AGEC 651 Econometrics II

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Description and Goals

This course is the second of a two-course sequence in econometrics for Ph.D. students in Agricultural Economics and related disciplines. As such, the course has two basic objectives. The first is to extend, modify, and otherwise build on the *econometric techniques* already covered in some depth in AGEC 650 (i.e., the classic linear regression model, nonspherical disturbances, instrumental variables, *et cetera*). Topics covered will likely include: a review of linear regression and hypothesis testing; asymptotic distribution theory; the method of maximum likelihood estimation and implications for hypothesis testing; Wald tests and Lagrange multiplier tests; nonlinear regression techniques; instrumental variables (IV) and two stage least squares (2SLS); generalized least squares and Seemingly Unrelated Regression (SUR); probit, logit, and multinomial logit models; an introduction to panel data methods; and (possibly) an introduction to some simulation methods useful in econometrics (i.e., parametric and nonparametric bootstrap methods).

The second objective is to, where necessary, present sufficient *econometric theory* so that students will have some understanding of the techniques they are using, and, as well, will recognize the circumstances under which they might be appropriately used. This will include, for example, a rather non-technical review of large sample (i.e., asymptotic) theory. Nevertheless, this is intended to be an applied course in econometric methods, and therefore the approach will primarily be “hands on.” In other words, the chief focus will be on empirical work as opposed to theoretical topics. As such, in-class examples and handouts will be provided from time-to-time that illustrate the concepts being covered in lecture and reading assignments by using the R-language. This package is currently considered to be “state-of-the-art” in much applied econometric research, and therefore familiarity with it should help prepare you for doing your own research. While you are free to use whatever package you want (i.e., GAUSS, Ox, RATS, SAS, TSP, STATA, *et cetera*) when completing homework assignments and projects, I do not feel obligated to provide technical support for these alternatives.

Prerequisites

I assume that you have a working knowledge of the topics taught in

- Econ 615 Mathematical Analysis for Economists  
- Econ 670 Probability and Statistics  
- AGEC 650 Econometrics I
or equivalent. Importantly, I assume that you have a working knowledge of differential calculus, matrix and linear algebra, mathematical statistics and probability theory at the level of, for example, DeGroot or Hogg, Craig, and McKean. Perhaps most importantly, I assume that you have a high level of familiarity with basic linear regression methods. If your background is deficient in one or more of these areas you are strongly encouraged to do the necessary remedial work before attempting AGEC 651.

**Required Text and References**

The only required textbook is


It is also recommended that you either purchase or otherwise have access to


Greene’s book is not necessarily ‘best’ for any topic, but it is likely, at a minimum, second best for just about every topic. Moreover, the level of presentation seems to strike an appropriate balance between theory and application; the presentation is about right for a general Ph.D. level course in econometrics. For this reason it seems to be the favored text for many courses similar to AGEC 651, and will therefore be used here.

Kennedy provides a very intuitive (and therefore potentially useful) introduction to nearly every topic that we will cover this semester. I personally still find it to be a very useful reference text. It also has very good exercises.

Several additional texts may also be useful for learning econometric methods. These include but are not limited to the following list.

1. A very good treatment of models dealing with cross sectional and panel data econometrics is:

2. A very good introduction to modern time series econometrics is:

3. A more advanced treatment of time series methods is available in:

   Hamilton’s is a rather ponderous text, and is, I believe, suitable for only the truly dedicated. Nevertheless, it is something of an encyclopedia on time series econometrics, at
least through circa 1994. His coverage of, for example, spectral methods is still among the most lucid that I have found.

4. A really good introductory text, and one that many practitioners even find useful (and one that every graduate student should, I believe, own or otherwise have access to) is:


**Homework Assignments, Cooperative Learning, and R**

Working on problems is a key ingredient of this course because it is one of the best ways to assess your understanding and to help you solidify new concepts. You should find that some problems are more challenging than examples presented in class. I will do my best to, at times, make problems intentionally challenging—and sometimes, no doubt, they may be unintentionally challenging. Working on challenging problems helps stimulate your higher-order thinking, deepens your understanding of the material, and provides an opportunity for you to think creatively and independently. Simply applying route formulae to straightforward questions does not necessarily accomplish these goals.

Here’s what I expect. I believe that you may well benefit from working together in small groups on homework assignments. Cooperative work on assignments is therefore not discouraged and indeed may even be encouraged. Even so, it is required that each and every individual hand in a complete and original set of answers to each homework assignment in order to receive maximum credit. Exams are, of course, not viewed as group exercises.

This year I will continue to make heavy use of the statistical computing package R, Version 2.8.1. R is free software that will run on a variety of platforms (i.e., Unix, Windows, MacOS, etc.). It is increasingly used as a genuine research tool by econometricians and statisticians alike (I note, for example, that it is apparently used with increasing frequency in spatial econometric analysis). I will provide you with several handouts as we go. In the meanwhile, you can learn more about R at [http://www.r-project.org/](http://www.r-project.org/).

