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Fall Semester, 2017
Lecture: 8:30 – 9:45 a.m. MW, 136 Soc. Sci. Bldg.
Office Hours: 3:00 – 5:00 p.m. Mondays or by Appt.
Latest Version: August 29, 2017

Economics 608D
Introduction to Econometrics (Masters Level)
Course Syllabus and Outline

Course Objectives

This course is designed to be a graduate-level course in econometrics for M.A. students with a strong mathematics and statistics foundation. Students will be introduced to the major quantitative techniques that economists use to test models, study economic behavior, evaluate policies, and relationships between variables. Our goal is to learn enough methods and theory to be able to:

- ***Read*** & ***understand*** the econometric theory and arguments used in the economics literature.
- Determine which econometric technique is appropriate (inappropriate) in various circumstances.
- Conduct basic econometric analyses of various types of data using a standard software package (STATA)
- Take other MA level econometrics courses, including:

    Econ 612 Time Series Econometrics (Masters Level)
    Econ 613 Applied Econometrics: Micro (Masters Level)

MA students who want to go on to a Ph.D. in Economics or a related field are encouraged to take the required Ph.D. Econometrics sequence (Econ 703D and 707D) during their course of study at Duke. For those wanting to take one or both of the courses in the Ph.D. sequence but do not have adequate preparation, we encourage them to take Stat 601 (Bayesian and Modern Statistics) or Stat 611 (Introduction to Statistical Methods), rather than Econ 608D.

Requirements and Prerequisites

The *formal* prerequisites for this course are a strong background in Calculus and Probability and Statistics and an understanding of Matrix Algebra. Students that do not have these prerequisites should see me or the Head teaching assistant (TA). With respect to probability and statistics, please understand that neither the TAs nor I will devote much, if any, time in the lectures or discussion sessions to *teaching* or *extensively reviewing* material in basic statistics. I will provide some elementary reviews of concepts from probability and statistical theory at various points in the lecture as they arise in my discussions of aspects of regression analysis. With respect to Matrix Algebra, I will begin the course with a brief review of key aspects that we will use to formulate and characterize results in regression analysis. If you are totally unfamiliar with Matrix Algebra, you should work through Appendix A in the Greene textbook (more on the textbook below) and/or work through a Matrix Algebra text. (One is listed below under **Other Resources**.)

If you need a *permission number* to add this class, please contact the MA Staff Assistant in the

Ecoteach office (138 Social Science Building).

University Policies

Students are expected to familiarize themselves with University policies concerning grading and disabilities. Below are links to these polices:

Grading: http://registrar.duke.edu/faculty-staff/grading
Disabilities: http://access.duke.edu/students/faculty.php

Teaching Assistants, Discussion Section and TA Office Hours

Scott Abrahams (scott.abrahams@duke.edu) will be the head teaching assistant (TA) for this course and **Hao Pang** (hao.pang@duke.edu) and **Qiaohui Lin** (qiaohui.lin@duke.edu) also will serve as TAs for the course. Scott will run the Thursday and Friday Discussion Sections and Hao and Qiaohui will run the Wednesday one. Qiaohui will handle the collection and distribution of the problem sets for the course. (More on problem sets below.) All three TAs will hold weekly office hours given below. If you have questions about the lectures, problem sets or exams, do make use of these additional office hours; the TAs are there to help you learn the material in this course.

TA Office Hours:

Scott Abrahams: Wednesdays, 2:00 – 3:00 p.m., Grad Lounge (3rd floor Soc. Sci. Bldg.)
Hao Pang: Thursdays, 3:00 – 4:00 p.m., Grad Lounge (3rd floor Soc. Sci. Bldg.)
Qiaohui Lin: Fridays, 12:00 – 1:00 p.m., Grad Lounge (3rd floor Soc. Sci. Bldg.)

Course Structure

The ***lectures*** will introduce new materials and develop the key concepts of the course. I will lecture using *slides*, which are organized into *Lectures*, and a series of *handouts*. These materials are posted in appropriately labeled folders under **Resources** on course website, ECON.608D.001.F17, Sakai. The slides and handouts for particular lectures should be available on Sakai at least 24 hours before the day I lecture on this topic in class. I recommend that you bring a copy to class. If I make major changes to the slides, either during or after class, I will post updated versions of them on Sakai.

