

ECMA 31000: Introduction to Empirical Analysis

University of Chicago, Autumn 2021

Lecture: TuTh 2:00PM - 3:20PM in Kent Chem Lab 101.

Discussion Section: W 4:30PM - 5:20PM in Rosenwald Hall 015.

Instructor: Joseph Hardwick

Office: All meetings will be held via Zoom.

Email: hardwick@uchicago.edu

Office Hours: Via Zoom on Wednesdays 9:30AM-11:00AM and 5:30PM-7:00PM.

Teaching Assistant: Tanya Rajan

Email: tanyar@uchicago.edu

Office Hours: Via Zoom on Mondays and Tuesdays 10AM-11:30AM.

Course Description: This course introduces students to the key tools of econometric analysis: Probability theory, including probability spaces, random variables, distributions and conditional expectation; Asymptotic theory, including convergence in probability, convergence in distribution, continuous mapping theorems, laws of large numbers, central limit theorems and the delta method; Estimation and inference, including finite sample and asymptotic statistical properties of estimators, confidence intervals and hypothesis testing; Applications to linear models, including properties of ordinary least squares, maximum likelihood and instrumental variables estimators; Non-linear models. Assignments will include both theoretical questions and problems involving data. Necessary tools from linear algebra and statistics will be reviewed as needed.

Required Readings: My lecture slides and annotations, which will be on Canvas. You will need to attend lectures for worked examples/proofs.

There is no required textbook, but parts of the following are useful references:

- *Probability and Statistics for Economists* (2021) and *Econometrics* (2021) by Bruce Hansen. These textbooks are available for free on Bruce's website.
- *Econometric Analysis of Cross Section and Panel Data* (2010) by Jeffrey M. Wooldridge. This textbook can be read online through the university library.
- *A Primer in Econometric Theory* (2016) by John Stachurski. The text contains many solved exercises on material covered in this class. Slides/Sample Chapters and code snippets in the book are available at <https://johnstachurski.net/emet>.

Grading: The final grade is determined by assignments submitted via Canvas, Exam 1 Tuesday, October 26 in class at 2:00PM-3:20PM (CT) and Exam 2 Thursday, December 9 at 12:30PM-2:30PM (CT) in Kent 101 (our usual classroom). These assessments will be weighted as follows:

Problem Sets: 20% The lowest problem set score will be dropped.

Exam 1: 30% (Covers lectures 1-8)

Exam 2: 50% (Covers lectures 1-16)

The final letter grade will be determined as follows:

Letter Grade	A	A-	B+	B	B-	C+	C	C-
Overall Score	90	85	80	75	70	65	60	55

Any student scoring higher than the cutoff given above will earn at least that grade in the course. For example, if everyone scores 93% overall, everyone gets an A. Scores may be curved up to the benefit of all students but will not be curved down. You may request Pass/Fail grading no later than Sunday, Dec 5 at 5PM CT. If you wish to withdraw from the course without a W on your transcript you must do so before Friday, October 15 at 5PM. A withdrawal after this date but before Sunday, Dec 5 at 5PM will result in a W grade on your transcript. A withdrawal may not be granted after this time except in extenuating circumstances, and you must submit a petition to withdraw with your academic adviser. You cannot switch back to a letter grade after withdrawing or opting for Pass/Fail, so you should discuss the ramifications with your academic adviser before requesting either.

Assignment Policy: Assignments will be made available following lectures on Thursdays. They are due a week later, Thursdays by 11:59PM (US Central Time), and should be submitted via the Assignments tab on the course Canvas page. Late problem sets will not be accepted. Students are encouraged to work together on problem sets and may submit in groups of up to 3 members, but I strongly recommend that each student also work on all of the problems individually. The name of each group member should be printed clearly and each member of the group should submit a copy. Submissions should be clearly legible, as no credit is awarded for responses the TA cannot read. Please leave enough space for the TA to annotate your work. Assignments that require coding should include as part of the submission a printout of the code used to generate output required for problem set questions. Submissions should be compiled into a single pdf file no larger than 20MB. Students may use any programming language. MATLAB is available to University of Chicago students at <https://www.mathworks.com/academia/tah-portal/university-of-chicago-719588.html>. Students may use vLAB to access university software. Off-Campus use requires cVPN.

Rules for Group Submissions: Students who submit their individual write up will receive an individual grade regardless of who their group members are. All group members submitting an identical copy of the problem set will receive the same grade. Any student who does not submit a copy of the problem set will receive zero points for that problem set, irrespective of the submission of any other group member. You are ultimately responsible for your own submission on Canvas.

Examination Policy: *Note: If, for any reason, the exam(s) must be conducted remotely, a modified version of the following policy will be announced on Canvas and appended to this syllabus.*

Exams 1 and 2 will be taken in person at the times indicated in the course schedule below. You will have 80 minutes to complete Exam 1 and 120 minutes to complete Exam 2. All examinations are open book/notes, but students may not use any electronic devices. Students should communicate with the instructor in case of any unforeseen hindrance in completing the exam. Any student who misses Exam 1 will have the weight of Exam 1 shifted to Exam 2. Examinations are to be attempted individually. No communication with others about any aspect of the course is permitted during any of the time period in which the exam is being held, including before or after students have themselves completed it. No part of the examinations may be copied, shared, posted on a website or otherwise distributed at any time. Scores awarded to late submissions are entirely at the discretion of the instructor. Any student who violates these examination policies will fail the course and will be referred to the Dean of Students for further disciplinary action.

