Simultaneous Equation Models

This course is about statistical models of more than one equation, accounting for more than one dependent variable, still sometimes called "causal models." We shall concentrate on linear models of a standard linear econometric sort, although we shall also consider nonlinear models, models with discrete dependent variables, and models with measurement error, as time permits.

Computer exercises and an optional term paper will provide practice at generating and interpreting concrete results, but the lectures and readings will dwell on more general questions of modeling, estimation, and inference: What sorts of models imply—and should reflect hypotheses of—what sorts of effects? What variables—and equations—must we include? What assumptions must we make, and what do they mean? How likely are the assumptions to be violated, and with what consequences? When is a model identified (roughly, estimable), and what can be done when it's not? What quantities should we be focusing on estimating? What estimators provide statistically desirable estimates? Where several different estimators might serve, what are their advantages and disadvantages? What do the estimates tell us, and how certainly? The answers enable us to understand the numbers the computer provides—and to decide what to ask it to do in the first place.

The lectures and readings will treat these questions practically but abstractly, referring more to $x$'s and $y$'s than to substantive variables. There will be much mathematical notation and mathematically phrased argument and some proof and derivation. The goal is to convey a good, reasonably deep understanding of the how's and why's of constructing, estimating, and interpreting the estimates of these models.

Students taking this course should be fluent in ordinary algebra, have a good knowledge of basic mathematical statistics (including familiarity with probability distributions, expected values, and their properties), have already taken Statistics I or an equivalent course covering the single-equation ("regression") model, and be reasonably familiar with at least one suitable statistical software package, like R, S-plus, STATA, or SAS.

Students taking this course should have already taken a course like the Government Department's Statistics II, covering the single-equation ("regression") model. There will be extra sessions, yet to be scheduled, to review matrix algebra, go over questions and assignments, and discuss concrete applications.
The readings are mainly selections from assorted econometrics texts. The widest swaths are in the following, all worth owning:


We may or may not get to the Long book, which falls at the end of the course, but it is inexpensive and useful enough to be worth having in any case.

**Outline and Readings**

I  **The Linear Simultaneous Equation Model**

Gujarati and Porter, ch. 18.
Kmenta, sec. 13.1.
Wooldridge, Sec. 9.1.


II  **Assumptions**

Kmenta, p. 656.

III  **Direct, Indirect, and Total Effects**


IV  **Identification**

Maddala and Lahiri, secs. 9.3-9.4.
Wooldridge, sec. 9.2.
V Review: Methods of Estimation and Properties of Estimators

Kmenta, secs. 6.1-6.3.
Wooldridge, chs. 1-3.
Maddala and Lahiri, ch. 2

VI More Review: The Single-Equation (Regression) Model, with a Sidebar on Seemingly Unrelated Regressions

Maddala, ch. 16.
Kmenta, sec. 12.3.
Wooldridge, secs. 4.1-4.3, secs. 7.1-7.5, 7.7.1

VII Simultaneous Equations Estimators

Gujarati and Porter, ch. 20.
Maddala and Lahiri, secs. 9.5-9.6, 9.8-9.9
Kmenta, secs. 13.3-13.6.
Wooldridge, secs. 5.1-5.2, 9.3

VIII Estimating Indirect and Total Effects (Including Reduced Form Coefficients)

Kmenta, p. 715.
Sobel, pp. 53-60.
Judge et al., sec. 15.6.

IX Special Cases: Recursive and Block-Recursive Models

Fisher, secs. 4.1, 4.2, 4.4.
Kmenta, pp. 719-20.
Hanushek and Jackson, sec. 8.5.

X Nonlinear Models

Wooldridge, sec. 9.5.

XI Models with Discrete Endogenous Variables
Models with Measurement Error

Assignments and Grading

There will be two exams, a series of exercises, and, optionally, a term paper. The exams will be in-class and closed-book. The exercises will be a mix of pen-and-paper and computer-based, the former to help cement the math, the latter, calling for you to write and analyze models of your own, to provide a taste of actual modeling. The optional term paper should apply simultaneous equation models and procedures to a substantive problem and data of the student’s choosing. It may build on but must go well beyond the exercises.

For students not writing a term paper, each exam will count for one-third of the course grade, as will the exercises (collectively, with each receiving equal weight). For students writing a term paper, the two exams, the exercises, and the term paper will each count for one-fourth.

Misc.

The class will use the UT Blackboard website, on which I shall post selected course materials, and through which I may send emails as necessary. Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, www.utexas.edu/diversity/ddce/ssd/, 471-6259.