Economics 316 **Dr. Gouri Suresh**
Computational Economics **Fall 2015**

Meetings: TR 12:15 pm – 1:30 pm in Chambers 3146

Office Hours: M 10:00 am – 12:00 noon and 3:30 pm – 4:30 pm, TR 1:30 pm – 3:30 pm, and by appointment

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Course Description

Eco 316 is a 'hands on' computational methods course in which various model building and model solving approaches will be studied with a focus on economics topics.

A significant fraction of the course will be devoted to agent-based simulation models developed to analyze complex adaptive systems (systems of interacting agents that display emergent behavior). Students will learn to set-up, simulate, and analyze agent-based models related to various topics such as segregation, market formation, institutional design, collective behavior, etc. Students will be encouraged to apply these techniques to topics other than the ones already covered in in class.

Another important topic that we will cover in this course is dynamic structural economic modeling. In this context, we will discuss dynamic programming using value function iterations for deterministic and stochastic models. The applications studied in class will include setting up and solving dynamic stochastic general equilibrium models. However, as with agent-based modeling, students will be encouraged to explore the broader applicability of such techniques.

Finally, in this course we will also cover miscellaneous estimation, modeling, and optimizing techniques such as calibration, method of moments, and genetic algorithms. These methods too are widely applicable to a variety of different problems.

Students will be presented sample models along with the associated computer programs (pre-written in MATLAB) each week. In their assignments, students will be required to improve upon these sample models or develop their own model using a similar methodology to answer questions of their own liking. In addition to these assignments, a significant component of this course will revolve around two independent research projects that require students to build and solve their own models using any of the methodologies from class and present their findings in the form of a research article.

Learning Outcomes

By the end of this course, successful students will be able to:

- Construct, modify, and analyze a variety of agent based and dynamic programming models.
- Create computer programs in MATLAB to simulate and/or evaluate those models.
- Explain the intuition behind the algorithmic structure of those computer programs.
- Assess and place into context the results from the execution of those computer programs.
- Implement several different estimation and optimizing techniques such as calibration, method of moments, and genetic algorithms.

Statement on Inclusion

Your success in this class is important to me. Please let me know if there is anything I can do to help you better understand the materials in this course, and I will try to do it if I can. Having trouble with the readings? Come talk to me! Not sure about implementing programs for your ideas? Come talk to me!

Davidson College is committed to insuring full access for all qualified students in its programs. If you have a documented disability (or believe you may have a disability) that might affect your work in this class, please contact the Academic Access and Disability Resources Office (Nance Longworth, nalongworth@davidson.edu) as soon as possible. Speak with me as well so that we can collaborate on your success in the course.

Required and Supplemental Readings

Excerpts from the following textbooks and professional papers will form the required and supplemental readings for the course. These readings will either be in the form of documents uploaded on the class network folder or handouts distributed one week prior to the related in-class discussion. The reading list is tentative and subject to change.

Textbooks:

- Adda, Jerome and Russell Cooper. 2003. *Dynamic Economics*. MIT Press. (AC)
- Batten, David. 2000. *Discovering Artificial Economics: How Agents Learn and Economies Evolve*. Westview Press. (DB)
- Kendrick, David, Reuben Mercado, and Hans Amman. 2005. *Computational Economics*. Princeton University Press (KMA)
- Mitchell, Mitchell. 2009. *Complexity: A Guided Tour*. Oxford University Press. (MM)
- Tesfatsion, Leigh and Kenneth Judd, eds. 2006. *Handbook of Computational Economics. Volume II: Agent-Based Computational Economics*. North Holland. (TJ)

Professional Papers:

