Syllabus

1 Contact Information

- Office Hours: 812 Uris Hall; open-door or by email
- Email: neng.wang@columbia.edu
- TA: Ran Liu, RLiu21@gsb.columbia.edu
- Course materials: I will distribute course materials in class as we move forward. Please email Leticia Jerman at lj2192@columbia.edu. She is super nice and will be extremely helpful.

- Class-room and Time: URIS 327, Wednesday 9:00AM-12:15PM.
  
  *But we need to reschedule several sessions to Fridays.*

2 Course Description

This course covers topics on no-arbitrage-based asset pricing (e.g. option pricing, term structure, credit risk), optimal consumption and portfolio choice, general equilibrium/asset pricing theory, dynamic contracting, and dynamic corporate finance theory using continuous-time methods. We cover both the classics and frontier research papers. The specific coverage for the course also depends on your background and preferences. I will not delve into the mathematical details of Stochastic Calculus but rather focus on economic applications and insights. It is very important for you to understand the economic mechanism and insights in these models. Most of you will not work with continuous-time models and hence my philosophy is to prepare you as an intelligent consumer of models and research that use continuous-time methods. I use continuous-time methods to teach economics of finance, rather than force this method onto economic and financial applications.
3 Readings and References

- The “textbook” (broadly interpreted) for the asset pricing part of the course is
  - Duffie, D. [2001]. *Dynamic Asset Pricing Theory*

Lectures will be based primarily on my notes and sometimes research articles. We will have a tentative course schedule. The exact progression of the course will depend on you. We will adapt our speed and coverage as we move forward.

- A standard reference book is
  - Merton, R. C. [1990]. *Continuous Time Finance*
  
  which includes a few overview chapters and a collection of Merton’s classic articles.

- Additionally, I also recommend the following books:
  - Dumas and Luciano’s “The Economics of Continuous-Time Finance”
  - Kerry Back’s “Asset pricing and portfolio choice theory”
  - George Pennachi’s “Theory of asset pricing”
  - Steve Shreve’s “Stochastic Calculus for Finance II: Continuous-Time Models.”

4 Course Requirements and Grading

Course requirements include (1) individual homework assignments, (2) a final exam, and (3) a referee report. It is possible that I may decide to do away with either (2) or (3), depending on how the course evolves. If I ask you to write a referee report, you will choose a paper within a subset of papers related to the course theme and approved by me. Writing high-quality referee reports is an important academic skill. Of course, class participation (broadly interpreted) is also part of your course evaluation.

Grading will be based on your overall performance on individual homework assignments, the final exam and the referee report.

I’ve intentionally chosen to provide a flexible course requirement. This is one of the few occasions in teaching that the value of ex post flexibility is greater than the value of ex ante commitment.

5 Course Outline and Readings (Tentative)

Below is a tentative schedule of topics and readings.
5.1 Brownian Motion and Stochastic Calculus

- Brownian motion and stochastic integration
- Stochastic discount factor (SDF)
- Equivalent Martingale Measure (EMM)
- SDF, EMM, and No Arbitrage

Readings:


5.2 Risk Neutral Pricing and Option Pricing

- Redundant Securities
- Complete Markets
- The Black and Scholes economy
- Pricing: The Martingale Approach
- Pricing: The PDE Approach
- Replication
- Put-Call Parity
- Stochastic Volatility and Jump Models

Readings:


5.3 Term Structure of Interest Rates

• ‘Equilibrium’ models

• Short-rate models

• Arbitrage-free models

• Affine models

Readings:


5.4 Stochastic Volatility and Jump Models

• Heston model

• Affine jump diffusion

Readings:


• Heston S. [1993]. A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options, Review of Financial Studies 6, 327-344.


5.5 Credit Risk Models

• “Structural” models, e.g. Merton, Leland, and etc.

• Reduced form models, affine models, doubly stochastic (Cox) models

Readings:


• Duffie and Singleton, Credit Risk, Princeton University Press


5.6 Optimal Portfolio and Consumption Choices

• Merton’s Problem

• The Hamilton Jacobi Bellman approach (Dynamic Programming)

• The Martingale approach

• Example: Portfolio choice with margin constraints, predictability, or labor income shocks

Readings:


• Cox and Huang (1989, JET)


• Heston S. [1993]. A Closed-Form Solution for Options with Stochastic Volatility with Applications to Bond and Currency Options, Review of Financial Studies 6, 327-344.
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• Davis and Norman
• Grossman and Laroque (1990, Econometrica)

5.7 Equilibrium
• The Lucas-Breeden Model and Consumption CAPM
• Production-based Asset Pricing
• Intertemporal CAPM
• Long-Run Risk Models (Bansal and Yaron)
• Habit Models (Campbell and Cochrane)
• Heterogeneous Agents Models

Readings:


• Lucas (1978, Econometrica)

• Bansal and Yaron (2004, JF)

• Campbell and Cochrane (1999, JPE)
5.8 Dynamic Corporate Investment under MM

Readings:

- Hayashi (1982, Econometrica) and the $q$ theory of investment
- McDonald and Siegel (1986, QJE), Dixit and Pindyck (1994) and Real options
- Abel and Eberly (1994, AER)

5.9 Contingent-Claims Capital Structure Models

Readings:

- Leland and Toft (1996, JF)
- More recent work on banking

5.10 Dynamic Models with Financial Constraints

Readings:

- DeCamps, Mariotti, Rochet, and Villeneuve (2011 JF)

5.11 Dynamic Contracting

Readings:


5.12 Financial Frictions and Macro

Readings:

- Brunnermeier and Sannikov (AER)
- Krishnamurthy and He (REStud)
5.13 Dynamic Learning Models

- Kalman filter and applications in Economics and Finance
- Nonlinear filtering and applications in Economics and Finance

5.14 Other Topics and Applications in Finance and Economics

Readings:

- Macro: household savings and self insurance models
- Wealth distribution and inequality
- International Finance: sovereign debt