University of Oregon
Department of Economics

ECN 607
Seminar in Computational Economics, Spring 2023

David Evans

**Office: 538 PLC**
**Office Hours: Tuesdays 1:30-3:30pm* and by appointment**
**Office Hours Zoom Link:**
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## Course Description

The goal of this course is to provide students with the tools necessary to approach interesting questions in macroeconomics. The first few weeks of the course will be focused on developing the tools that will form the foundation of the course. In the remaining weeks, we will explore a variety of topics at the forefront of Macroeconomics and study how computational tools are applied to these topics. By the end of the course the goal is for students to have a toolbox of computational techniques that can be applied at the forefront of macroeconomics.

**Learning Goals and Outcomes:**

1) Demonstrate understanding of existing numerical techniques for solving dynamic economic problems
2) Develop good programming skills
3) Demonstrate the ability to build a solution algorithm suitable for a given economic problem

## Grading

Grading will consist of problem sets due every two weeks and a replication project due at the end of the course. Grades will be determined as follows:

| | |
|---|---|
| **40%** | **HOMEWORK** |
| **60%** | **REPLICATION PROJECT** |

* From 2:30-3:30 priority will be given to students in this class

## Software

We'll be studying numerical techniques to approximate competitive equilibria. You can use any language you want. I recommend using the Julia programming language as it provides an easy to learn language with performance near that of C++,C, or Fortran. I've found VS Code to be a very clean interface for working with Julia. You can find instructions for it here: https://www.julia-vscode.org/docs/dev/gettingstarted/. A good introduction to Julia can be found at https://lectures.quantecon.org/jl/learning_julia.html, which provides a good introduction to applying Julia to many economic problems.

## Homework

Electronic copies of homework assignments must be by 11:59 pm on the due date. Work in groups is encouraged but each student must submit an assignment consisting of his/her own work.

## Replication Project

In the 10th class I will give a list of papers. Your assignment will be to choose one of those papers (you may also suggest your own) and to replicate the main results. The replication project will be due by 11:59PM on the Monday of finals week. Submission should include

1) A short report documenting the main results of the paper and your corresponding replication.
2) The code which produces the replication

Electronic submission of projects is preferred. In addition to the replication, each student will be required to create a short (20 minute) presentation which summarizes the methodology and main results of the paper they are going to replicate.

## Class Recordings

Capturing what happens during our live meetings is a way to take care of one another in our COVID context and help all students deepen learning. I will make a recording of class content so that students who must miss will have a resource to refer to, and students who attended will have a resource to go back to and strengthen their learning. **I will post those recordings to Canvas** as Federal privacy law (FERPA) restricts the sharing of recordings that identify students outside of this class. Please note that recording or sharing the recordings I make without written permission from me is also a violation of the Student Conduct Code.

## Academic Honesty

Academic dishonesty (plagiarizing work, cheating on exams, mass distribution of course notes/slides) **will not be tolerated**. While I will freely post all class slides to the course website on Canvas I do not consent to having these notes mass distributed or sold to third parties (such as note-selling companies). Please acquaint yourself with the Student Conduct Code, which is published in the Schedule of Classes each term. The following are **allowed and encouraged:** studying in groups with classmates, visiting office hours in groups for collective discussion, and note sharing with others in this class.

## Accommodations and Exceptions to Rules

- Generally, I appreciate you sticking to due dates and requirements because it helps the class to go more smoothly. **HOWEVER,…**
- The world is undeniably a difficult place right now, and we don't know what the future is going to bring. We all have limits and days when we are overwhelmed. **PLEASE COMMUNICATE** with me if you feel you are falling behind or need accommodations of any kind. I will work out something reasonable. We're in this together.
- I also encouraged to seek accommodations through the UO Accessible Education Center (http://aec.uoregon.edu). AEC will then provide me with a formal letter documenting your required accommodations.

## Other Important Information, Resources, and Policies

The UO has a variety of general policies and resources you should review. Please visit https://provost.uoregon.edu/standard-university-syllabus-language or one of the more specific links below for information on the following:

- Accessible Education
- Academic Misconduct
- Inclement Weather: https://hr.uoregon.edu/content/inclement-weather-immediate-updates
- Reporting Obligations
- Mental Health and Wellness: https://counseling.uoregon.edu/
- Support for students struggling to meet Basic Needs: https://blogs.uoregon.edu/basicneeds/food/
- Accommodations for Religious Observances: https://registrar.uoregon.edu/calendars/religious-observances

## Outline of Course Material

The following is a tentative schedule of lectures and may be subject to change.

### Part 1: Tools (Weeks 1-7)

1. **Random Variables and Markov Processes:** Pseudo random variables, Monte-Carlo experiments, Finite state Markov Processes, The Kalman Filter
2. **Bellman Equations:** Value function iteration, Howard Improvement Algorithm, Solving Models with Uncertainty, Application: RBC model
3. **Root Solving:** 1 Dimensional Root Solving, N Dimensional Root Solving, Solving Perfect Foresight Models, The Diamond Mortensen Pissarides Matching Model
4. **Optimization:** 1 Dimensional Optimization, Multi-Dimensional Optimization: Gradient and Non-Gradient methods, Constrained Optimization, Optimal Tax Policy.
5. **Interpolation:** B-Splines, Spectral Methods, Basis Functions
6. **Numerical Integration:** Gaussian Quadrature, Smolyak quadrature, Monte Carlo Methods
7. **Perturbation Theory:** Linearization and Log Linearization, Blanchard-Kahn Conditions, Higher Order Perturbation, Pruning Methods
8. **Accuracy Measures:** Residuals in the model's equations, errors in model's variables. Economically meaningful measures of accuracy.
9. **Parallel processing:** Shared and Distributed Memory, Race Conditions, MPI
10. **Writing Efficient Code:** Application to a consumption savings problem.

### Part 2: Challenging Economic Applications (Weeks 8-10)

1. **Models with A Continuum of State Variables:** Bewely/Aiyagari Models, Transitions Paths, Krusell-Smith Models, Modern Perturbation Techniques
2. **Learning in Heterogeneous Agent Models:** Locally Rational Agents
3. **Bayesian Estimation of DSGE Models:** Monte Carlo methods for DSGE models
4. **Dynamic Games:** Markov perfect equilibria, stochastic games and time inconsistency
5. **Default Risk:** An introduction to sovereign default models

## References (Part 1)


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Maliar, Lilia, Serguei Maliar, and Sébastien Villemot. 2013. “Taking Perturbation to the Accuracy Frontier: A Hybrid of Local and Global Solutions.” *Computational Economics* 42(3):307–25. doi: 10.1007/s10614-012-9342-y.

Maliar, Serguei, Lilia Maliar, and Kenneth Judd. 2011. “Solving the Multi-Country Real Business Cycle Model Using Ergodic Set Methods.” *Journal of Economic Dynamics and Control* 35(2):207–28. doi: 10.1016/j.jedc.2010.09.014.

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