- Albin, Peter, and Duncan K. Foley (1992), "Decentralized, Dispersed Exchange Without an Auctioneer: A Simulation Study," *Journal of Economic Behavior and Organization,* 18, pp. 27-51.
- Callahan, Paul, "What is the Game of Life?" Accessible online at http://www.math.com/students/wonders/life/life.html
- Echenique, Federico and Roland Fryer (2007). "A Measure of Segregation based on Social Interactions," *The Quarterly Journal of Economics*, 122(2), 441-485
- Epstein, Joshua M. (2001), "Learning to be Thoughtless: Social Norms and Individual Competition," *Computational Economics,* 18, pp. 9-24.
- Epstein, Joshua M. (2002), "Modeling Civil Violence: An Agent-Based Computational Approach," *Proceedings of the National Academy of Sciences,* 99,pp.7243-7250.
- Gode, D.K., and S. Sunder (1993), "Allocative Efficiency of Markets with Zero Intelligence Traders: Market as a Partial Substitute for Individual Rationality," *Journal of Political Economy,* 101, pp. 119-137.
- Hofstadter, Douglas (1983), "Computer Tournaments of the Prisoner 's Dilemma Suggest How Cooperation Evolves," *Scientific American,* pp. 18-26.
- Holland, John H. (1992), "Genetic Algorithms," *Scientific American,* 267, pp.66-72.
- Howitt, Peter and Robert Clower(2000), "The Emergence of Economic Organization," *Journal of Economic Behavior and Organization*, 41, pp.55-84.
- Kollman, Ken, John H. Miller, and Scott E. Page (1997), "Political Institutions and Sorting in a Tiebout Model," *American Economic Review*, 87, pp. 977-992.
- Miller, John, and Scott E. Page (2004), "The Standing Ovation Problem," *Complexity,* 9(5), pp. 8-16.
- Nowak, Martin A., Karen M. Page, and Karl Sigmund (2000), "Fairness Versus Reason in the Ultimatum Game," *Science,* 289, pp. 1773-1775.
- Roth, Alvin, and Ido Er'ev (1995), "Learning in Extensive Form Games: Experimental Data and Simple Dynamic Models in the Intermediate Term," *Games and Economic Behavior* 8, 164–212.
- Schelling, Thomas (1969). "Models of segregation," *American Economic Review*, 59(2), 488–493
- Vriend, Nicolaas (2000), "An Illustration of the Essential Difference between Individual and Social Learning, and its Consequence for Computational Analyses," *Journal of Economic Dynamics and Control,* 24, pp. 1-19.
- Wilhite, Allen (2001), "Bilateral Trade and 'Small-World' Networks," *Computational Economics,* 18(1), pp. 49-64.

Grading

Lab Reports (45% of the course grade)

The course will comprise multiple distinct units. For every unit, we will study one or more models and discuss their pre-written MATLAB code. In your lab exercise for each unit, you will be required to apply any of the methods discussed in that unit to a question of your interest by modifying the code accordingly. You will describe your efforts in a lab report that must include three major sections:

- Introduction: introduce your question, explain your motivation, briefly sketch the proposed solution method, and predict outcomes and potential challenges.
- Description: describe the changes you made and state your reasoning where relevant. Remember to refer to your modified code and include detailed documentation within your code as well.
- Results: Present and explain your results clearly (in most cases this would be in the form of output from the program as well as supplementary tables and/or graphs). If your program did not work as expected, explain what you think went wrong and how you think the problem could be fixed in a future version of the program.

Over the semester, there will be 11 lab exercises and you will turn in 11 lab reports – of these, the top nine scores will be counted towards your course grade. You may work in pairs for conducting lab exercises and writing lab reports; however, you may not pair up with the same student for more than three exercises and you need to work on the last four lab exercises independently.

First Project (20% of the course grade) and Second Project (35% of the course grade)

The purpose of these projects is for you to demonstrate mastery of three skills: (1) constructing a well specified economic model, (2) simulating or solving the model using computational techniques, and (3) writing about your findings effectively.

- First Project:
  i. Proposal (3 points, due on **September 24**) – the proposal for the first project should be no longer than two pages in which you need to briefly describe your question and motivation, your modeling approach, key variables and parameters, and associated literature.
  ii. Paper (17 points, due on **October 20**) – the paper for the first project should be no longer than 10 pages in which you need to include the following sections: introduction (this section should read like a refined version of your proposal), model description (this section should describe your model clearly in terms of your variables, their interactions, and your underlying assumptions), model implementation (this section should describe how you implemented the model on the computer – be sure to refer to your well-documented computer code), and results and conclusions (please present your results clearly in the form of graphs, tables, and images for this section and explain your conclusions on the basis of your results).

- Second Project:
  i. Proposal (5 points, due on **November 3**) – the requirements for this proposal are similar to those for the proposal of the first project. If you choose to continue on your first project you may do so – be sure to include references to your first project in your proposal for the second project.
  ii. Poster Presentation (10 points, due on **December 8**) – for the second project, you need to present your results to the class in a five minute presentation as well as in the form of a poster for the Economics Poster Session. Your poster should include a summary of your question, a description of your model and the computational technique, a clear presentation of your relevant results, and a discussion of your findings.
  iii. Paper (20 points, due **before the end of Exam Period**) – the requirements for this paper are similar to those of the first project.

The Honor Code is a critical component of life at Davidson. Let's keep it that way!