Economics 613: Seminar in Applied Econometrics  
(Continuous-Time Models)  
Spring 2017

Contact Details
Instructor: Xiye Yang  
Office: NJ Hall, Room 415  
Telephone: (848) 932-8655  
Email: xiyeyang@econ.rutgers.edu

Class Time and Location

Course Overview
The main purpose is to introduce students to the recent development of continuous-time modeling techniques in economics (macroeconomics and contract theory), finance (asset pricing and theoretical corporate finance), and econometrics (high frequency analysis). Students will learn how to employ the mathematical tools of stochastic optimization and stochastic control to solve various economic problems, and get to know the frontiers in high frequency econometrics.

Evaluation: homework and term project.

Course Outline

Part I. Mathematical Preliminaries

• Deterministic optimization/control revisited  
  – Pontryagin’s maximum principle (MP): Hamiltonian systems (first-order)  
  – Bellman’s dynamic programming (DP): HJB equations (first-order)  
  – Mathematical relationship and economic interpretation (shadow price)

• Stochastic process and stochastic calculus  
  – Brownian motion and Itô process  
  – Quadratic (co-)variation and Itô formula

• Stochastic optimization/control  
  – Pontryagin’s maximum principle (MP): Hamiltonian systems (first-order and second-order)  
  – Bellman’s dynamic programming (DP): HJB equations (first-order and second-order)  
  – Mathematical relationship and economic interpretation (shadow price and relative risk aversion)
Reference:

**Part II. Continuous-Time Macroeconomics**

- Neoclassical growth model in continuous-time
- New Keynesian model in continuous-time
- Heterogenous agent model in continuous-time

References:
Achdou, Yves, Jiequn Han, Jean-Michel Lasry, Pierre-Louis Lions and Benjamin Moll (2015), Heterogeneous Agent Models in Continuous Time. Working paper.

**Part III. Contract-theory in Continuous-Time**

- First best (risk-sharing)
- Second best (moral hazard)
- Third best (adverse selection)
- Dynamic corporate financing

References:

**Part IV. Option pricing**

- Equivalent martingale measure
- Risk premium
Part V. Continuous-Time Econometrics

- Volatility and jumps
  - Integrated volatility and spot volatility
  - Jumps and co-jumps
  - Jump excitation
- Continuous-time regression
- Factor model in continuous-time

References:


Aït-Sahalia, Yacine and Jean Jacod (2014), High Frequency Financial Econometrics, Princeton University Press.

Jacod, Jean (2009), Statistics and High Frequency Data, Lecture notes.


Li, Jia, Viktor Todorov and George Tauchen (2016), Jump Regressions, accepted for publication in Econometrica.


Aït-Sahalia, Yacine and Dacheng Xiu (2016), Principal Component Analysis of High Frequency Data, Working paper.