Economics 208D Fall 2014
Department of Economics
Duke University

INTRODUCTION TO ECONOMETRICS
Intuition, Theory and Applications

Instructor: Duncan Thomas
Office: 314 Social Sciences
Email: dthomas@econ.duke.edu
Lectures: Tuesday and Thursday 11.45am – 1.00pm
Old Chemistry 116
Office hours: Tuesday 1.15-3.15pm
Class web site: http://ipl.econ.duke.edu/dthomas/ec208d (or log on through sakai)

Graduate teaching assistants

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Sections	*Day/time (meet in Social Sciences 229)*
02	Thursday 4:55-5:45 pm
04	Thursday 1:25-2:15 pm
05	Monday 3:05-3:55 pm

Attendance at lectures and sections is required. Sections will be led by TAs. We are very fortunate to have three PhD students as TAs. They are not only experts in econometrics but each of them has experience teaching the material in this course. In addition to sections, the TAs will hold office hours on Mondays from 4pm to 6pm and Fridays 1pm to 3pm in Social Sciences 134.

Examinations

Midterm: *Thursday October 2, 11.45am-1.00pm*
The in-class mid-term is *required*. It will be open book. You may bring any materials you need to the exam. You may not communicate with anyone inside or outside the room during the examination.

Final: *Wednesday, December 10, 2:00pm-5:00pm*
The final is required. It will be closed book. You may bring *one two-sided 8.5"*11" page of formulae* that you construct and that you think will be of use to you during the exam. The sheet must be handed in with your exam.

If you have substantive questions about the course material, please see me during my office hours. Emailed questions about the material are very hard for me to answer effectively. It has been my experience that I typically need to know more about the problems you are encountering than you tell me in your email. In addition, I have no way to assess whether my e-mail response has cleared up the problem for you. I will, therefore, not attempt to answer substantive questions sent to me by email. If you cannot attend my office hours, we can make an appointment to meet at a time that is convenient for you or we can meet immediately before or after class.

Objectives

The goal of this course is to provide an introduction to both *the theory and application* of modern econometric methods to address questions in economics and the behavioral sciences. Mastery of the material is intended to provide you with sufficient knowledge of statistical and econometric theory to enable you to think critically when you evaluate the quality of evidence in support of a claim about how the world around us works. You will develop the skills to be an effective consumer and producer of empirical research in economics. Throughout the class, emphasis is placed on *intuitive understanding* of underlying concepts with more rigorous arguments serving to strengthen the foundation of your knowledge. Central concepts are illustrated with *applications*.

Requirements

You are required to have passed Probability and Statistical Inference (Stat 111). This class builds on the foundation laid in that class. Ideally you will have taken Stat 111in the semester immediately preceding this class or at least within the twelve months preceding enrolling in this class. It will be assumed that you have a good understanding of the material covered in Stat 111. With my permission, you may substitute Stat 130, 203, 250 Math 230 or 342 for Stat 111. In addition, it is assumed that you have a good grasp of calculus.

Building on the foundation laid in the pre-requisite classes, this class will begin with an introduction to the linear regression model. Core statistical concepts that you have covered in your statistics preparation will be applied to the regression model to provide a fuller understanding of the value of these tools to better understand economic phenomena and the world around us. This class will evaluate extensions to the linear regression model that are designed to address real world problems that arise in the study of economic behavior and provide rigorous tests of hypotheses in the economics and related literatures. In addition to understanding the theoretical concepts that underlie modern regression analysis, you should develop the practical skills necessary for good data analysis as well as learn how to interpret the results of your analyses. You will be required to do econometric analysis with real data from actual applications. You may use whatever computer hardware and software you like. Instruction will be provided for using STATA which you are strongly encouraged to learn. The product will serve you well in this class and other classes, research at Duke and beyond Duke. We will use STATA (version 13) in this class. You may download a copy of STATA/SE 13 for your own Mac, Windows or Linux machine. Instructions are on the class web site, http://ipl.econ.duke.edu/dthomas/ec208d/statalinks.html.

In addition, help using STATA is available in the Data and GIS lab in Perkins and at SSRI West. There are many good on-line resources, some of which are linked from the class web page.

Grading and Organization

Each week there will be two lectures. You are *required* to attend every lecture. Please turn off all phones, tablets, laptops etc before class starts. Lectures will be supplemented by a weekly section which will cover statistical material that is not covered in this class and should have been covered in your pre-requisite class. You will be responsible for this material. Sections will also review lecture material, discuss problem sets and provide computer instruction. Attendance at section is *required*. Each week, one TA will be responsible for all sections and the same material will be covered in every section that week. Attend the section for which you have signed up; if you want to change section, please check with the TAs so that we can ensure no section is too large to accommodate all students in the room.

All students are expected to understand and uphold the Honor Code, http://studentaffairs.duke.edu/conduct/about-us/duke-community-standard.

