ECON 5213: Advanced Econometrics

University of Oklahoma

Department of Economics

Fall 2022

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TA Office Hours:	TTR or by appointment

1 Covid Guidelines

See https://www.ou.edu/together for the University's current Covid policies.

- Please understand that a mask is welcome in class.
  - If you choose not to wear a mask, please be courteous to the instructor or others expressing health concerns and be recommended that you do not sit in close proximity to them.
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  - If you are vaccinated, thank you.
  - If not, OU has walk-in vaccine clinics available. Information is on the OU Together website.
- Please use the Daily Passport in the Healthy Together app every day before coming to class.
- Please note that spare masks are available from the department.

2 Remark

This syllabus is *only* tentative and subject to change. I will update it according to the progress of this course. **It is your responsibility to check Canvas and Github page constantly for updates.** There may be major changes regarding the course such as grading policy, exams and empirical project if deemed necessary, but they will be explicitly announced in class at least one month ahead.

Email is the fastest way to contact me.

3 Course Description

This is a graduate level introduction to econometrics offered primarily to first-year Ph.D. economics students. The course is designed to provide a **foundation** for and a **general introduction** to econometric technique, theory, and application to prepare students for future study of 1) frontier topics in econometrics or 2) empirical applications of these techniques in topical areas. Knowledge of multivariate calculus, some probability and mathematical statistics is assumed. As well, you should be comfortable with basic matrix algebra. A prior course in undergraduate econometrics would be helpful, but not required.

The course has four basic objectives. The first is to provide knowledge in probability theory and mathematical statistics necessary for econometrics. The second is to review, extend, modify, and otherwise build on the **econometric techniques** already covered in undergraduate econometrics classes (i.e., the classic linear regression model). The third objective is to present sufficient **econometric theory** (i.e., large sample/asymptotic theory) so that students will 1) have deeper understanding of the techniques they are using, and as well, will recognize the circumstances under which they might be appropriately used; 2) gain experience of formal proofs and rigorous derivations of econometric theory. It is important to know that "To understand a mathematical proof, it is not sufficient to simply read the proof, you need to follow it, and re-create it for yourself." (Bruce Hansen, 2019)

Finally, while this is a more theory oriented course, we should also emphasize the "application" aspect of this course, which entails becoming familiar with statistical software (Stata and R will be used in the course). Students will eventually develop knowledge of Stata or R in order to learn further, to apply the techniques learned, and to evaluate the theories.

I would like to emphasize that this is an *econometrics* course. And we will try to distinguish ourselves from statisticians or other quantitative researchers by emphasizing the economic motivations and interpretations behind these methods whenever we can. This course will introduce concepts in probability and mathematical statistics in a way that would eventually prepare you to study *econometrics*, instead of treating these topics as stand-alone ones.

Throughout, the most important thing is **communication**. Show understanding and patience to each other, and collectively come up creative solutions to address any challenges that may get in the way of our learning during this particular challenging time.

4 Required Readings

My lecture slides will be the main material for the course. But the following resources will prove to be useful as well. Later I will provide a course schedule noting how our material is corresponding to some of these recommended books and notes.

[BH] Bruce Hansen of Wisconsin provides two used-to-be-free textbooks that cover the core material typically taught in a one-year Ph.D. course in econometrics. Both are published, but the versions before publications are provided on Canvas.

The Book of Statistical Proofs is a book and website that provides a centralized, open and collaboratively edited archive of statistical theorems for the computational sciences, available at `https://statproofbook.github.io/`

"Probability, Statistics, and Econometrics" by Oliver Linton is also closely related to the structure that I use in this course. This book used to be freely available through our library website, but this service was unfortunately disconnected, effective in July 2019.

4.1 Math Prerequisites

You should be very familiar with the material in Appendix A in BH's notes. You should come in familiar with material covered in Cal I and Cal II, including integration techniques (a review is available here, `https://tutorial.math.lamar.edu/Classes/CalcI/CalcI.aspx`, `https://tutorial.math.lamar.edu/Classes/CalcII/CalcII.aspx`).

You may also find the following website for symbolic calculation useful. `https://www.symbolab.com/solver/integral-calculator`

4.2 Probability Theory and Mathematical Statistics

The first part of the semester will be focused on probability theory and mathematical statistics so that everyone is on the same page for more advanced econometrics. Pick any mathematical statistics book, Review Appendices in Greene, Google any material that you think would be helpful. Below is a link to Penn State website that would be helpful for those of you who need some reviews at the undergrad level.

