted percentages for assignments and assessments. Feedback and scores are typically posted within one week of due dates.

| | |
|---------------------------|-----|
| Problem Set 1 (due 10/07) | 6% |
| Problem Set 2 (due 10/21) | 10% |
| Problem Set 3 (due 11/04) | 10% |
| Problem Set 4 (due 11/18) | 6% |
| Problem Set 5 (due 12/02) | 12% |
| Problem Set 6 (due 12/07) | 6% |
| Midterm (11/06) | 20% |
| Final Exam (12/10) | 30% |

Your overall course grade will be determined by how your performance on graded assignments, a midterm, and a final exam ranks in comparison with other students in the class according to the grade distribution model set forth by the MFE Program Office.

Course Materials

Required Texts

The core set of course materials will be lecture slides and the following two textbooks:

- **BHP:** Hansen, Bruce *Probability & Statistics for Economists* ([website](#))
- **BHE:** Hansen, Bruce *Econometrics* ([website](#))

BHP covers prerequisite material on probability and statistics, as well as key chapters on maximum likelihood, Bayesian statistics, and non-parametric density estimation.

BHE is an excellent and modern treatment of graduate-level econometrics. This course will cover 25% of the material in BHE: most of chapters 1-7 and 9, and a few sections from the other 20 chapters.

Additional Texts

Other highly recommended econometric texts include:

- **DM2:** Davidson, Russell & James MacKinnon *Econometric Theory and Methods*
- **GLD:** Goldberger, Arthur *A Course in Econometrics*
- **KEN:** Kennedy, Peter *A Guide to Econometrics*
- **SKI:** Stachurski, John *A Primer in Econometric Theory*
- **CSI:** Efron, Bradley & Trevor Hastie *Computer Age Statistical Inference* ([link](#))
- **MHE:** Angrist, Joshua & Steffen Pischke *Mostly Harmless Econometrics*

Well-known encyclopedic and/or classic econometric texts include:

- **GRN:** Greene, William *Econometric Analysis*
- **JW2:** Wooldridge, Jeffrey *Econometric Analysis of Cross Section & Panel Data*
- **CAT:** Cameron, Colin & Pravin Trivedi *Microeconometrics: Methods and Applications*
- **DM1:** Davidson, Russell & James MacKinnon *Estimation and Inference in Econometrics*
- **HYA:** Hayashi, Fumio *Econometrics*

Excellent texts that start at an undergrad level but progress to a graduate level:

- **FOX:** Fox, John *Applied Regression Analysis & Generalized Linear Models*
- **JW1:** Wooldridge, Jeffrey *Introductory Econometrics: A Modern Approach*
- **VBK:** Verbeek, Marno *A Guide to Modern Econometrics*

The best texts on Bayesian statistics/econometrics:

- **BDA:** Gelman, Andrew et al. *Bayesian Data Analysis*
- **RTH:** McElreath, Richard *Statistical Rethinking*
- **JKR:** Kruschke, John *Doing Bayesian Data Analysis*

Course Policies

Class Attendance

I do not take attendance. However, lectures are the primary delivery method of content in this course, and the material covered in class is meant to provide intuition, connection, and harmonization of topics covered in the textbooks. Failure to attend class regularly is almost certain to impact your course performance and mastery of econometrics.

Class Participation

Please participate! Don't deprive your peers of your inquiries, insight, and perspective.

I do not award explicit points toward your final grade due to class participation. However, some letter grades may be adjusted based on class contributions. For example, regular positive contributions to class may lead to "rounding up" of your score for students near a threshold between letter grades.

Collaboration

All assignments, but not the midterm or final exam, may be worked on in collaboration with other students currently enrolled in any section of this course. Collaboration is optional, and when undertaken, groups should be small. However, each student is individually responsible for creating and submitting their own answers and code.

It is a violation of UCLA's Student Code of Conduct and this course's policies to have one group member type the assignment while other group members simply copy the file and change their names, or to collaborate with other humans (eg, via StackOverflow, students who took the course in the past, etc.). Such violations will be reported to the MFE Program Office and the UCLA Anderson Dean of Students Office.

Exam Materials

You may bring writing instruments, blank scratch paper, a calculator, and the allowed note sheets (specified next) to the midterm and final exam. The MFE Program Office may also require that you bring your ID.

You are allowed to bring one sheet of notes to the midterm and two sheets of notes to the final exam. Each note sheet may be no larger than 8.5x11.0 inch. Notes can be written on both sides of each sheet of paper. The spirit of this rule is that you create your own note sheet(s) as a form of studying for the exams. Please do not copy or distribute note sheets.

