Jeff Grogger
Harris School

Winter 2022
University of Chicago

PP 421: Applied Econometrics

Live Class, while remote: Thursday, 9:30-10:50am, via Zoom
Live Class, when in-person: Tuesday/Thursday, 9:30-10:50am, Keller 2112

Instructor: Jeffrey Grogger
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Office hours: TBA

Teaching Assistants:

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Office hours: Tuesdays 11am-12pm and Thursdays 3:30pm-4:30pm, by Zoom (while remote)/in Keller 2054 (afterward).

Web site: All materials for the class will be posted to its site on Canvas.

Course content: This class covers linear regression from basic Gauss-Markov theory to the LATE theorem. Think of it as a theoretical course for applied researchers.

Prerequisites: Matrix algebra and PPHA 420.

Reference: The text for the class is William Greene, *Econometric Analysis*, 7th edition. If you choose to use a different edition, the responsibility for cross-walking the reading assignments lies with you.

Grading: There will be four problem sets and a final exam. Problem sets will include paper-and-pencil problems and empirical exercises. Only the three problem sets with the highest scores will be used in calculating the student's grade.

Students may complete the empirical portion of the problemsets using either R or Stata. Please submit both your raw code file (.R .Rmd or .do) along with a writeup of your answers to each problem (.pdf). Please include tables, figures, and other relevant output from your code inside your writeup. You may not write your answers to each problem as comments inside your code (unless you are using Rmarkdown in an appropriate manner).

Problem sets: Students may work together on problem sets but each student must write up his/her answer set individually. Problem sets will count for 2/3 of the course grade.

Problem sets will be turned in via Canvas. The due date and time for each problem set will appear on the heading of the problem set. *No late problem sets will be accepted*. Answer keys will be posted to the website shortly after the problem sets are due.

Exams. The final exam will count for 1/3 of the course grade. It will be a take-home exam, distributed on March 10, 2022, the last day of class. It will be due 24 to 48 hours later, with details forthcoming later in the quarter. ***There will be no make-up exams***.

Academic Integrity. To reiterate, you may consult with others while you work on the problem sets, but you must follow these procedures:

- Your problem set must be solely your authorship (written up by yourself, in your own words, including your own code for the empirical part.)
- Your code must have a comment at the top listing the students/TA's/consultants with whom you consulted.
- Any part of your code that was substantially altered because of your discussion with other students/TA's/consultants should cite others' contributions with names and descriptions in a comment at the place where it is applicable.
- Any code based on code that you found online must be documented as such. This includes single lines of code and code that you found but then modified to fit your purpose. Documentation must include the URL and the date and time of access.

Students who violate these procedures, or otherwise violate academic honesty policies, will receive a zero for the problem set or exam in question. This problem set will **NOT** be dropped for the purpose of calculating your grade.

All University of Chicago students are expected to uphold the highest standards of academic integrity and honesty. Among other things, this means that students shall not represent another's work as their own, use disallowed materials during exams, or otherwise gain unfair academic advantage. All students suspected of academic dishonesty will be reported to the Harris Dean of Students for investigation and adjudication. The disciplinary process can result in sanctions up to and including suspension or expulsion from the University, in addition to the grade penalty mentioned above. The Harris policy and procedures related to academic integrity can be found at https://harris.uchicago.edu/gateways/current-students/policies. The University of Chicago Policy on Academic Honesty & Plagiarism can be found at https://studentmanual.uchicago.edu/academic-policies/academic-honesty-plagiarism/

Logistics for remote portion of class. Until January 24, or later if modified by the University administration, instruction will be online. Nevertheless, my goal is to make the class as engaging as possible, given the constraints. The procedures spelled out here are designed to help make that possible, as well as to let you know what to expect about how the class will work. Details may change before, or even during, the quarter. One thing will remain unchanged, though, which is the live meeting time above.

