

ECONOMICS 885 — SPRING 2014
TOPICS IN ECONOMIC THEORY: CONTINUOUS TIME METHODS

Instructor: R. Vijay Krishna

Email: vijay.krishna@duke.edu

Textbook: *Stochastic Calculus for Finance II*, Steven Shreve, Springer; *The Economics of Inaction*, Nancy Stokey, Harvard.

Where: Thursday 6:30 pm – 9:00 pm, Social Sciences 228

Course Content

The course consists of two modules. The goal of the course is to provide more than a passing familiarity with stochastic calculus so that you are able to read research papers and use these techniques in your own research. The first module will provide us with basic techniques in stochastic calculus, while the second module will look at applications, especially control and filtering problems. My own research interests are primarily in information economics, mechanism design, and contract theory, and this will reflect, to some extent, the choice of papers we will consider. Of course, your interests can also affect our choice.

Module 1

The course will begin with a quick review of discrete time martingales. We will cover the basics of continuous time stochastic processes that have continuous paths. This will include a study of Brownian motion, continuous time martingales, stopping times and related properties, a construction of the Ito stochastic integral, Ito's formula, the PDE connection, Girsanov's Theorem, the Martingale Representation Theorem, and connections to the heat equation and the Black-Scholes formula, as well as infinitesimal generators for Markov processes (diffusions), and Kolmogorov's equations.

This will be groundwork for the Module 2.

Module 2

I will assume that you have taken Continuous Time Methods, Module 1. We will primarily be interested in the control and regulation of continuous time, continuous

path stochastic processes. Topics include the HJB equation, stopping problems, and applications in dynamic games and mechanism design. The second half of the course will involve studying important and exemplary papers.

Economic applications will include dynamic mechanism design with a focus on corporate finance and macroeconomics; information acquisition and experimentation; equilibrium models at the interface of finance and macro. We will also look at inventory and storage models, which are very useful in the macro literature. A text for the second half is Stokey's *The Economics of Inaction*.

Below is a small sample of the papers we will read. We will try and understand these papers very well. The last couple of weeks of the course will involve student presentations of other papers.

Papers

- P. DeMarzo and Y. Sannikov. Optimal security design and dynamic capital structure in a continuous-time agency model. *Journal of Finance*, 61(6):2681–2724, 2006.
- B. Biais, T. Mariotti, G. Plantin, and J.-C. Rochet. Dynamic security design: Convergence to continuous time and asset pricing implications. *Review of Economic Studies*, 74(2):345–390, 2007.
- P. Bolton and C. Harris. Strategic experimentation. *Econometrica*, 67:349–374, 1999.
- B. Daley and B. Green. Waiting for news in the market for lemons. *Econometrica*, 80(4):1433–1504, 2012.
- Y. Sannikov. A continuous-time version of the principal-agent problem. *Review of Economic Studies*, 75(3):957–984, 2008.