The weekly ***discussion sections*** are intended to help you get answers to questions about concepts from the lectures, the problem sets and, later in the course, about past exams. These sessions are ***not*** intended to be additional lectures. Students should come to the sessions to which they are assigned prepared with questions to ask or send them to the TAs in advance of a session so they can prepare responses to them. The discussion sections will start the week of September 5-9.

There will be ***7 problem sets*** distributed out during the course. They will be posted on Sakai, in the "Problem Sets" folder under **Resources**. This folder contains a schedule for when each problem set will be posted and when they are due. The problem sets will be *turned in* to Qiaohui Lin on or before the date they are due.

I strongly encourage you to complete the problem sets. Working problems is an effective way of

learning the theoretical aspects of econometric methods. Each problem set will include at least one empirical problem in which you will be asked to conduct some analyses on a data set. These data sets will be made available on Sakai and most of them will be in STATA format. (More on STATA below.) You are encouraged to work on the analytic problems together. You will probably find it easier to work on the empirical exercises individually, but that is up to you.

The schedule for the release and due dates for the problem sets is as follows:

Problem Set	Release Date	Due Date
Problem Set #1	8/31/2017	9/6/2017
Problem Set #2	9/11/2017	9/18/2017
Problem Set #3	9/20/2017	10/2/2017
Problem Set #4	10/4/2017	10/11/2017
Problem Set #5	10/12/2017	10/25/2017
Problem Set #6	10/30/2017	11/15/2017
Problem Set #7	11/16/2017	11/27/2017

The problem sets and any associated data files will be released on the Sakai course site and Haoyang will send you an email when they are available and tell you where the materials are located. You need to turn them in by placing them in Qiaohui Lin's Mailbox on the 2nd floor of the Social Science Building by 11:59 a.m. of the Due Date. ***No late problem sets will be accepted***. The problem sets will be graded within a week after the Due Date and will be returned at the end of class on that day. Students not picking up their graded problem sets must arrange to secure it from Qiaohui within a week of their being returned.

There will be a ***mid-term exam*** and a ***final exam*** in the course. The ***schedule*** for these exams is as follows:

Exam	Day and Time	Location
Mid-Term Exam	Monday, October 16 (in class)	139 Soc. Sci. Bldg.
Final Exam	Monday, December 18 (2 – 5:00 p.m.)	139 Soc. Sci. Bldg.

Grading

Your Course Grade will depend on your performance on the problem sets, mid-term exam and final exam in the following way:

Course Activity	Share of Course Grade
Problem Sets	5%
Mid-Term Exam	40%
Final Exam	55%
Total	100%

Concerning ***grading*** of ***problem sets***, ***exams*** and ***class attendance***, I maintain the following grading policies and practices:

1. ***Problem Sets:*** The problem sets will be graded as follows. The TA will check whether students

submitted a problem set and whether they provided answers to all of its parts. Credit on each problem set will be assigned as follows: 0 *credit if student does not hand-in problem set on time; ½ credit if student turned in problem set but didn't complete all parts; full credit if student completed all parts.*

2. ***Makeup Exams***: There will be ***no makeup exams*** and there are ***no exceptions to this rule***. If you miss the midterm, the weight of the missed exam will be placed on the final. If you miss the final exam, you will need to retake the course next year.

3. The final exam is ***comprehensive***. As you will see, it could not be otherwise, given that everything we do in this course builds on previous material.

4. The ***exams*** will be ***closed book***, but you will be allowed to bring a ***cheat sheet*** to each of the exams. There will be page limits on the cheat sheets. More on this in a couple of weeks.

5. ***Class Attendance***: Class attendance is strongly encouraged, but it is not required. I will not take attendance. Please arrive on time.

Materials Distributed in this Course

Please read and observe: All Lecture Slides, Handouts, Past and Current Exams and their Answer Sheets are **copyrighted materials**. Copyrighted materials may only be used by individuals registered for this course. They may not be given or sold to any other individuals, company or organization and may not be posted on one's own or anyone else's website without my express written permission. Copyright infringement is a violation of federal law and subject to civil penalties and, in certain circumstances, may be a violation of federal criminal law.