General plan

The class will be a mix of asynchronous and synchronous instruction. In English, that means video-recorded lectures and live class meetings. Lectures will be posted a few days before they will be discussed in class. I encourage students to post questions about the material (or up-vote existing questions) on the canvas discussion board to discuss during the live class. The general schedule will go like this:

Example schedule:

- By Saturday, 8 pm: Professor Grogger uploads first batch of lecture videos
- By Monday, 8 pm: Professor Grogger uploads second batch of lecture videos
- By Wednesday, 9:30 am: Students submit and upvote questions via the Canvas discussion board (under the appropriate weekly thread)
- Thursday, 9:30-10:50 am: Live class with responses to questions

I strongly encourage you to post questions to the canvas discussion board under the appropriate weekly thread (and upvote existing questions) in advance for discussion in class. The reason is simple: as a general rule, I can provide better answers to questions if I get them with some advance warning. Seeing questions in advance also lets me prioritize them, which allows for more efficient use of class time. Questions that do not make the cut for class may be brought up to TAs in office hours.

And yes, discussion board questions will be public. Why? One reason is efficiency: true singleton questions are rare. If you have a question (after watching the video, reading the readings, and thinking about them a bit), it is almost certain that someone else will have the same question. Another reason is that questions beget questions. If one student sees others posting, that student is more likely to post him/herself. And more questions are better. Furthermore, part of post-graduate education is learning to make yourself heard, even in situations you may find awkward. Finally, I want to encourage cross-talk. If a student has a question, and you know the answer, or have a helpful way to think about it, or even have the same question, please post!

Guidelines for live class

The goal here is to produce something as close to the classroom environment as we can, subject to the constraint of looking into a screen with a bunch of picture tiles. So please follow these guidelines:

- Show up on time.
- Mute your microphone.
- Turn your camera on. I expect students to be actively engaged and on camera during the live class. If you require an exception, you will need to email me directly at least an hour before class. Exceptions will be granted on a class-by-class basis; there will be no blanket exceptions. If you haven't asked for an exception, you may be dropped from the session. A profile picture does not count.
- Use the Raised Hand to ask a question. Or raise/wave your hand in view of your camera. If I miss it, interrupt at a reasonable point. I will not be using Q&A or Chat to take questions. Why not? Think of the last time you spoke to an audience while simultaneously reading incoming text. Exactly. The human brain doesn't work that way.
- Use Chat to report technical issues. Hopefully, one of the TA's will be able to resolve it.

Communication with TAs

Please use the Canvas discussion board to communicate with the TAs. They will respond in a reasonable amount of time, but immediate turnaround is not a reasonable expectation. They're dealing with the new world order, too.

Topics and Readings

1. Multivariate Linear Regression

    a. Lecture Notes Topic 1
    b. Estimation: Mechanics, Greene Ch. 3
    c. Estimation: Statistical properties, Greene Ch. 4
    d. Prediction, Greene Ch. 5.6

2. Multivariate Linear Regression (cont.)

    a. Lecture Notes Topics 2-3
    b. Finite-sample inference, Greene Ch. 5.1-5.5
    c. Large-sample inference, Greene Chs. 5.6

3. Specification Issues

    a. Lecture Notes Topic 5
    b. Dummy Variables, Greene Ch. 6.2
    c. Non-linearity, Greene Ch. 6.3
    d. Structural Breaks, Greene Ch. 6.4
    e. Omitted Variable Bias, Greene Ch. 4.3.2
    f. Collinearity, Greene Ch. 4.7.1

4. Heteroskedasticity and Generalized Least Squares

    a. Lecture Notes Topic 4
    b. Heteroskedasticity, Greene Ch. 9.4-9.6
    c. Non-Spherical Disturbances and OLS, Greene Ch. 9.2
    d. Generalized Least Squares, Greene Ch. 9.3

5. Models for Panel Data

    a. Lecture Notes Topic 6
    b. Models, Greene Ch. 11.1-11.2
    c. Estimators, Greene Ch. 11.3-11.6, 11.1
    d. Moulton (1990)
    e. Bertrand, et al. (2004)
    f. Solon et al (2013)
    g. Abadie, et al. (2017)
    h. Goodman-Bacon (2021)
    i. Borusyak, et al (2021)

6. Instrumental Variables

    a. Lecture Notes Topic 7
    b. Greene Ch. 8
    c. Hausman (1978)

d. Bound, et al. (1995)
e. Pouliot (2019)
f. Angrist, Imbens, and Rubin (1996)
g. Mikusheva (n.d.)

7. Additional Topics, (time permitting)
    a. Bootstrap Inference
    b. Penalized Regression