Meetings: Purnell 450, M&W 11:10am-12:25pm  
Instructor: Matthew N. White, Purnell 416B  
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Phone: 302-831-1906 (office), 603-566-0413 (cell)  
Textbook: Numerical Methods in Economics, Judd  
Website: Sakai (https://sakai.udel.edu)  
Office Hours: W 2:00-5:00pm or by appointment

Course Overview: This course is an entry point into the often inscrutable world of numerically solving dynamic models. I will assume that you have some familiarity with dynamic models – i.e. you will not be shocked by the concept of intertemporal choice. My intention is for the material from the PhD macroeconomics sequence to be sufficient background. Moreover, I assume that you have programmed in some computer language in the past. However, the course does not assume that you have any idea about how to actually solve dynamic models using numeric methods; that’s what I’m here to teach you.

The course can roughly be divided into three parts. The first five weeks of the course will concern numeric methods outside the context of economics or dynamic models. These are the building blocks or basic tools of the trade, which will be applied in later work: solving non-linear equations, optimization methods, functional representation (approximation and interpolation), and numeric integrals. This part of the course will draw very heavily from the Judd textbook, but will also include other methods.

The second part of the course concerns solving (and simulating) dynamic microeconomic models in discrete time. By “microeconomic”, I mean here that we are concerned with agents who take the “rules” of their dynamic problem as exogenously given: they know their own preferences and how their state will (stochastically) evolve depending on their choices. We will begin with a theoretical presentation of the class of models, then make the concepts more concrete with some simple non-economic models (and one or two “classic” economic models). The bulk of the unit will focus on consumption-saving / buffer stock problems, culminating in solving a model with two continuous controls.

The final part of the course takes a step back from microeconomic modeling and considers dynamic “macroeconomic” models. In these models, some of the objects that agents treat as exogenous inputs to their problem are actually equilibrium quantities that depend on the collective action or state of many agents. After honing concepts on a simple non-economic model, we will focus on a discrete state, discrete choice “macroeconomic” model (in a setting you probably didn’t think economics had much to say about). In the final week of the course, we will return to consumption-saving problems, but with endogenous factor prices.
About the Textbook: I'll be blunt—Judd's textbook is great. It was published in 1998 (and thus probably written primarily in the early-mid 90's) but its lessons and methods are timeless. From the perspective of twenty years in the future, there are a few anachronistic sentences, but these are largely immaterial. Do not fall into the trap of believing that we don’t need efficient numeric methods because computers today are so much faster and have so much more storage. All you’re really saying is that today’s computers allow us to solve yesterday’s models in dumb and/or lazy ways. Combining intelligent numerics with modern computing power is what allows us to solve models that would have been considered impossible in the past—the “cutting edge” of economic modeling.

Grading: TBD. The course is experimental, and the number of enrolled students is very low. I expect there will be several programming assignments throughout the semester, but I’m more concerned with providing useful feedback on style and substance rather than a numeric grade. The material is not conducive to a formal examination (certainly not a sit-down exam), but I hope to have a final project, which might be due well after the semester ends. The intent of a second year topics course is not to “weed out” underperforming students, but rather to set you on the path toward conducting your own novel research.

Reading: In grad school, all reading is recommended reading.

Schedule: The course schedule is somewhat loose and will likely be revised as the semester progresses. Take this as a rough guideline only.

PART I: Numeric Methods
Week 0, Jan 30 - Feb 1: Introduction to Python. Sheppard chapters 3-8, 9-13.
Week 1, Feb 6-8: Fundamentals of numeric programming. Judd chapter 2.1-2.8.
Week 2, Feb 13-15: Solving non-linear equations. Judd chapter 5.1-5.5.
Week 5, Mar 6-8: Integrals and random variables. Judd chapter 7.1, 7.2, 8.1, 8.2.

PART II: Microeconomic Dynamic Modeling
SPRING BREAK
Week 8, Apr 3-5: Discrete choice continued; dynamic games. Judd chapter 4.9.
Week 9, Apr 10-12: Consumption-saving with risky income. MicroDSOPs 1-5.7, 6.1.
Week 10, Apr 17-19: Consumption-saving continued. MicroDSOPs 5.8-12, 8.1; White (2015).
Week 11, Apr 24-26: Multiple controls: portfolio allocation. MicroDSOPs 7.

PART III: “Macroeconomic” Dynamic Modeling
Week 12, May 1-3: Dynamic equilibrium, representing expectations.