During the exams, you may not consult with any humans; access any other written, audio, or visual material; or interact with a device that can access the internet. Violation of these rules will be punished to the full extent permitted under UCLA policy.

Use of Artificial Intelligence Technology

You may use AI technology (e.g. ChatGPT) to help you develop an understanding of a topic or complete an assignment, in much the same way that you may use online search (e.g. Google and Bing) and online information sources (e.g. Wikipedia or StackOverflow). Recognize, however, that you are responsible for the content of your work and that you must be able to explain and defend the content of your submissions.

It is plagiarism and a violation of [UCLA's Student Code of Conduct](#) to copy work created by someone else (or someone else's technology) and pass it off as your own. Relevant additional information is available at [Dean of Students](#) and via [UCLA's Memorandum](#) specifying Guidance for the Use of Generative AI Technology.

Late Submissions

Late deliverables will only be accepted for full credit in grave circumstances with documentation, such as serious illness or death in the family, with some form of notification required prior to the deliverable due date (e.g., a text or email).

However, at the discretion of the professor and TA(s), an assignment may be accepted late for *partial credit*. It should be exceedingly rare that any student requests this, and there is no guarantee that such a request will be granted.

Re-grade Requests

Any request for re-grading must be made *in writing* within two weeks of a deliverable being assessed and before final course grades are submitted to the Registrar. The professor and/or TA(s) will entirely regrade any such deliverable, meaning that the resulting grade change may be positive or negative, depending on the specific situation.

How to Succeed

The topics in this course build upon each other. It is important to establish a strong foundation with fundamentals in order to make progress on more advanced topics. Don't fall behind.

When engaging with new content, you should interact with the content multiple times: read the assigned textbook sections, attend class and engage with the lectures, and revisit the books and slides as you work through problem sets. This level of engagement should enable you to rephrase the ideas in your own words. Do this! Talk about econometrics with your fellow students; you will discover much value in the process.

Lastly, be professional. Complete the assignments with integrity. Turn them in on time. Take the exams seriously. I have never failed a student who made an honest effort towards the course. I have failed students who cheated or failed to complete assignments and exams.

Course Outline

Week 0: R Programming

- Attend the MFE R Workshop [\[link\]](#)

Week 1: Intro & Review

- Introduction to Course and Instructional Team
- What is Econometrics
- Probability and Statistics Review
- Linear Algebra Review

Week 2: CEF and OLS Estimation

- Joint, Marginal, and Conditional Distributions
- The Conditional Expectation Function (CEF)
- Linear CEF Model
- The Ordinary Least Squares (OLS) Estimator
- Unbiasedness of the OLS estimator

Week 3: Error Variance and OLS Estimator Variance

- Error Variance
- Variance of the OLS Estimator (Under Homo- and Heteroskedasticity)
- Residuals
- Projections (a geometric perspective on OLS)
- Estimators of Error Variance
- Estimators of Variance of the OLS Estimator (Under Homo- and Heteroskedasticity)
- R-Squared and Adjusted R-Squared

Week 4: Inference for Linear Regression

- Asymptotic Theory
- Asymptotic Properties of the OLS Estimator
- Inference under Asymptotic Approximation
- Confidence Intervals and Hypothesis Tests
- Inference under Normality of Errors Assumption
- Linear Hypothesis Tests

Week 5: Additional Regression Topics

- Binary Explanatory Variables
- Log-Linear, Linear-Log, and Log-Log Regression Models
- Multicollinearity
- Omitted Variable Bias, Endogeneity, and Measurement Error
- Leverage and Influential Observations
- Forecasts and Prediction Intervals

Week 6: Midterm and Computational Topics

- Midterm
- Subset and Stepwise Regression
- Cross Validation
- Bootstrap

Week 7: Causal Inference

- Introduction to Causal Inference
- Potential Outcome Framework
- Conditioning on Covariates
- Difference-in-Differences
- Regression Discontinuity

Week 8: Maximum Likelihood

- Introduction to the Likelihood and Log-Likelihood Functions
- Maximum Likelihood Estimation
- Optimization
- Examples of one-parameter models
- The MLE of the Normal Linear Regression Model
- The MLE of the Logit and Probit Regression Models

Week 9: Properties of MLEs and Logit Example

- Properties of Maximum Likelihood Estimators
- Inference with MLEs
- Extended Example: Logit

Week 10: Bayesian Statistics

- Introduction to Bayesian Statistics
- Conjugate Priors
- One-Parameter Models
- Posterior Approximation via Grid Approximation
- Posterior Sampling via Markov-Chain Monte-Carlo Simulation

