

UNIVERSITY OF COLORADO
BOULDER, COLORADO

Economics 4868:
Simulation Modeling in Microeconomics

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Office: Economics Building 216,

Office Hours: Tuesday, Thursday 11.00-12.00, 13.00-14.00

No class (I'm out of the country or state): Thursday March 19, Thursday April 16

Course Outline and Reading List: Preliminary and Incomplete!

This is a new course not only to CU Economics, and it is something I am crafting from scratch and there is no textbook or other off-the-shelf materials for it. It should be of interest to students in applied math, computer science and engineering as well as to economics majors. Section size is capped at 30. We take problems from microeconomic theory, public economics, labor, trade, and environmental economics and translate them into numerical, computable models.

N.B., because there is no textbook and we work through all material in class, attendance at all classes mandatory. Three (1.5 weeks in effect) results in an F. No kidding. There will be exercises due every second week, and it is mandatory that these all be done and done on time. There will be an exercise due the second week of class, and failing to turn any exercise in on time results in the loss of half a grade point.

Intermediate microeconomics, Econ 3070 is necessary (as well as formally required) for the course. The level of math required will NOT be higher than any other 4000 level economics course, nor will the work load. But the nature, requirements, and pacing of the course will be somewhat different. Indeed, there is going to be a lot of "play it by ear" and I am prepared to adapt and improvise when a need or problem becomes clear.

The course is related to what is commonly called "operations research", which is an amalgamation of economics, engineering and applied math. We will of course focus a lot more on the economics parts of operations research.

The idea behind the course is to translate economic ideas and models that are dealt with graphically and algebraically into computable, solvable simulation models. I am hoping that this will prove to be fun as well as really solidifying people's understanding of economics. We will be able to try out ideas and scenarios in order to see the quantitative effects of changes to the economy. These could include taxes and subsidies, environmental externalities, income redistribution policies, international trade restrictions and liberalizations, public goods and so forth. We will learn how to dump simulation output to excel and create graphics.

The course will use a software package called 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 undergraduate computer lab. 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).

Look for the file “Welcome to GAMS” on my personal website for downloading and installing the software. I hope you will find it fairly easily. You can find this at:

<http://spot.colorado.edu/~markusen>

Then click on “Teaching” on the left menu

Then under “Simulation Modeling in Microeconomics”, click on “GAMS Chapter 1 2012 (Jensen)”

Or you can go there directly at:

http://spot.colorado.edu/~markusen/teaching_files/applied_general_equilibrium/GAMS/intro1.pdf

I very much hope that you will do this before the first class.

By the end of the first week, you will also need to start reading

http://spot.colorado.edu/~markusen/teaching_files/applied_general_equilibrium/GAMS/intro2.pdf

I am sorry to say that GAMS doesn’t work very well on Apple products, a common problem with many types of scientific computing software. Please see the GAMS website:

www.gams.com

I will also attach a guide for installing GAMS on Apple computers.

Likely method of assessment:

Exercises and problem sets:	40%	these must be done on time
Project:	40%	due at the time of the final exam
Class participation:	20%	ask interesting and challenging questions

The following are a list of topics for the lectures. For the reasons noted above, slides and exercises will be made up as we go along.

1. Installation of gams
 - installing on your laptop, **but please do this ahead of time**
 - installed on machines in the Economics Building computer lab (basement)
 - creating a project file and directory
 - running gams, reading output, debugging
2. Example: profit maximization for a competitive firm
 - algebra: first-order condition, derivation of cost function

3. Simple syntax, introduction to the solvers

NLP (non-linear programming, used in constrained optimization)

MCP (mixed complementarity programming - for $n \times n$ systems of equations and inequalities in n bounded (e.g., non-negative) unknowns)

direct solution as an NLP (non-linear programming) problem

solution using first-order condition as an MCP (mixed complementarity problem)

derivation of the cost function and alternative MCP solution.

4. Theory light: the Karush-Kuhn-Tucker theorem

fundamental result for optimization. Tells us we can convert a non-linear constrained optimization problem into a set of equations and inequalities in matched variables.

5. Introduction to complementarity

example of supply and demand: three types of solutions to two inequalities and unknowns with non-negative price and quantity

correspondence between equations and unknowns

use and interpretation of marginals (aka slack variables)

6. Maximizing utility subject to a budget constraint

formulated as an nlp

formulated as an mcp using the KKT (first-order) conditions

interpreting marginals as shadow values and Lagrangean multipliers

deriving Marshallian demand functions

deriving Hicksian demand functions, expenditure function

Preliminary and incomplete - January 12, 2015

7. Brief presentation of the Newton method for solving $n \times n$ problems
8. Introduction to general equilibrium modeled as a complementarity problem
Intro2.pdf, Part B
conditions for equilibrium: zero profits, market clearing, income balance
micro consistency
9. A basic two-good, two-factor general-equilibrium model
model M21.gms
assessing and interpreting counter-factuals
10. Variations on the basic model
specific factors of production, income distribution
slack activities; e.g., solar and wind power unprofitable at market prices
labor-leisure choice
two households with different preferences, income distribution
11. Taxes, distortions, public goods and bads
benchmarking with taxes
labor supply and distortionary income taxes
equal-yield tax reform with endogenous labor-leisure choice
modeling a public good or bad (pollution)
endogenous, optimal provision of the public good
12. Open (trading) economy models
modeling a small open economy
tariffs versus real trade costs
small economy with a benchmark tariff
quantitative restriction such as a quota
modeled as an endogenous tax equivalent
modeled as a license: an artificial commodity
benchmark trade imbalance
large open economies and the optimal tariff argument
13. Increasing returns to scale and imperfect competition
simple monopoly, markup formulae
oligopoly with free entry and exit
monopolistic competition
14. Added topics
games with continuous strategies as a complementarity problem
sets and conditionals
games with discrete strategies
balancing a matrix to achieve micro-consistency
comparative steady-state analysis

Policies, Etiquette

E-mail policy: you may email me with small questions, but I tend not to answer questions that have been answered twice in class. *You are responsible for what is presented in class, including revisions to the syllabus and changes in mid-term dates.*

Class attendance policy: Since there is no textbook and we are making things up as we go along, class attendance is mandatory.

Athletics, clubs events, religion, weddings, etc. policy: all these things are known well ahead of time. If you have a conflict with an exam, tell me this week or forever hold your peace.

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and www.Colorado.EDU/disabilityservices Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at www.colorado.edu/disabilityservices

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, { {insert your procedures here} } See full details at http://www.colorado.edu/policies/fac_relig.html

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

The University of Colorado at Boulder policy on Discrimination and Harassment, the University of Colorado policy on Sexual Harassment and the University of Colorado policy on Amorous Relationships apply to all students, staff and faculty. Any student, staff or faculty member who believes s/he has been the subject of discrimination or harassment based upon race, color, national origin, sex, age, disability, religion, sexual orientation, or veteran status should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the ODH, the above referenced policies and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at <http://www.colorado.edu/odh>

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students

who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academics/honorcode/>