Numerical Methods-Lecture I: Outline of Course

Trevor Gallen

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. Calibrate (and possibly estimate) structural models

Odds & Ends

1. This course runs for 8 weeks, from October 21st-December 7th.

2. Office hours will be coordinated with the student(s)

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?