`https://onlinecourses.science.psu.edu/stat414/node/3`

Below are some recommended (NOT required) readings:

[CB] George Casella, Roger L. Berger, 2001, *Statistical Inference*, 2nd edition.

Vadim Marmer's lecture notes: `http://faculty.arts.ubc.ca/vmarmer/econ327/index.html`

Robert V. Hogg , Allen Craig , Joseph W. McKean, *Introduction to Mathematical Statistics* or any versions no later than 5^{th} edition.

Herman J. Bierens, *Introduction to the Mathematical and Statistical Foundations of Econometrics*

4.3 Econometrics

The second part of the sememster will be focused on econometrics. While I emphasize the separation of these two parts for the organization purpose, it does not mean that these two parts are distinct and unrelated. Instead the second part is built on and transitioned from the first part. Hopefully by presenting these two parts altogether, we can see the connections between the two, and probably understand them better as well.

William Greene, *Econometric Analysis*. The 8^{th} edition is the most recent. Corrections and other information for the text can be found at `http://pages.stern.nyu.edu/~wgreene/Text/`

econometricanalysis.htm. Certain chapters and material in the older editions can be used as a substitute.

It is also recommended that you have access to the following:

Jeffrey M. Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, Cambridge, MA: MIT Press, 2010 (Second Edition).

Note that Greene's book is not necessarily "best" for any topic, but it is likely, at a minimum, second best for just about every topic.

5 (Some) More Recommended Readings

1. Symposium on Econometric Tools, Journal of Economic Perspectives, Vol. 15, No. 4, Fall 2001
2. A Guide to Econometrics, 6th Edition, Kennedy, Peter, The MIT Press: Cambridge, MA.
3. Introduction to Econometrics, Fourth Edition, Maddala and Lahiri, Wiley: 2009, ISBN: 9780470015124
4. Introductory Econometrics, Fourth Edition: Wooldridge, South-Western: 2009, ISBN: 9780324660545

6 (Some) Recommended Resources for Stata

1. Undergrad Econometrics Using Stata at Rochester https://www.youtube.com/channel/UCbeLdyQFjWuP39wuVfl4Xlw

7 Assignment, Testing, and Grading

7.1 Tests

There will be one midterm exam (**tentative date: 10/19/2021**) and one final exam. The format of these exams will be announced later. **No make-up exams will be given.** If a student misses a midterm examination for **any reason**, the weight of that examination will be added to that of the final exam. I'd like to have the flexibility to speed up or slow down depending on how I think the class understands the material. So, the midterm date may be subject to change according to the progress but will be announced one week in advance.

7.2 Homework Assignment

There will be homework assignments following each topic. Students are usually given a week to complete these assignments, but this could vary depending on the length of the homework. **Homework assignments will be due at the beginning of class and late homework**

assignments will not be graded for credit. It is important to know that the homework assignments are very important in that the basic ideas covered by them invariably show up on the mid-term and the final. If you know you are going to be missing a class on the day a homework exercise is due, hand in your homework **in advance** to receive full credit for your work.

- You should try to type all the homework. This is also courteous to your TA who would be grading the homework.
- Group discussion is encouraged when working on the problem sets. Your answers should show individual understanding of the materials and be written in your own words. If you collaborate with other student(s), everyone in your group should be acknowledged at the beginning of the homework. Identical homework assignments would receive a zero for both students.

7.3 Grading

The weights in the final grade are assigned as follows:

Homework Assignments:	35
Midterm :	25
Final:	35
Participation:	5

The grading scale is:

90-100	A
70-90)	B
60-70)	C
55-60)	D
0-55)	F

A number with a parenthesis means any number less than it. For example 90) means any number less than 90, but not equal to 90. It could be 89.9999999. I reserve the right to change the grading scale. The required score for the final grade could be lower but not higher. For example, the current requirement for an A is 90-100, but later I may change the cut-off point to 85-100, but won't change it to 97-100.

