Weatherhead School of Management
Department of Economics

ECON 380: Computational Economics

Fall 2021, 08/24/2020 – 12/03/2020

Class Information:

Classroom: Peter B Lewis 501
Meeting Time: Tue&Thur 2:30 pm - 3:45 pm

Instructor Information:

Sining Wang

email: sining.wang@case.edu
website:sparks5969@github.io

Virtual Office Hours:

Tue&Thur 10:00 am - 11:30 am AND by appointment
Meeting ID: 2265058895
Passcode: 224701
Zoom Link: https://cwru.zoom.us/j/2265058895

Prerequisites:

Either ECON 102 or ECON 103 AND either OPRE 207, STAT 243, STAT 312, or STAT 312R
Prior programming experience (e.g. Python, R, Matlab, Stata) is recommended but not required.

Course Description:

Over the past two decades, computational methods have become an indispensable tool in social science studies. The goal of this course is to introduce undergraduate students to numerical methods and computer implementations for conducting modern quantitative research in economics and social sciences. At the conclusion of this course, students will:

> • be able to effectively apply quantitative solution methods and agent-based modeling and simulation to a wide range of economic, financial, and business issues;
>
> • learn Python and develop your programming skills. The learned programming skills will be readily applicable out of classroom;
>
> • distinguish themselves on the job-market — The course will be highly useful for students who plan to go to graduate school in either economics, business, finance or statistics as well as for students who plan to work in an environment that requires strong quantitative data/ computational skills.

Course Materials:

Textbook: There is no required text for this course. The lecture notes are fully self-contained.

Programming Software: The course will focus on Python. Python is one of the most popular programming languages. It is open source (and therefore free) and platform independent. You will be required to complete your exercises in Python. Learning the basics in Python will help you learn R, Matlab, STATA, SAS, C++, Julia, or any other language you may prefer later.

Recommended materials:
While we will cover the basics of Python in the first module of the class, I would recommend you to get familiar with Python and learn some of the basic programming techniques. The easiest way to install Python and all sorts of other useful packages for scientific computing is to install Python via the Anaconda distribution from: https://store.continuum.io/cshop/anaconda/ This is a simple one click installation process which works for Linux/Windows/Mac and it installs everything!

For those who are new to programming, I would recommend you the website https://www.learnpython.org/ This resource is very friendly to new programmers and therefore should be a good start.

Moreover, you can find many detailed and interactive tutorial practices from the book *How to think like a computer scientists*. by Allen Downey, Jeffrey Elkner and Chris Meyers. This book can help you gradually build confidence in programming. Again, both of the book and short video tutorials are available for free at https://runestone.academy/runestone/books/published/thinkcspy/index.html.

I will also recommend Dr. Susan Athey's paper "*Machine Learning Methods Economists Should Know About*" as a general advice. This paper listed some commonly used machine learning techniques in economic studies. The paper is available for download at https://arxiv.org/pdf/1903.10075.pdf

In addition, assignment readings for each of the topics will be possted along the way. Most assignment readings will focus on the theoretical background of the learning topics.

Grading:

A student's grade will be determined according to the following criteria and percentages.
- Weekly Projects   60%
- Final Exam   30%
- Quizzes   10%

Explanation of the evaluation criteria:
- **Weekly Projects:** There will be 14 projects through the semester. Usually you will have a week working it. In each of the projects, you will need to use computational methods to solve specific questions. Students are encouraged to work together on the projects, but are required to submit **independent** work.

- **Final Exam:** The final exam will be a take-home problem set. You will have 2 days working on it. No make-up or extension will be granted.

- **Quizzes:** We will have 12 quizzes through the term. Each quiz will take 5 - 10 mins. Only 10 of them will count for your final grade. The lowest two will be dropped.

Exam and Homework Policies

Typically no extensions or make-up homework or exams will be granted. If you anticipate having to miss homework or exams due to reasons out of your control, please contact your Navigator to arrange for accommodations. Note that travel plans are not an acceptable reason to reschedule exams. It is the responsibility of students to ensure that they write exams in the location, date, and time as scheduled.

Academic Integrity

A sound education is built on intellectual honesty. Students at Case Western Reserve University are required to uphold the highest ethical standards of academic conduct. All members of the campus community are responsible for preserving the standards of academic integrity and supporting the practices that promote a fair and just process. Please read the University Policy carefully at https://bulletin.case.edu/undergraduatestudies/academicintegrity/.

Academic Accommodation

Academic accommodations are available to students with documented disabilities. In order to access the accommodations for which you may be qualified, please register with the Office of Disability Resources (Sears 470) 216.368.5230 (https://case.edu/studentlife/healthcounseling/disability-resources). Their staff will verify your need for specific accommodations and provide you with a memo to inform me of your needs. Once you have received this memo, please make an appointment to see me privately to discuss your needs. Please be aware that any needed accommodations cannot be implemented retroactively; therefore, timely notification of your needs is in your best interest. You must notify me of your accommodations for each exam at least two days before an exam (i.e. where you will take the exam and other accommodation required). If you fail to do so, I cannot guarantee I can make the accommodations, since I may have to schedule a room and find a proctor.

Mental Health Support

All of us need a support system. I encourage you to seek out mental health supports if they are needed. University Health and Counseling Services (UHCS) has improved access to counseling services with Walk In visits during all office hours. We have made the process of accessing care more efficient and have eliminated the wait. It is as straightforward as this: If you would like to see a counselor, walk in. For more detail, please visit the University Counseling Service Website (https://case.edu/studentlife/healthcounseling/counseling-services).

Tentative Schedule

Section 1. Crash Course on Python (Week 1 - Week 3)

Module 1. **Class Introduction**
Coding technique: python basics

Module 2. **Will You Marry Me? The Gale-Shapley Algorithm**
Coding technique: flow control tools

Module 3. The Pandemic of COVID-19
Coding technique: scientific computing with Python

Section 2. Applications in Theory (Week 4 - Week10)

Module 4. Revisit the Market Mechanism
Coding technique: object oriented programming

Module 5. Consumer's Choice and Utility Maximization
Coding technique: root finding and optimization

Module 6. The Evolution of Cooperation in Society
Coding technique: agent-based simulation modeling

Module 7. Solow's Growth Model
Coding technique: simulation of a dynamic system

Section 3. Application in Empirical Studies (Week 11 - Week 15)

Module 8. Data Manipulation with Pandas

Module 9. Machine Learning in Economics

9-1. Regression

9-2. Classification

9-3. Cluster

9-4. Time Series Analysis