Problem sets

There will be a problem set approximately every other week. The problem sets will help you understand important ideas in the theory and application of econometric methods and help you develop and interpret empirical evidence in a practical, real-world setting. To underscore the importance of taking the problem sets seriously, they will account for 25% of the final course grade. Completed problem sets must be submitted in person at the beginning of the lecture on the due date. Late problem sets will not be accepted. If you cannot hand in your problem set at the beginning of the lecture, with my prior consent, you can hand it in earlier. Problem sets must be handed in on paper, preferably typewritten. Emailed problem sets will not be accepted.

You may work with other students in this class on problem sets. By collaborating with your peers, my expectation is that you will more fully learn the material. Explaining an idea, concept, method or result to a peer is one of the best ways to reinforce your own understanding. However, to be sure that you do understand the work, *you must write up your own answers and submit your own work.*

For each problem set, the grades will be 3 if your answer is, as far as we can tell, perfect, 2 if you appear to have a very good understanding of the material and 1 if your answers indicate a weak understanding and signal to you that you need help. A very poor grasp of the material will be assigned a grade of 0. That indicates a very serious problem and you should seek help from the TAs or me immediately. Problem sets handed in late will get a grade of 0. To convert grades to the 25% contribution of the final grade, I expect that 3 will earn 100%, 2 will earn 85% and 1 will earn 60%. 0 will earn 0%. This scheme is intended to signal to you that it is worth your while to make a good faith attempt to complete every problem set and submit it on time. Each problem set will be graded by one TA. If you have any questions, that TA will be the best person to review your answers after you have submitted your problem set. All questions about grades should be taken up with the TA who graded the problem set.

We will post carefully constructed detailed answer keys on the class web page for each problem set soon after you have submitted your problem set. Each problem set will be reviewed in section. The section will not only go over the answers but also provide insights into how to think about the problem set and thereby strengthen your understanding of the material. Given the size of the class, it is not possible to provide detailed written individual-specific feedback tor each student on his/her answer. More importantly from your point of view, it is also very difficult for us to identify every instance in which you do not understand something. It is, therefore, your responsibility to make sure you understand all the material covered in each problem set.

In-class quizzes

In-class quizzes will be administered to those attending lectures at randomly assigned times during the term. The quizzes are intended to assess your understanding of concepts covered in lectures up to that point and to provide feedback to you regarding your grasp of the material covered in the class. The in-class quizzes will account for 20% of the final grade. If you are absent from class, no matter what the reason, your grade for that in-class quiz will be zero.

Weekly discussion section

Each weekly discussion section will be led by a graduate TAs. Sections will provide instruction in STATA, including classes on good programming and data management practices; review problem sets and extend ideas covered in the problem sets; review and reinforce material covered in class or material that was covered in Stats 111. Attendance at section is required. Attendance at a section in a "week" (i.e. Section 02 or 04 on a Thursday or Section 05 the following Monday) will earn 1/3% towards the final grade. Students who attend section every "week" (as defined above) will receive a bonus and earn the maximum grade for participation in section of 5%.

Mid term exam

There will be a mid-term which will account for 10% of your course grade. The mid-term will be an open book examination. You may bring any books or materials you want to the class. You may not communicate with anyone inside or outside the classroom during the exam; this includes texting, emailing or any other form of electronic communication. There will be no make-up midterm. If you are unable to take the midterm, you must provide a written explanation *before* the mid-term. If the written explanation provides a reason that is clearly beyond your control, and I judge that it is appropriate to do so, then I will substitute your final grade for your midterm grade. In any other instances, your midterm grade will be zero.

Final exam

The final exam will be closed book and will cover all the material in the course. You do not need to memorize formulae for this class. You may bring one 8½*11 page of formulae with you for reference during the final exam; you may use both sides of the page. No other reference material is allowed. You may not communicate with anyone inside or outside the classroom during the exam; this includes texting, emailing or any other form of electronic communication. The final exam score will contribute 40% of the final grade for the course. If you miss the final exam for a reason that is outside of your control, with the approval of the Dean and if I judge that it is appropriate, you may be able to take the final exam the next time it is offered. In that case, I will substitute your grade in that exam for the final exam grade for this class after adjusting the grade so that the mean grade in both exams is the same.

Reading

The recommended text for this class is

Wooldridge, Jeffrey M. (2013) *Introductory Econometrics: A Modern Approach, 5th Edition,* Cengage

I encourage you to purchase this book. You may buy a paper or electronic copy. You do not need access to on-line resources. You may buy an earlier edition of the book.

If you find you do not like the presentation in Wooldridge's book, you might consider looking at:

Angrist J. and S. Pischke. (2009) *Mostly Harmless Econometrics*. Princeton University Press.
Goldberger, A. (1998). *Introductory Econometrics*, Harvard University Press.
Gujarati, D. (2003), *Basic Econometrics*, Irwin-McGraw-Hill.
Hill, C., W. Griffiths, and G. Lim (2011). *Principles of Econometrics*, Wiley.
Stock, J and M. Watson (2011) *Introduction to Econometrics*, Pearson.
Studenmund, A. H. (2013) *Using Econometrics: A Practical Guide*. Pearson.