Class Schedule

| Sun | Mon | Tues | Wed | Thurs | Fri | Sat |
|-------|-----------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------|-----------------------|-------------------------------------------------------------|-------|
| 9/22 | 9/23 R Workshop 10a-2:30p G304 | 9/24 R Workshop 3p-7p G304 | 9/25 R Workshop 10a-2:30p Crown Auditorium | 9/26 | 9/27 | 9/28 |
| 9/29 | 9/30 | 10/01 Class 1 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 10/02 | 10/03 | 10/04 | 10/05 |
| 10/06 | 10/07 HW 1 Due (6%) TA Session 5pm C303 | 10/08 Class 2 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 10/09 | 10/10 | 10/11 | 10/12 |
| 10/13 | 10/14 | 10/15 Class 3 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 10/16 | 10/17 | 10/18 | 10/19 |
| 10/20 | 10/21 HW2 Due (10%) TA Session 5pm C303 | 10/22 Class 4 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 10/23 | 10/24 | 10/25 | 10/26 |
| 10/27 | 10/28 | 10/29 Class 5 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 10/30 | 10/31 | 11/01 | 11/02 |
| 11/03 | 11/04 HW3 Due (10%) TA Session 5pm C303 | 11/05 | 11/06 Midterm (20%) 1:00-2:30pm Lecture follows in B313 2:50-3:50pm | 11/07 | 11/08 | 11/09 |
| 11/10 | 11/11 | 11/12 Class 7 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 11/13 | 11/14 | 11/15 | 11/16 |
| 11/17 | 11/18 HW4 Due (6%) TA Session 5pm C303 | 11/19 Class 8 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 11/20 | 11/21 | 11/22 Class 9 Crown Auditorium Sec 1&2 1:00p-3:50p | 11/23 |
| 11/24 | 11/25 | 11/26 | 11/27 | 11/28 Thanksgiving | 11/29 | 11/30 |
| 12/01 | 12/02 HW5 Due (12%) TA Session 5pm C303 | 12/03 Class 10 D313 Sec 2 8:30a-11:20a Sec 1 1:00p-3:50p | 12/04 | 12/05 | 12/06 | 12/07 |
| 12/08 | 12/09 HW6 Due (6%) | 12/10 Final Exam (30%) G419 & D313 11:30a-2:30p | 12/11 | 12/12 | 12/13 | 12/14 |

Anderson Policies

Netiquette

The written language has many advantages: more opportunity for reasoned thought, more ability to go in-depth, and more time to think through an issue before posting a comment. However, written communication also has certain disadvantages, such a lack of the face-to-face signaling that occurs through body language, intonation, pausing, facial expressions, and gestures. As a result, please be aware of the possibility of miscommunication and compose your comments in a positive, supportive, and constructive manner.

UCLA Policies

Code of Conduct

All participants in the course are bound by the [UCLA Student Conduct Code](#)

Academic Integrity

UCLA is an institution of learning, research, and scholarship predicated on the existence of an environment of honesty and integrity. As members of the academic community, instructors, students, and administrative officials are all responsible for maintaining this environment. It is essential that all members of the academic community practice academic honesty and integrity and accept individual responsibility for their work. Academic misconduct is unacceptable and will not be tolerated in this course. Cheating, forgery, dishonest conduct, plagiarism, and collusion in academic misconduct erode the University's educational, research, and social roles.

Students who knowingly or intentionally conduct or help another student engage in acts that violate UCLA's expectations of academic integrity will be subject to disciplinary action and referred to the Dean of Students' Office.

Please familiarize yourself with UCLA's [Academic Integrity Policy](#). Speak to your instructor if you have any questions about what is and is not allowed in this course.

Integrity in Research

Integrity in research includes not just the avoidance of wrongdoing, but also the rigor, carefulness, and accountability that are hallmarks of good scholarship. All persons engaged in research at the University are responsible for adhering to the highest standards of intellectual honesty and integrity in research.

Please familiarize yourself with the University of California [Policy on Integrity in Research](#)

Accessible Education & Inclusive Education

Disability Services

UCLA is committed to providing a barrier-free environment for persons with documented disabilities. If you are already registered with the Center for Accessible Education (CAE), please request your Letter of Accommodation in the Student Portal. If you are seeking registration with the CAE, please submit your request for accommodation via the CAE website. Students with disabilities requiring academic accommodations should submit their request for accommodations as soon as possible, as it may take up to two weeks to review the request. For more information, please visit the [CAE website](#), visit the CAE at A255 Murphy Hall, contact CAE by phone at (310) 825-1501, or by telecommunication device for the deaf at (310) 206-6083.

Equity, Diversity, and Inclusion

Please familiarize yourself with UCLA Anderson's [commitment to maintaining an equitable, diverse, and inclusive community](#)