Econ 7760: Computational Economics

Lectures: TBA
Office hours: MW10-11AM, Uris Hall, room 452.

The course is centered around three things: approximation, optimization and simulation. Every applied work usually has these three steps. And in this class you should learn how to solve interesting economic models numerically, how to simulate models and (sometimes) how to estimate them. This class is best suited for students that intend to do numerical/applied work. Students working on problems requiring numerical solutions are especially welcomed.

Your performance will be evaluated using homework assignments (25%) and a course project (75%). For a course project you will have to either compute a solution to a model that is related to your thesis, or find an interesting published work and replicate its result using methods learned in this class.

Basic knowledge of Matlab is required. You can also use Fortran or C in this class. For computation intensive non-linear solutions Fortran is probably the best choice.

The first part of the class aims to teach basics of computation: how to approximate functions and how to find an optimum of a function.

The second part of the course aims to apply techniques learned in the first part to a neoclassical growth model. In addition to standard solution methods we will learn less used (but very useful) "endogenous grid" and "parameterized expectations" algorithms.

The third part deals with heterogeneous agents models. We start with a classic by Krusell and Smith (JPE, 1998). Then we will move to asset-pricing in incomplete markets endowment economies, *e.g.* Kubler and Schmedders (Econometrica, 2003).

The fourth part is about solving dynamic contracting problems. It will be mostly about solving principal-agent problems, but if there will be interest we can look at dynamic games from IO literature. Here we also learn how to formulate dynamic games in continuous time. Usually solutions to a continuous-time models can be characterized with a simple PDE that we will learn how to solve.

Non-parametric estimation deals with econometric models with unknown

functions. These are often used in economics to approximate distributions or to model non-linear time processes. We may also cover Bayesian estimation.

The text-book that is useful for this course is "Applied Computational Economics and Finance," by Miranda and Fackler (MIT press, 2004). But we will occasionally raid through Judd's "Numerical Methods in Economics" and de Boor's "A Practical Guide to Splines".

So, the list of topics includes but is not limited to the following.

1. Approximation of functions
2. Numerical optimization
3. Solving a neoclassical growth model
   - Value function iterations
   - Time-iterations
   - Endogenous grid method
   - Parameterized expectations method
4. Solving heterogeneous agents models
   - Krusell-Smith economies
   - Asset-pricing in endowment economies
5. Solving dynamic contracting problems
6. Optimal contracts with default
7. Optimal contracts with asymmetric information
8. Continuous time principal-agent models
9. Non-parametric estimation
   - Non-linear models with unknown functions density
   - Maximum likelihood with unknown pdf
   - Simulation-based estimation
10. Bayesian estimation