Numerical Methods-Lecture I: Outline of Course

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Goals

Aim is to teach numerical methods, give you the tools you need to write down, solve, and estimate models

1. Interpolation
2. Numerical derivatives
3. Maximization/minimization
   - Deterministic, stochastic
   - Derivative-based, derivative-free
   - Local, global
4. ~~Numerical integration/quadrature~~
5. Bellman equations
6. Reinforcement Learning
7. Calibrate (and possibly estimate) structural models

Odds & Ends

1. This course runs for 8 weeks, from October 19th-December 7th(ish).

2. Office hours are Thursday evenings before class, 6:00-7:00 a.m. in KRAN 315

3. Contact: tgallen [at] purdue

4. Grading: Four homeworks, one "paper"/model

5. Course Text: Judd

6. Also useful: Miranda & Fackler

7. Various readings

Background on Computational

- More and more, interesting problems have wrinkles
- Simple examples:
  - Game theory (Bringing game parameters to data)
  - Industrial organization (Demand system estimation)
  - Labor economics (Household bargaining, nonlinear constraints)
  - Public economics (program participation, dynamics)
  - Macroeconomics (DSGE models of last 30 years)

Distinguishing characteristics

- Explicit specifications of preferences, production, and behavior
- Frequently, many different actors
- Frequently, markets clearing
- Numerical output
- Increasingly, dynamic

Great Leap Forward

- Focus on numerical output has been great!
  - Complexity
  - No more hand waving (or less)
  - Closer link to data
  - Failure of models is feature not bug
  - Real predictions
- But it has its costs
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  - Death of economic intuition
  - Closed form
  - Unclear if many numerical heuristics work
  - Perhaps most importantly: black hole of time!

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Outline of course

- Matlab introduction
- Bellman equations: theory
- Bellman equations: extremely limited numerical solution
- Numerical derivatives
  - Derivative-based and derivative-free
  - Local and global
- Maximization
- Equation solving
- Interpolation
- Integration
- Simulated methods of estimation

Potential Uses of concepts

- Bellman equations: most dynamic problems
- Numerical derivatives: maximization, equation-solving
- Maximization: Agent problems, estimation
- Equation solving: Solving models
- Interpolation: Making your life easier, allowing for richer agent choice, better estimation
- Integration: Allowing for shocks, allowing for agent heterogeneity

What do you want to see?

What tools, models, papers, methods would you like to learn?