The course covers a set of numerical methods that are used to compute and estimate economic models. We mainly study dynamic models and their applications in IO and labor economics, including dynamic discrete choice, dynamic games, two-step methods (CCP based methods), and general equilibrium models. We also cover several technical tools, such as methods for solving nonlinear equations, numerical integration, approximation, and optimization.

**Reading.** There is **no required textbook** for this course. During the lectures, I will mainly use expositions and examples from the following three textbooks:


You do **not** need to buy any of these textbooks. I will distribute class slides every week. Additional readings for each topic are listed below.

**Lectures.** Lectures will be held Tuesdays and Thursdays from 11:00am-12:20pm on Zoom.

**Zoom.** I will post the Zoom meeting ID on the Canvas announcement a few hours before each lecture.

**Materials.** Each week, class notes are posted on the course website at [https://sites.google.com/site/yuyasweb/teaching/numerical](https://sites.google.com/site/yuyasweb/teaching/numerical). Homework assignments and notifications are also available there.

**Grading.** There will be **eight** problem sets, each of which accounts for one eighth of the course grade. Due dates for assignments will be announced later:

Homework 1: Solving linear/nonlinear equations  
Homework 2: Computing the Ramsey growth model  
Homework 3: Estimating a Rust (1987) type model  
Homework 4: CCP methods  
Homework 5: Computing a dynamic Markov game  
Homework 6: Function approximation
Homework 7: Interpolation in a DDC model
Homework 8: Numerical derivative/integral

I strongly recommend you work as a group of several students, but each of you should write your own answer/code.

Office Hours. By appointment.

Outline Schedule (subject to change).

Week 1 (Mar. 31, Apr. 2) Linear and non-linear equations
- L-U factorization
- Iterative methods
- Newton and quasi-Newton methods

Week 2 (Apr. 7, 9) Dynamic programming I
- Math preparation
- Value function iteration, policy function iteration
- Optimal growth model
- Dynamic discrete choice

Week 3 (Apr. 14, 16) Dynamic programming II
- Rust (1987)
- Timmins (2002)

Week 4 (Apr. 21, 23) Optimization
- Comparison method
- Newton-Raphson method
- Stochastic search

Week 5 (Apr. 28, 30) CCP methods
- Hotz and Miller (1993)
- Hotz, Miller, Sanders and Smith (1994)

Week 6 (May 5, 7) Estimation of dynamic game
- Dynamic Markov game

Week 7 (May 12, 14) Function approximation
- Local approximation methods
- Interpolation methods
- Application to dynamic discrete choice models: Keane and Wolpin (1994)
Week 8 (May 19, 21) Numerical integration and differentiation
- Gaussian quadrature
- Random number generation
- Numerical differentiation

Week 9 (May. 26, 28) Heterogeneous agent GE model I
- Computing a stationary equilibrium
- Dynamics of a heterogeneous-agent model

Week 10 (Jun. 2, 4) Heterogeneous agent GE model II
- Aggregate uncertainty

Readings.