Accessibility: The University of Chicago is committed to ensuring equitable access to our academic programs and services. Students with disabilities who have been approved for the use of academic accommodations by Student Disability Services (SDS) and need a reasonable accommodation(s) to participate fully in this course should follow the procedures established by SDS for using accommodations. Timely notifications are required in order to ensure that your accommodations can be implemented. Please meet with me to discuss your access needs in this class after you have completed the SDS procedures for requesting accommodations.

Phone: (773) 702-6000

Email: disabilities@uchicago.edu

Attendance: *Note: If, for any reason, the class must be conducted remotely, a modified version of the following policy will be announced on Canvas and appended to this syllabus.*

The class is taught in person but office hours will be held over Zoom. Neither will be recorded. Please note that food and drink are not allowed in classrooms. If you are required to miss class because you are in isolation after testing positive for COVID-19, experiencing symptoms prior to obtaining a COVID-19 test, or quarantining, you may inform me of your absence so I can make alternative arrangements for you to keep up with classwork.

Course Expectations: Student participation is incredibly helpful to fellow students and the instructor. In addition, students are strongly encouraged to use Canvas discussion boards. Questions and answers posted to these boards will be actively monitored by the instructor, and all participants are encouraged to write and answer questions there.

All participants must follow the requirements set forth in the University's COVID-19 attestation. Any student who is unable to attend class during the Autumn Quarter is expected to adhere to the usual health protocols, including abiding by the University's COVID-19 Health Requirements and Protocols for Addressing Confirmed or Suspected COVID-19 Exposures, which include guidelines for self-monitoring for symptoms. Any member of the University community who tests positive for COVID-19 should inform the University contact tracing team at C19HealthReport@uchicago.edu. Any concerns over inappropriate PPE usage, physical distancing, cleaning/disinfection, or other COVID-19 related public health concerns should be directed to UCAIR. If there is an emergency, call 773-702-8181 or dial 123 on any campus phone.

Title IX: Faculty, staff, lecturers, teaching assistants, postdoctoral fellows, and all others who have teaching responsibilities in the classroom and/or lab are considered "Individuals with Title IX Reporting Responsibilities", and must report on gender-based discrimination, sexual harassment, sexual abuse, sexual assault, dating violence, domestic violence, or stalking to the University Title IX Coordinators. For more information, see <https://harassmentpolicy.uchicago.edu/>. See here for an overview of confidentiality options and University resources.

Academic Integrity: Students must abide by the University's policy on academic honesty. Instances of academic dishonesty will be reported to the Office of the Provost for adjudication. Policies specific to assignments and examinations in this class are outlined in the Assignment Policy and Examination Policy above.

Diversity and Inclusion: The University of Chicago believes that a culture of rigorous inquiry demands an environment where diverse perspectives, experiences, individuals, and ideas inform intellectual exchange and engagement. I concur with that commitment and expect to maintain a productive learning environment based upon open communication, mutual respect, and non-discrimination. All students enrolled this class are and will always be equally welcome. I cannot overstate the value that each individual's contribution brings to lectures, sections, office hours, online discussion boards and the overall quality of this class. Any student who feels unable to participate fully in any class section for any reason should not hesitate to reach out to me. The University does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender identity, national or ethnic origin, age, status as an individual with a disability, protected veteran status, genetic information, or other protected classes as required by law.

Course Schedule

Lecture	Date	Topics	PS Out	PS In
1	Tu, Sep 28	Intro ; Probability Review	—	—
2	Th, Sep 30	Distribution Theory	1	—
3	Tu, Oct 5	Asymptotics	—	—
4	Th, Oct 7	Asymptotics	2	1
5	Tu, Oct 12	Asymptotics	—	—
6	Th, Oct 14	Asymptotics	3	2
7	Tu, Oct 19	Estimation	—	—
8	Th, Oct 21	Estimation	—	3
—	Tu, Oct 26	Exam 1 in Kent 101 2:00PM-3:20PM CT	—	—
9	Th, Oct 28	Hypothesis Testing	4	—
10	Tu, Nov 2	Linear Regression	—	—
11	Th, Nov 4	Linear Regression	5	4
12	Tu, Nov 9	Linear Regression	—	—
13	Th, Nov 11	Linear Regression	6	5
14	Tu, Nov 16	Instrumental Variables	—	—
15	Th, Nov 18	Instrumental Variables	7	6
Thanksgiving Break 11/22 - 11/26				
16	Tu, Nov 30	Topics/Catch-Up	—	—
17	Th, Dec 2	Review	—	7
—	Th, Dec 9	Exam 2 in Kent 101 12:30PM-2:30PM CT	—	—