Overview

- The two main goals of this course are: 1) to provide numerical solution methods, optimization techniques, and simulation methods and implement them using R, Python, Mathematica and/or MATLAB; and 2) to apply these tools to the domain of experimental and computational economics.
- The course will have two parts: the first part will provide methods for solving optimization problems, and numerical and simulation tools that are necessary to conduct simulation experiments.
- The second part of the course is devoted to applications of these tools in a variety of problems in experimental and computational economics such as the study of individual choice, learning, repeated games, and market design.

Recommended Texts:


Course Materials:

Slides from class will be posted on blackboard. Other relevant links and information will be posted on the course resources page: http://web.ics.purdue.edu/~yrosokha/comp_econ_2015.html

Course Requirements:

1. **Written responses to the readings (15%) [Starting the second week of class]:**

   By 9pm on the night before a class with a new reading assignment due, everyone must submit a brief question or comment about the readings via email. Please use the subject line "Econ690 readings for [due date]". In some cases, specific questions may be posted along with the readings. But in general, it is free form. Credit will be based on evidence that you have done the readings carefully. Acceptable responses include (but are not limited to):
• Insightful questions and critiques
• Clarification questions about ambiguities
• Solutions to problems or exercises posed in the readings
• Thoughts on what you would like to learn about in more detail
• Possible extensions or related studies
• Thoughts on the paper's importance
• Summaries of the most important things you learned

2. Class participation (15%):
Students are expected to be present and participate actively in the discussions.

3. Oral presentation/discussion moderation (10%):
Each student will be expected to lead a discussion on one of the readings. The discussion can begin with a brief summary/overview of the important points in the readings, but the assumption is to be that everyone has already completed the readings. The student may either present material related to the readings (perhaps from an outside source) or moderate a class discussion about the readings. In the latter case, the student must be prepared to keep the conversation flowing. If you would like feedback on your discussion topic, please contact Yaroslav (yrosokha@purdue.edu) by 9pm two nights before the discussion.

4. Preliminary programming/simulation exercises (5) (20%):
Each student will be required to complete five weekly programming assignments of his/her own choosing. In most cases these will come from the exercises, though other options are possible upon consultation with the instructor. Please use the subject line "Econ690 HW[#]."
It is recommended that one exercise will be completed in conjunction with the student's oral presentation/discussion/moderation.

Grading criteria for programming assignments:

• 8 - Good job, but there is room for improvement
• 9 - Good analysis, results well presented
• 10 - Excellent, with interesting research issues identified. Doing more than what has been asked.

5. Final project (40%):
A more extensive final project, along with written report, will be due on the last day of class. Students will be expected to agree with the instructor on the topic of the project by about halfway through the module. Please email a copy of your code, your final report, and any relevant data by May 5th.

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<td>Final Project</td>
<td>40%</td>
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<tr>
<td>5 Exercises</td>
<td>20%</td>
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<tr>
<td>Class Participation</td>
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<td>Written Response to the Readings</td>
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<td>Presentation</td>
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### Tentative Schedule:

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<td>3/11</td>
<td>2 Solution Methods Continued. Programming.</td>
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<td>3/18</td>
<td>------------------------------------------------------------------ Spring Vacation -------------------</td>
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<td>3/23</td>
<td>3 Numerical Methods: Function Approximation, Gradient Descent, Genetic Algorithm, Simulated Annealing</td>
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<td>HW1</td>
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<td>4 Numerical Methods Continued.</td>
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<td>9 Application: Choice Under Risk and Uncertainty</td>
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<td>10 Application: Agent-based Computational Economics</td>
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<td>11 Application: Markets and Auctions</td>
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<td>12 Application: Repeated Games</td>
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<td>13 Application: Learning</td>
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<td>14 Application: Networks</td>
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<td>5/5</td>
<td><strong>Final Project Due No Later Than Tuesday, May 5</strong></td>
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Reading List [Tentative]

1) Solution Methods: Dynamic Programming (DP), Monte Carlo (MC), and Temporal-Difference (TD)

Free Programming Resources:
- **R**
  - [http://www.r-project.org/](http://www.r-project.org/)
  - [http://www.rstudio.com/](http://www.rstudio.com/)
  - An Introduction to R:
    - [http://cran.r-project.org/doc/manuals/r-release/R-intro.html](http://cran.r-project.org/doc/manuals/r-release/R-intro.html)
    - [https://www.datacamp.com/courses/introduction-to-r](https://www.datacamp.com/courses/introduction-to-r)
- **Python**
  - [https://www.python.org/](https://www.python.org/)
  - [http://continuum.io/downloads](http://continuum.io/downloads)
  - Beginner’s Guide to Python:

Experiments:


More experiments on solving dynamic optimization problem.


In depth:

2) Numerical Methods

Discussion:


In depth:

Judd, Kenneth L. *Numerical Methods in Economics*. MIT Press, 1998. Chapter 4-4.4: Optimization; Chapter 6: Approximation Methods; Chapter 7: Numerical Integration and Differentiation; Chapter 8: Monte Carlo and Simulation Methods

3) Solution Methods Continued

Discussion:


4) Simulation Assisted Estimation and Testing

In depth:


5) **Using Simulations for Experimental Design**

Roth, Alvin E. “The Economist as Engineer: Game Theory, Experimentation, and Computation as Tools for Design Economics.” *Econometrica* 70, no. 4 (July 1, 2002): 1341–78


More on Experimental Design for Computer Simulations


6) **Choice Under Risk and Uncertainty**


Discussion


More Experiments with Stochastic Discrete Choice Model Component


7) **Agent Based Computational Economics**


Discussion

More on Experimental-Computational Complementarities


8) **Markets and Auctions**


Discussion:


More on Zero-Intelligence Agents and Market Design


9) **Repeated Games**


Discussion:


Could be interesting for discussion:


10) **Learning**


Discussion


More Experiments on Learning


11) **Networks**


Discussion


More (Computational) Experiments on Networks

