

## Computational Economics

EBGN 645, Fall 2017

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Division of Economics and Business, Colorado School of Mines

**Class Meetings:** TR, 11a-12:15p, EH 211

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**Course Website:** [http://www.mines.edu/~jcarbone/EBGN\\_645\\_f17/](http://www.mines.edu/~jcarbone/EBGN_645_f17/)

**Instructional activity:** 37.5 hours lecture, 0 hours lab, 3.0 semester hours

**Course designation:** Elective

### Course description

This course is about learning the skills required to construct and manipulate numerical models as an instrument of economic research. It is also about learning when the use of numerical models is appropriate and, if so, what type. The first part of the course is focused on putting economic equilibrium modeling in context by exploring the theory and numerical implementation of mathematical optimization. We will learn about some basic classes of optimization problems — linear programming, non-linear programming and complementarity problems — as ways to operationalize models of individual choice and decentralized equilibrium behavior from economics. A complementary activity will be to get basic facility with writing and debugging computer programs and using the GAMS software package. In the second part of the course, we will focus on the techniques used specifically in computable general equilibrium (CGE) analysis and developing applications of CGE models to topics in energy, environmental and natural resource economics (as well as parts of international trade, public and urban economics that overlap with these fields.) Successfully completing the course will leave you with a working knowledge of how to formulate your own economic models on the computer and use them to conduct theoretical or quantitative counterfactual analysis.

The course is open to both Master's and PhD students in the Mineral and Energy Economics program. I will assume that you have successfully completed at least one graduate course in microeconomic theory and that you are comfortable with the standard mathematical tools used in economics: multivariate calculus, constrained optimization and linear algebra. You should have basic familiarity with the use of Windows-based computers. You do not need to have a background in programming to enroll in the course but you should be prepared to put in the effort needed to acquire basic programming skills early in the semester.

Textbook and/or other requirement materials:

- Required text: None
- Other required supplemental information: Course materials distributed via the course website or as books on reserve at Arthur Lakes Library.

Student learning outcomes:

At the conclusion of the class students will . . .

1. Understand basic classes of mathematical programming problems.
2. Be able to formulate and solve economic models on the computer.
3. Be able to calibrate numerical models for quantitative economic analysis.

Brief list of topics covered:

1. Theory of mathematical programming
2. Use of the GAMS numerical modeling software
3. Numerical implementation of economic models of optimization and equilibrium

Policy on academic integrity/misconduct:

The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every students academic achievements, and giving credence to the universitys educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

The complete policy is online.

Disability Support Services:

The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and I have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities, I encourage you to visit [disabilities.mines.edu](http://disabilities.mines.edu) for more information.

## Grading Procedures:

Assignments are marked on a numerical (percentage) basis, then converted to letter grades. The course grade is then calculated using the weights indicated above. As a guide to determining standing, the following letter grade equivalence will generally apply:

A	93-100	B-	80-82	D+	67-69
A-	90-92	C+	77-79	D	60-66
B+	87-89	C	73-76	F	<60
B	83-86	C-	70-72		

Students must successfully complete all components of the course to successfully complete the course. At the instructors prerogative, remedial assignments for partial credit may be requested of students who have attempted term work without achieving passing grades. Any work which is not attempted and submitted will be assigned a grade of zero.

There is no final exam scheduled for this course. There will be a final written project which will be due on Dec. 12th.

## Notes:

Students seeking reappraisal of a piece of graded term work (term paper, essay, etc.) should discuss their work with the Instructor within 15 days of the work being returned to the class.

## Readings and Problem Sets:

The readings and problem sets will be posted on the course website at least a week in advance of day they are due. The problem sets are a critical tool for learning how to master the course material. Many of the problem sets are challenging. The fact of the matter is that coding and debugging your programs is time-consuming and detailed work. The best way to learn is to struggle through these assignments and do them yourself in their entirety. You may consult your classmates or me if you get stuck but it is in your own best interest to spend a few hours on your own with the problem set before you resort to these options. A good working routine might look something like this:

1. Sit on your hands for an hour and think conceptually about how to formulate the problems in the problem set.
2. Spend an hour in front of the computer coding and debugging.
3. If you are stuck, consult your classmates.
4. If you are still stuck, send me an email.
5. Spend another hour at the computer trying to fix the problem.
6. If things are still broken, write up what you have and a few sentences explaining what parts of which problems tripped you up.

The answers to the programming exercises on the assignments should be submitted to me as a set of clearly labeled GAMS-readable files, each containing the solution to one of the problem-set questions. Homework will not be accepted if turned in late. If there are exceptional circumstances that prevent you from doing this, you must make arrangements with me in advance of the posted due date.

### Final Project:

You will complete a final project of your own design. The main parameters of the assignment that you: (i) identify a research question in economics that can be profitably answered by constructing a numerical model using the tools we have developed over the course of the semester, (ii) construct the numerical model to answer it, (iii) write a report documenting the methods for formulating, solving and calibrating the model as well as your analysis of economic issue at hand. I anticipate that your report will be approximately 15 pages in length. To help you formulate your research question for the project, you will submit a short (2 page) proposal to me by **October 10th** in which you briefly outline what your research question is and why you think it is suitable for the assignment. After submitting your proposal, you will submit a first draft of your paper on **November 9th**. Time permitting, you will also report on your progress completing the project in our class meetings during the final weeks of the semester. The final write-up of the final project is due **December 12**.

Here are some examples of projects students have pursued in the past:

- A general equilibrium assessment of energy-efficiency standards
- How can we explain the growth in France from the post WWII period using the Ramsey-Cass-Koopmans model?
- How will learning-by-doing technological change advance the market for solar photovoltaic electricity?
- A simple CGE model to estimate the effect of free trade: a study for NAFTA
- Modeling investment in low-carbon electricity generation capacity in response to the Clean Power Plan
- What is the effect of renewable portfolio standards on the U.S. steel industry?
- Modeling groundwater use in California's San Joaquin Valley

### Evaluation

Your final grade is based on the problem sets (75%) and the final project (25%).

### Coursework Return Policy:

Graded coursework will be returned to students within two weeks of the date it is submitted for evaluation.

Absence Policy (e.g., Sports/Activities Policy):

You are required to attend lecture. Notification of planned absences must be given to the instructor in advance.

Common Exam Policy (if applicable): N/A

## Course Outline and Readings

See the course website at: [http://www.mines.edu/~jcarbone/EBGN\\_645\\_f17/](http://www.mines.edu/~jcarbone/EBGN_645_f17/)