AAE 526: Quantitative Methods in Agricultural and Applied Economics

University of Wisconsin Madison

Biochem 1116
9:55-10:45 AM, MWF

Fall Semester, 2018

Professor Thomas Rutherford
`rutherford@aae.wisc.edu`

September 5, 2018

Overview

What modeling frameworks can be used to evaluate the economic consequences of Brexit? How does road infrastructure affect congestion and urban unemployment? What about methods for evaluating the impact of parking fees on urban traffic congestion? How do renewable portfolio standards affect regional electricity prices? Economic equilibrium models provide one method of producing *ex-ante* assessment of policy impacts in a wide range of policy issues.

The starting point for this course will be nonlinear programming, a modeling format commonly employed in economic and managerial decision making. We will subsequently introduce nonlinear complementarity models, a format which is well suited for models based on the building blocks of microeconomics (price theory and game theory).

This course provides an introduction to applied general equilibrium and other applied models of economic choice commonly formulated for economic policy analysis. The course will more generally cover applications of nonlinear optimization and complementarity methods in economics, with a problem-solving perspective emphasizing the formulation and application of models to economic issues.

This semester we focus on (i) partial and general equilibrium models commonly applied for trade policy analysis, (ii) linear and nonlinear programming methods for estimation and matrix balancing, (iii) bottom-up models for transportation and electricity networks, (iv) methods for top-down / bottom-up assessment of transportation and electricity policy impacts from an economy-wide perspective.

Learning Objectives

This is a three credit course appropriate for undergraduate and graduate students interested in learning about economic policy analysis, applied nonlinear programming, and the use of numerical methods in economic policy analysis. This semester will focus on applications in traffic and electricity networks in addition to mainstream economy-wide general equilibrium applications.

The course is open to students who have had been introduced to textbook models of economic choice, linear algebra and calculus. Familiarity with linear programming is recommended but not required.

Economics students will be introduced to a bit of the science and art of numerical modeling. Industrial engineering and computer science will be introduce to some of the key ideas in the economic theory of choice and their application to practical issues.

The course incorporates skills related to both numeracy and literacy. We will learn about how to locate and interpret economic datasets. We learn to use a modeling language, methods for graphical representation and elementary spreadsheet and database skills for understanding data. We develop an appreciation for the role of models and evidence in the rhetoric of economic policy.

Instructional Mode: Face-to-face

Assignments and Assessment

- Four modeling assignments (40% total, September 28, October 19, November 9, November 30) *Attendance required.*

- Five homework assignments (20% total, September 14, October 5, October 26, November 16, November 30)

- One mid-term exam (15%, held in class on Wednesday, October 31)

- A final exam (25%, 7:25 pm, Monday, December 17). Students with an A grade at the end of the term may skip the final.

Homework assignments must be done individually, but the modeling assignments can be completed in groups of two. You may work with a particular classmate on at most one assignment. The assignments will require preparation of a deck of slides outlining your approach to the problem, model formulation, data and results. Depending on the number of persons in the class, at most three presentations will be selected for presentation to the rest of the class.

Texts and Teaching Resources

Class notes, assignments, readings, and other resources will be posted to the class site Canvas page on Learn@UW. A few readings will have direct web links from the syllabus. My goal is to place the PDF lecture notes on line by the evening before lecture to encourage participation by providing a clear summary of what material the class session will cover. Access to the site requires registration for the

class and a valid UW NetID.

The course will use the GAMS modeling language runs on both Windows and Mac computers. The course license is shown below. This license will work with all platforms supported by GAMS and will expire at the end of 2018.

```
Course_License_University_of_Wisconsin-Madison_G180806/0001AO-GEN
Agricultural_&_Applied_Economics_____
1253701901ECATBACOCPDEDIGLIPKNLGLDLSM5MBGEOQPTSBSCOSSNXAXP_____
113979150404040404040404040404040404040404040404040404040404_____
DC13532_____l_1,_m_0,_b_0,_q_0,_p_0,_d_1,_g_7_A_Eval_____
License_Admin:_Thomas_F._Rutherford,_rutherford@aae.wisc.edu_____
```

You may download the latest GAMS distribution from: `http://www.gams.com/download/`. Release notes and detailed installation instructions can be found at the top of that page. GAMS system documentation is provided electronically with the software and is also available at: `http://www.gams.com/latest/docs`. There are also several videos on YouTube introducing GAMS (e.g., `https://www.youtube.com/watch?v=p1D86dpyFfY&t=586s`).

Topics

There are three parts to the course. The initial lectures will focus on Marshallian and Harberger trade models, introducing GAMS/LP, GAMS/QCP, GAMS/NLP, and GAMS/MCP (linear, quadratic and nonlinear optimization and mixed complementarity). The link between optimizaiton and complementarity programming is Lagrangian duality which will be covered informally. Subsequent set of lectures will introduce general equilibrium analysis and GAMS/MPSGE, and the final set of lectures will deal with integrated top-down / bottom-up models.

Lectures and homework introduce the GAMS modeling language.

Weekly topics are as follows:

Market Equilibrium and Integrability

Linear, quadratic and nonlinear Programming

Lagrangian duality: nonlinear complementarity

Applications: disruptive trade policy, electricity network pricing, Wardropian traffic equilibria.

Conjugate duality: cost and expenditure functions:

General Equilibrium

Applications: trade policy, environmental policy, transportation network investment

Estimation, Calibration and Estibration

Integration of top-down with bottom-up

Textbooks

Background material for the course is covered in two textbooks. Simon and Blume provide an introduction to the mathematics of constrained optimization. Varian provides an intuitive introduction to the economic models and their application.

- Mathematics for Economists by Carl P. Simon and Lawrence E. Blume Norton, W. W. & Company, Inc.

- Intermediate Microeconomics, A Modern Approach Hal R. Varian (Author, University of California, Berkeley)

The remainder of readings for the class will be provided on the course web page.

Contact Information: Thomas F. Rutherford

- `rutherford@aae.wisc.edu`
- Office hours:
    - Thursday mornings, 330 Taylor Hall, 9:30-11:30am (phone 608 890 4576)
    - By appointment, 4243b Wisconsin Institute for Discovery (phone 608 316 4362),