**Evaluation**

There will be somewhere between six and eight homework sets assigned during the semester, a midterm, a final exam, and a term paper. The weights in determining your final grade are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>30%</td>
</tr>
<tr>
<td>Midterm</td>
<td>30% (Tentative Date: Wed, March 25th)</td>
</tr>
<tr>
<td>Final</td>
<td>40% (Finals Week: May 4th – May 9th)</td>
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The final exam will be cumulative, although it will emphasize more heavily the material covered following the midterm. Problem sets are due in class on the date assigned. Late problem sets will only be accepted on the date due in the event of verifiable extenuating circumstances (or if there is general amnesty offered by me). Otherwise, I generally do not accept problem sets after the due date.
In the event you must miss an exam, please contact me and notify me of the circumstances in advance. Otherwise, I will not give you a makeup exam. If you do not show up for an exam and otherwise fail to notify me in advance, you will receive zero points for that exam. Makeup exams are typically more difficult than are the original exams.

Individual letter grades are not assigned to any of the exams or homework sets. Your letter grade for the course will be based on your overall score. I do plan on using the +/- grading scale.

Course Outline and Readings

Note: The papers listed below will not be covered explicitly in lectures; they are included mainly as supplementary readings, i.e., for your personal information, although some of them may be used in problem sets.

1. Review of Least Squares and Finite Sample Theory (Greene, Chapters 2, 3, and 4)
   (a) Linear Regression Models and Ordinary Least Squares
   (b) Efficiency of the OLS Estimator and the Gauss-Markov Theorem
   (c) Distribution of the OLS Estimator and Sampling Distributions
   (d) Finite Sample Properties of Least Squares and Hypothesis Testing (Greene, Appendix B.4.1 through B.4.2 may also be useful here)

2. Large Sample Properties of Least Squares (Greene, Chapter 5, Sections 5.1–5.4 and Appendix D)
   (a) Concepts and Tools in Asymptotic Theory
   (b) Consistency and Asymptotic Normality of the OLS Estimator
   (c) Wald Test Statistics and Lagrange Multiplier (LM) Tests
   (d) Special Cases

3. Nonlinear Regression Models (Greene, Chapter 11, Sections 11.1–11.4)
   (a) Assumptions, Orthogonality Conditions, and Linearization
   (b) Large Sample Properties
   (c) Numerical Optimization and Estimating Nonlinear Models
   (d) Hypothesis Testing
   (e) Applications and Examples
4. Maximum Likelihood Estimation (Greene, Chapter 16, Sections 16.1-16.4, 16.6, and 16.9)
   (a) The Principle of Maximum Likelihood
   (b) Properties of MLE Estimators
   (c) Likelihood Ratio Tests and relationship with Wald and LM Tests
   (d) Quasi MLE and Robust Covariance Matrices
   (e) Applications and Examples

5. IV and 2SLS Estimators (Chapter 12, Sections 12.1-12.6)
   (a) IV and 2SLS estimation
   (b) Measurement Error
   (c) Identification, overidentifying restrictions, and tests of overidentifying restrictions
   (d) Applications and Examples

6. Generalized Least Squares (Greene, Chapter 8, Sections 8.1–8.7)
   (a) Generalized Linear Regression Model
   (b) Feasible Generalized Least Squared (FGLS)
   (c) Heteroskedasticity and Inefficiency of Least Squares
   (d) Estimation when Ω Contains Unknown Parameters
   (e) Applications and Examples

7. Models for Panel Data (Greene, Chapter 9, Sections 9.1–9.6)
   (a) What is Panel Data?
   (b) Fixed Effects Models
   (c) Random Effects Models and Testing for Random Effects
   (d) IV Estimation and the Random Effects Model
8. Systems of Regression Equations (Greene, Chapter 10, Sections 10.1–14.2 and 10.4)

(a) The Seemingly Unrelated Regression Model
(b) Feasible GLS and Maximum Likelihood Estimation
(c) Singular Equation Systems
(d) Applications and Examples

9. Models for Discrete Choice (Greene, Chapter 23, Sections 23.1–23.4, 23.11)

(a) Discrete Choice and the Linear Probability Model
(b) Logit and Probit Models
(c) Maximum Likelihood Estimation, Inference, and Robust Covariance Matrix Estimation (QMLE)
(d) Marginal Effects, Hypothesis Testing, Goodness of Fit
(e) Conditional and Multinomial Logit Models
(f) Applications and Examples

10. The Bootstrap (Greene, Chapter 17, Sections 17.5-17.6, Handouts, and Select Articles)

(a) The Parametric Bootstrap
(b) The Nonparametric Bootstrap
(c) Pivotal Statistics and the Percentile t-Method

**Caveat**

The information and course outline contained in this syllabus are subject to change due to: (1) the needs of the class; (2) the needs of the instructor; or (3) extenuating and unforseen circumstances.