Data Analysis, Computer Labs, and Statistical Software

As noted above, most of the empirical problems included in problem sets will use data sets set up in STATA. I also will use STATA for some empirical examples in my lectures. The data for these examples will be made available on Sakai, so you can replicate the results I present in class. STATA is available on the computers in the Basement (Room 01) of the Old Chem Building. You also can download and install a version of STATA on your PC/laptop for use in this course. The instructions for doing this can be found here. The Activation Codes for students in this course can be found in the "STATA Activation Codes" folder in **Resources** on the course website on Sakai.

I will use Stata 15 for the empirical examples I present in class.

Course Textbook

The recommended textbook for this course is:

> Greene, William H. 2012, *Econometric Analysis*, 7th Edition. Prentice Hall.
> or
> Greene, William H. 2018, *Econometric Analysis*, 8th Edition, Pearson.

Either Edition of this text is fine for use in this course. You can purchase the 8th Edition in the

Duke Bookstore. For either Edition, you also can purchase, new or used, or rent a copy at amazon.com or valorebooks.com, and BarnesandNoble.com. I would note that you can obtain used copies of previous editions of this book and, by and large, using those previous editions (at least back to the 5th Edition) should be fine for this course. That said, it is up to students to "translate" the reading assignments below, which are given for the 8th Edition, to the earlier editions.

Other Resources

Other good undergraduate econometrics texts:

- Wooldridge, J. *Introductory Econometrics: A Modern Approach.*
- Stock, J., Watson, M. *Introduction to Econometrics.*
- Goldberger, A.S. *Introductory Econometrics*

More Advanced econometrics texts:

- Wooldridge, J. *Econometric Analysis of Cross Section and Panel Data.*
- Hayashi, F. *Econometrics.*
- Hamilton, J. *Time Series Analysis.*
- Gallant, A.R. *An Introduction to Econometric Theory.*

Texts for Linear Algebra and Statistics:

- Strang, G. *Linear Algebra and Its Applications.*
- Casella, G., Berger, R. *Statistical Inference.*

STATA
- STATA reference manuals
- STATA website: www.stata.com (See Support/Statalist)

MATLAB
- MATLAB reference manuals
- http://www.mathworks.com/
- Duke Econ computing site provides many helpful links: https://help.econ.duke.edu/wiki/help:linuxmatlab and http://dialog.econ.duke.edu/help/

Course Outline

Lecture	Topic	Readings from Greene
Introduction		
Lec. 1	Brief Intro to Matrix Algebra	Chapter 1 & Appendix A
Algebra of Least Squares		
Lec. 2	Bivariate Regression & Properties	Chapter 3
Lec. 3	Multiple Regression & Properties	Chapter 3
Lec. 4	*Ceteris Paribus* & Interpreting Multiple Regression Coefficients	Sections 3.3 & 3.4
Brief Review of Probability, Distribution Theory & Statistical Inference		
Lec. 5	Probability & Distribution Theory	Appendix B
Lec. 6	Forms of Statistical Dependence	Lecture Notes
Lec. 7	Key Issues in Statistical Inference	Appendix C
Statistical Distribution Theory for Linear Regression Model		
Lec. 8	Linear Regression Model (LRM)	Chapter 2
Lec. 9	Properties of OLS Estimation for LRM in Small Sample	Chapter 4 & Appendix D
Hypothesis Testing for Linear Regression Model		
Lec. 10	Hypothesis Testing & Confidence Intervals	Appendix C.6 & C.7
Lec. 11	Hypothesis Testing for Regression Coefficients under Normality Assumption	Chapter 5
Lec. 12	Testing Joint Hypotheses and Linear Restrictions on Regression Coefficients	Chapter 5
Additional Topics for Linear Regression Model		
Lec. 13	Functional Forms within Linear Regression	Chapter 6
Lec. 14	Heteroskedasticity	Sections 9.4 – 9.6
Sources of Bias & Ways to Deal with Them		
Lec. 15	Omitted Variable, Endogeneity & Other Biases	Chapter 8
Lec. 16	Endogeneity, Causal Effects, Instrumental Variables (IV) & Two-Stage Least Squares (2SLS)	Chapters 8 and Section 10.4
Estimation Methodology		
Lec. 17	Minimum Distance & Generalized Method of Moments (GMM)	Chapters 12 &13
Lec. 18	Maximum Likelihood	Chapter 14
More on Testing		
Lec. 19	Three Alternative Tests	Chapter 5