University of Colorado, Boulder
Economics 8858
Simulation Techniques for Applied Microeconomics
Spring 2012, MW 10:30-11:45

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> "Many branches of both pure and applied mathematics are in great need of computing instruments to break the present stalemate created by the failure of the purely analytical approach to nonlinear problems"
>
> --- John Von Neumann, 1945

Course Objectives

There seems to be an increasing use of simulation techniques in economics. There are several reasons for this. (1) for theoretical modeling, traditional analytical methods have sharp limitations. (2) for empirical analysis, traditional canned software might not be adequate for some questions and there is a huge role for simulations in performing counter-factual experiments on results. (3) many authors effectively use simulations to provide numerical (and then graphical) examples of opaque analytical results.

The objective of this course is to provide an introduction to simulation modeling in microeconomics in order to illustrate all of these advantages. There will be an emphasis on simple general-equilibrium models (which cannot be solved analytically past extremely simple cases) using common and well-known problems in problems in public economics, labor economics, international trade, environmental economics, industrial organization and in other applied micro fields.

But I will also provide a good number of other examples that illustrate the computation of problems in games and information, econometrics (e.g., constrained, non-linear least squares), matrix algebra (inverting a matrix) and calibration (basis for doing structural estimation).

Basic Information

There is no textbook for the course. All course materials will be available on both my personal website and the course website. Readings will be available on my personal web site:

http://spot.colorado.edu~markusen. Click on "Teaching", click on "Simulation modeling in microeconomics".

The course will use the software GAMS (general algebraic modeling system), a demo version which is downloadable for free - and large enough for anything we will be doing. It is already installed on all the machines in the Econ building computer labs. GAMS is widely used by economists and engineers for optimization problems and for solving systems of equations and inequalities (e.g., GAMS is used by engineers for refinery scheduling programs).

You will find GAMS notation and syntax much clearer than that in other packages such as gauss, which is a bad compromise between econometrics and simulation. The GAMS solvers are extremely robust and powerful (meaning handling problems that gauss cannot such as complementarity problems (virtually all general-equilibrium models are complementarity problems)).

I will not provide a detailed tutorial on GAMS notation and syntax. Begin with the link on my website

"Introduction to GAMS Chapter 1"

for downloading instructions and a lot of basic details. Ignore anything about a license file, you don't need one for the demo version (good up to perhaps 100 equations and unknowns). GAMS is also installed on computers in both our Econ labs.

Note for Apple users: GAMS won't work on Apple products, which are not really computers and never were. They're gadgets, and the recent outpouring over Steve Jobs is rather sickening. The solution is to partition your hard drive and then install Windows on one part. That will work and CU ITS presumably has the licenses to allow you to do this for free. The GAMS website

A Basic Course in Economic Simulation Modeling using GAMS

Preface etc.

Chapter 8: Open Economy Models for Competitive Economies

8.1 Small open economy
Model M8-1

8.2 Small open economy: tariffs versus trade costs
Model M8-2

8.3 Small open economy: calibrating to tariffs in the benchmark
Model M8-3

8.4 Small open economy: modeling a quota
Model M8-4a modeled with an endogenous (variable) tax equivalent
Model M8-4b modeled as supply/demand for licenses

8.5 Large economy and the optimal tariff (rest of world not explicitly modeled)
Model M8-5

8.6 Two-country Heckscher-Ohlin model: Nash tariffs as an iterative MPEC
Model M8-6a scalar version
Model M8-6b same model in set notation

Chapter 9: Open Economy Models for Imperfect Competition and Scale Economies

9.1 A two-country oligopoly model
Model M9-1

9.2 A two-country monopolistic-competition model
Model M9-2

9.3 Monopolistic-competition with horizontal multinationals
Model M9-3

Chapter 10: Basics of Dynamic Modeling:

10.1 Comparative steady-state analysis
Model M10-1

10.2 Converting an Infinite Horizon Problem to an MCP
Model M10-2 (currently only available in an MPS/GE format)

Chapter 11: Toward CGE Modeling;

10.1 CES functions and the calibrated-share form

10.2 The MPS/GE subsystem of GAMS

10.3 The Armington assumption

10.4 From an IO Table into GAM

Special Accommodations Policy
If you have specific physical, psychiatric, or learning disabilities and require accommodations, let me know early in the semester so that your needs may be appropriately met. You will need to provide documentation of your disability to the Disability Services Office in Willard 322 (telephone 303-492-8671)