MFE 402: Econometrics

Course Syllabus – Fall 2023

Dan Yavorsky

Course Meeting Times and Location

Course Day & Time:	Section 1: Tuesdays 4:10pm – 7:00pm
	Section 2: Tuesdays 8:30am – 11:20am
Course Location:	B-313
Midterm:	Tuesday Nov 7 8:30am – 10:00am, class afterwards
Final Exam:	Tuesday Dec 12 from 11:30am – 2:30pm
Course Site:	BruinLearn Section 1
	BruinLearn Section 2

Instructor & Teaching Assistant

Instructor

Faculty of Record:	Dan Yavorsky
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Teaching Assistants

Teaching Assistant:	Varun Datta Punjala
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Please email the professor and cc the TAs (or vice-versa); do not email us separately. Please do not "email" us through the "conversations" feature on Bruinlearn.

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 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, and test a regression model.
3. Compute all common linear 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 10/09)	8%
Problem Set 2 (due 10/23)	10%
Problem Set 3 (due 11/06)	12%
Problem Set 4 (due 11/27)	12%
Problem Set 5 (due 12/08)	8%
Midterm (11/07)	20%
Final Exam (12/12)	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 do participate: don't deprive your peers of your 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 very 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 (e.g., it is a violation of UCLA's Student Code of Conduct and this course's policies to have one group member type the assignment, and other group members simply copy the file and change their names. Such violations will be reported to the MFE Program Office and the UCLA Anderson Dean of Students Office.)

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 Succed

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. Esure you have mastery of the "easier" topics at the beginning of the course (i.e., probability, statistics, linear algebra, and a good grasp on the concept of the Conditional Expectation Function).

When engaging with new content, you should interact with the content 3 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.

Course Outline

Week 0: R Programming

Read one of:

- Lander, Jared (2017) *R for Everyone (2nd Ed)*
- Matloff, Norman (2011) *The Art of R Programming*
- Wickham, Hadley & Garrett Grolemund (2017) *R for Data Science* [link]
- Wickham, Hadley (2019) *Advanced R (2nd Ed)* [link]
- Chambers, John (2008) *Software for Data Analysis: Programming with R*
- Leemis, Lawrence (2022) *Learning Base R (2nd Ed)*

...or any free R book online at the Big Book of R.

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

- The Conditional Expectation Function (CEF)
- Linear CEF as a Predictor or Approximation
- The Least Squares (LS) Estimator
- Unbiasedness of the LS estimator

Week 3: Error Variance and OLS Estimator Variance

- Residuals
- Projections (a geometric perspective on LS)
- R-Squared
- Error Variance
- Variance of the LS Estimator
- Generalized Least Squares Estimator

Week 4: Inference for Linear Regression

- Asymptotic Theory
- Asymptotics Properties of Least Squares Estimator
- Inference under Asymptotic Approximation
- Confidence Intervals and Hypothesis Tests
- Inference under Normality of Errors Assumption

Week 5: Additional Regression Topics

- Linear Hypothesis Tests
- Multicollinearity
- Omitted Variable Bias, Endogeneity, and Measurement Error
- Tests for Heteroskedasticity
- Leverage and Influential Observations
- Forecast Intervals

Week 6: Midterm and Computational Topics

- Bootstrap
- Subset and Stepwise Regression
- Cross Validation

Week 7: 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 8: Properties of MLEs and Logit Example

- Properties of Maximum Likelihood Estimators
- Inference with MLEs
- Example: Logit Regression for Binary Dependent Variable Model

Week 9: Bayesian Statistics

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

Week 10: Bayesian Linear Regression & Non-Parametrics

- Bayesian Normal Linear Regression Model
- Gibbs Sampling of the Normal Linear Regression Model
- Introduction to Non-Parametric Regression
- Kernal Density Estimation and Splines

Week 11: Final Exam

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