Simultaneous Equation Models

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This course considers systems of equations. In contrast to single equation models, these models include more than one dependent variable. These simultaneous models can be grouped into two major types: recursive models, which do not create any special problems, and nonrecursive models, which require special treatment. For each of these major types, we will discuss the specification, identification, estimation, and assessment of these systems of simultaneous equations. Nonrecursive models introduce the problem of identification, or, how to establish that the parameters of the model are estimable. These models also require alternative estimation techniques.

As time permits, advanced topics, including limited dependent variables, measurement error, and handling longitudinal data will be covered. This course emphasizes application, with multiple references to published analyses and hands-on computer programming. Students should have a good understanding of the classical linear regression model and matrix algebra.

Most of the readings are drawn from four econometric texts:


Additional readings are drawn from the following structural equation modeling (SEM) texts:


All of the readings are available in the summer program library in the Newberry House.

There will be approximately 6 assignments. Due dates of assignments will be announced in class. We will also be discussing application papers as appropriate to recursive and non-recursive models (listed on last page of syllabus). Lab sessions will be announced in class.
Topics and Readings:

I. Introduction to Simultaneous Equation Models
   a. A brief introduction to simultaneous equation models

II: Review of the Classical Linear Regression model
   a. Review of matrix algebra

Readings:
   · Johnston: pp.89-100, 122-138 (ed. 4: 459-483)

b. Classical linear regression model

Readings:
   · Gujarati: chp.9
   · Greene: chp.6
   · Johnston: chp.5 (ed 4: chap 3)

Note: if you feel you need to review, read Gujarati chp.2 & 6 or Johnston chp.1-2 first.

III: Overview of simultaneous equation models
   Recursive vs. nonrecursive models; path diagrams/equations/matrices; reduced vs. structural form; direct, indirect and total effects.

Readings:
   · Gujarati: chp.18
   · Bollen: pp.32-34; 36-39
   · Kmenta: 13.1 or Greene: 16.1-16.2

IV: Recursive models
   a. Specification

Readings:
   · Gujarati: p. 764
   · Johnston: pp.467-468 (ed 4: 305-309)
   · Kmenta: pp.719-720

b. Identification

Readings:
   · Bollen: p. 88-98
   · Kenny: p. 34-41, 61-62
c. Estimation

readings:
- Gujarati: p. 681-682
- Johnston: p. 468-469 (ed. 4: 314-318)
- Kmenta: p. 720


d. Decomposition of effects

Readings:
- Bollen: pp.36-39

Defining mediation.

Readings:

Optional Reading:
- Cheung
- Preacher and Hayes.

V: SUR (seemingly unrelated regressions) models
VI: Nonrecursive simultaneous equation models

a. Specification.
   Readings:
   · Gujarati: 18.3-18.4

b. Identification
   Reading:
   · Gujarati: chp.19.1-19.3

c. Estimation
   Reading:
   · Gujarati: 20.1

   c1. Indirect least squares
      Readings:
      · Gujarati: 20.3
      · Johnston: pp. 469-472 (ed 4: 314)

   c2. 2SLS
      Readings:
      · Gujarati: 20.4, 20.5
      · Greene: 16.4, 16.5.2, and 16.5.2b
      · Kmenta: pp.681-687

Examples:
VI: Nonrecursive simultaneous equation models (cont.)

c3. 3SLS
Readings:
  · Johnston: pp.486-490
  · Kmenta: pp.695-701

c4. MLE
Readings:
  · Greene: 16.6.2
Example:
  “Relationship Between Job and Family Satisfaction: Causal or Noncausal  

d. Comparison of Methods
Reading:
  · Greene: 16.7
  · Kmenta: pp.711-714

e. Decomposition of Effects
Readings:
  · Bollen: pp.376-389

Optional Reading:
Kaplan

VII. Assessment of models

a. Equation by equation
   a1. Endogeneity tests:
      Readings:
        · Gujarati: 19.4-19.5
        · Greene: 16.8
          Econometrica 6:1251-1271
a2. Assessment of Instruments

Readings:

Optional reading:

b. Global goodness of fit statistics for overidentified models

Reading:
- Bollen: pp.263-289

Additional Topics: (covered as time permits)

Simultaneous equations with limited dependent variables

Readings:


Example:

Optional readings: Maddala 5.1, 5.8, chapter 7 and chapter 8.


**Modeling change**

*Readings:*

*Optional Reading:*

**Consequences of measurement error**

*Reading:*
Bollen: chp.5, Greene: 9.5

**Power Issues in Simultaneous Equations**

*Readings:*

**Lagged Endogenous Variables with autocorrelation**

*Readings:*
Kmenta: 13.5

**Standard Errors of indirect effects**

*Readings:*

**Using simultaneous equations to handle spatial effects**
Readings:

Autocorrelation or heteroskedasticity in simultaneous equations

Readings:
Kmenta: 13.5

Application Papers:

**SUR:** Presentation on Tuesday July 28.

**Nonrecursive:** Presentation on Monday, Aug 3.

**Nonrecursive:** Presentation on Wednesday, Aug 5.

**Categorical Variables:** Presentation on Monday, Aug 10.

**Issues to consider in your reading of the application paper**
1. Describe what the paper is trying to do, highlighting the theoretical model and how it is implemented statistically. How well is this accomplished?
2. In what ways do complexities encountered by the authors intersect with issues we’ve discussed in class?