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Syllabus: Estimating dynamic models of investment & innovation

This class will cover empirical approaches to estimate dynamic models in micro-economics, focusing on applications that model firms' investment in capital goods, innovation, and R&D. These models are widely used in structural models of firm or worker behavior that are popular in the fields of industrial organization, international trade and labor economics.

Each lecture will run for 3 hours. It will start with a 2-hour overview of the underlying theory and empirical methodology. In the 3rd hour, we will implement the different estimation algorithms in a simple application. We will go over the computer code in simple Matlab programs that the students will receive beforehand. Students will then need to complete or adapt the programs to answer questions. From the 2nd lecture onwards, it will be very useful to bring your laptop to class with Matlab or Octave (a free version of Matlab) installed. Instructions will be given in the first lecture.

The class will be taught at the level of advanced (research) MA and PhD students.

Lecture 1	Monday, April 22	14:00 – 17:00	Zhifuxuan Classroom
Lecture 2	Tuesday, April 23	14:00 – 17:00	512 Classroom
Lecture 3	Wednesday, April 24	14:00 – 17:00	Zhifuxuan Classroom
Lecture 4	Thursday, April 25	14:00 – 17:00	512 Classroom
Lecture 5	Friday, April 26	14:00 – 17:00	Wanzhonglou Small Classroom

Outline

Lecture 1: Background on dynamic programming and the recursive formulation in micro-economic applications

- Lecture notes will be made available

Lecture 2: Estimating a machine-replacement problem with the nested-fixed point algorithm

- Rust, John (1987). "Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher," *Econometrica*, 55(5), 999-1033.

Lecture 3: Estimating a dynamic (single-agent) model of R&D with the NFXP algorithm using different functional form and distributional assumptions

- Peters, Bettina, Mark J. Roberts, Van Anh Vuong, and Helmut Fryges (2017). "Estimating Dynamic R&D Choice: An Analysis of Costs and Long-Run Benefits," *RAND Journal of Economics*, 48(2), 409-437.
- Doraszelski, Ulrich and Jordi Jaumandreu (2013). "R&D and Productivity: Estimating Endogenous Productivity," *The Review of Economic Studies*, 80(4), 1338-1383.
- Olley, G. Steven and Ariel Pakes (1996). "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64(6), 1263-1297.

Lecture 4: Estimating discrete, dynamic problems using conditional choice probabilities

- Arcidiacono, Peter and Paul B. Ellickson (2011). “Practical Methods for Estimation of Dynamic Discrete Choice Models," *Annual Review of Economics*, 3(1), 363-394.
- ○ Aguirregabiria, Victor and Pedro Mira (2002). “Swapping the Nested Fixed Point Algorithm: A Class of Estimators for Discrete Markov Decision Models,” *Econometrica*, 70(4), 1519-1543.

Lecture 5: Market structure & innovation: Estimating a dynamic investment game on the global automotive industry with forward simulation

- Hashmi, Aamir Rafique and Johannes Van Biesebroeck (2014). “The Relationship between Market Structure and Innovation in Industry Equilibrium: A Case Study of the Global Automobile Industry," *The Review of Economics and Statistics*, 98(1), 192-208.
- ○ Bajari, Patrick, C. Lanier Benkard, and Jonathan Levin (2007). “Estimating Dynamic Models of Imperfect Competition," *Econometrica*, 75(5), 1331-1370.

Note: papers indicated by a solid bullet (●) will be covered in most detail, the others (○) contain relevant background material