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.
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:
V: SUR (seemingly unrelated regressions) models

Readings:
- Greene: pp.674-688
- Kmenta: 12.3

Example:

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

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:

d. Comparison of Methods

Reading:
- Greene: 16.7
- Kmenta: pp.711-714

e. Decomposition of Effects

Readings:
- Bollen: pp.376-389

Optional Reading:

VII. Assessment of models

a. Equation by equation

a1. Endogeneity tests:

Readings:
- Gujarati: 19.4-19.5
- Greene: 16.8
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:
- Bollen: 433-446.

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:

Endogeneity tests for models with dichotomous dependent variables

Readings:
Using simultaneous equations to handle spatial effects

Readings:

Autocorrelation or heteroskedasticity in simultaneous equations

Readings:
Kmenta: 13.5

Application Papers:
Recursive: Monday, July 28.

SUR: Thursday, July 31.

Nonrecursive: Tuesday, Aug 5.

Nonrecursive: Thursday, Aug 7.

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.
2. Evaluate how well the first issue is accomplished.
3. Point out any complexities that are encountered.
4. In what ways do these intersect with issues we’ve discussed in class?
5. Evaluate the paper overall. Discuss why you have given this assessment.