None of these books covers statistical theory in a comprehensive manner. If during the course you feel you need a statistical reference, you should refer to the text you used in your statistics course. The books that I recommend for background are:

Hogg, R. V. and E. A. Tanis. (1988). *Probability and Statistical Inference*, 2nd ed, MacMillan.

If you find that book tough, take a look at

Ben-Horim, M. and H. Levy (1984) *Statistics*, 2nd edition, Random House

I will provide handouts throughout the course to supplement the lectures and textbook.

I recommend that you peruse one or more of the following texts if you are having difficulty with particular topics or concepts.

Johnston, J. and J. Dinardo (1997) *Econometric Methods*, McGraw Hill.
Johnson, A., M. Johnson and R. Buse (1987), *Econometrics: Basic and Applied*, MacMillan. [HB139.J63]
Maddala, G. S. (1988), *Introduction to Econometrics*, McGraw-Hill. [HB139.M53]
Mirer, T. W. (1988), *Economic Statistics and Econometrics*, 2nd edition, MacMillan. [HB137.M57]
Pindyck, R. S. and D. L. Rubenfeld (1981), *Econometric Models and Econometric Forecasts*, 2nd edition, McGraw-Hill. [HB3730.P54]
Tukey, J. (1970), *Exploratory Data Analysis*, Addison-Wesley. [QA278.T84]
Wallace, D. and J. L. Silver (1987), *Econometrics*, Addison-Wesley. [HB139.W32]
Wonnacott, T. H. and R. J. Wonnacott (1984), *Econometrics*, 2nd edition, Wiley. [HA29.W654]

Mirer and Wallace and Silver provide a very accessible introduction to much of the material; Johnston and Dinardo, Johnson, Johnson and Buse, Maddala and Wonnacott and Wonnacott are more advanced. Tukey is the best source for exploratory data analysis methods which are not well discussed in the other texts.

Course Outline and Required Reading

Readings from Wooldridge are required. They are intended to complement the lectures and I encourage you to read the appropriate chapters before class.

		Wooldridge
1.	*Introduction to econometrics*	Chapters 1 and 19
2.	*Simple linear regression model*	Chapter 2, 9.5, 9.6
3.	*Fundamentals of multiple regression*	Chapter 3, 9.2 9.3, 9.4
4.	*Theory of estimation and inference*	Appendices B and C
5.	*Linear regression model: Inference*	Chapter 4
6.	*Linear regression model: Asymptotics*	Chapter 5
7.	*Linear regression model: Interpretation*	Chapter 6
8.	*Indicator variables*	Chapter 7
9.	*Non-spherical errors: Heteroskedasticity and correlated errors*	Chapter 8
10.	*Limited dependent variable models*	Chapter 17
11.	*Omitted variables and sample selectivity*	Chapter 9
12.	*Instrumental variable estimation and two stage least squares*	Chapters 15 and 16
13.	*Panel data methods*	Chapters 13 and 14
14.	*Time series methods*	Chapters 10, 11 and 12

If, after class, you have difficulty with the lecture notes and Wooldridge's presentation, you should consult one of the alternative texts. They are listed, with chapter references, below. Alternative readings are identified only to assist you and are not required.

Alternative readings

Sections 1, 2 and 3: Introduction to regression model

Angrist and Pischke	Chapters 1 and 2
Goldberger	Chapters 1 and 2
Gujarati	Chapters 1, 5 and 6
Hill, Griffiths and Lim	Chapters 1, 2 and 4
Stock and Watson	Chapter 1

Section 4 : Theory of estimation and inference

Goldberger	Chapters 2-4
Gujarati	Chapters 2, 3
Hill, Griffiths and Lim	Chapters 1P, 3
Stock and Watson	Chapters 2-3

Section 5, 6 and 7: Classical multiple regression model

Angrist and Pischke	Chapter 3
Goldberger	Chapters 6 -12
Gujarati	Chapters 7-9
Hill, Griffiths and Lim	Chapters 5-7
Stock and Watson	Chapters 4 -7

Sections 8, 9 and 10: Relaxing assumptions of the regression model

Angrist and Pischke	Chapter 8
Goldberger	Chapters 13-17
Gujarati	Chapters 10-14
Hill, Griffiths and Lim	Chapter 8
Stock and Watson	Chapters 8, 9 and 11

Sections 11 and 12: Unobserved heterogeneity and instrumental variable methods

Angrist and Pischke	Chapter 4
Goldberger	Chapters 18 and 20
Gujarati	Chapter 15
Hill, Griffiths and Lim	Chapters 10-11
Stock and Watson	Chapter 12

Section 13: Panel data methods

Angrist and Pischke	Chapter 5
Gujarati	Chapters 10, 11 and 12
Hill, Griffiths and Lim	Chapter 15
Stock and Watson	Chapter 10

Section 14: Time series methods

Goldberger	Chapters 13 and 15
Gujarati	Chapters 10, 11 and 12
Hill, Griffiths and Lim	Chapter 9
Stock and Watson	Chapters 14-16