8 University Policies

8.1 Accommodations for Students with Disabilities

The Accessibility and Disability Resource Center is committed to supporting students with disabilities to ensure that they are able to enjoy equal access to all components of their education. This includes your academics, housing, and community events. If you are experiencing a disability, a mental/medical health condition that has a significant impact on one or more

life functions, you can receive accommodations to provide equal access. Possible disabilities include, but are not limited to, learning disabilities, AD(H)D, mental health, and chronic health. Additionally, we support students with temporary medical conditions (broken wrist, shoulder surgery, etc.) and pregnancy. To discuss potential accommodations, please contact the ADRC at 730 College Avenue, (ph.) 405.325.3852, or adrc@ou.edu.

8.2 Academic Honesty

Cheating is strictly prohibited at the University of Oklahoma, because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the Student's Guide to Academic Integrity at `http://integrity.ou.edu/students.html`.

8.3 Religious Observance

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

8.4 Title IX Resources and Reporting Requirement

Anyone who has been impacted by gender-based violence, including dating violence, domestic violence, stalking, harassment, and sexual assault, deserves access to resources so that they are supported personally and academically. The University of Oklahoma is committed to offering resources to those impacted, including: speaking with someone confidentially about your options, medical attention, counseling, reporting, academic support, and safety plans. If you would like to speak with someone confidentially, please contact OU Advocates (available 24/7 at 405-615-0013) or another confidential resource (see ?Can I make an anonymous report??). You may also choose to report gender-based violence and discrimination through other means, including by contacting the Institutional Equity Office (ieo@ou.edu, 405-325-3546) or police (911). Because the University of Oklahoma is committed to the safety of you and other students, I, as well as other faculty, Graduate Assistants, and Teaching Assistants, are mandatory reporters. This means that we are obligated to report gender-based violence that has been disclosed to us to the Institutional Equity Office. This includes disclosures that occur in: class discussion, writing assignments, discussion boards, emails and during Student/Office Hours. For more information, please visit the Institutional Equity Office.

8.5 Adjustments for Pregnancy/Childbirth Related Issues

Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact your professor or the Disability Resource Center at 405/325-3852 as soon as possible. Also, see `http://www.ou.edu/eoo/faqs/pregnancy-faqs.html` for answers to commonly asked questions.

8.6 Final Exam Preparation Period

Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to OU?s Final Exam Preparation Period policy.

8.7 Emergency Protocol

During an emergency, there are official university procedures that will maximize your safety.

Severe Weather: If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather 1. LOOK for severe weather refuge location maps located inside most OU buildings near the entrances 2. SEEK refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. 3. GO to the building?s severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. 4. GET IN, GET DOWN, COVER UP. 5. WAIT for official notice to resume normal activities.

8.8 Armed Subject/Campus Intruder

If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots:

1. Avoid: If you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. 2. Deny: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. 3. Defend: As a last resort fight to defend yourself. For more information, visit OU?s Emergency Preparedness site. Shots Fired on Campus Procedure ? Video

8.9 Fire Alarm/General Emergency

If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: 1. LEAVE the building. Do not use the elevators. 2. KNOW at least two building exits 3. ASSIST those that may need help 4. PROCEED to the emergency assembly area 5 ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. 6. WAIT for official notice before attempting to re-enter the building. OU Fire Safety on Campus

8.10 Mental Health Support Services

If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call (405) 325-2911. For more information, please visit University Counseling Center.

9 Tentative Course Outline

Note that the schedule is subject to change depending on the pace of the course. Not all material would be covered, and extensions of the basic models not listed below may be added to deepen our understanding of these techniques. Moreover, the material will not be necessarily covered in the same order as below.

1. Intro to Probability Theory and Distribution
2. Mathematical Expectation
3. Alternative Ways to Characterize Distributions
4. Quantile Function
5. Monte Carlo Simulation and Parametric Distributions
6. Joint Distribution
7. Conditional Distribution
8. Conditional Expectation and Its Properties
9. Linear Regression: Basics
10. Linear Regression: Computational Tool
11. Linear Regression: Approximation Tool
12. Understanding OLS more: Holding Everything Else Constant
13. Understanding OLS more: Finite Sample Properties
14. Understanding OLS more: Asymptotic Properties
15. Hypothesis Testing
16. Violations I and II: Collinearity and Functional Form (time permitting)
17. Violation III: Endogeneity and IV (time permitting)
18. Violation IV: Endogeneity and Panel Data (time permitting)
19. Violation V: Heteroskedasticity (time permitting)