

Applied Stochastic Processes

Module 2, 2014

Instructor:

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Teaching Assistant:

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Lecture Hours:

Tuesday and Friday (3:30 – 5:20pm)

Office Hours:

Wednesday (4:30 – 5:20pm)

Lecture Hall:

PHBS 319

Course Aims and Objectives:

This course is designed to provide students with mathematical background on the stochastic processes and its applications to the modern Finance. The course begins with intermediate probability theory and the derivation of the famous Black-Scholes' formula. Subsequently, three solution methods of the BS formula are introduced, i.e. using CRR model, heat equation, and quantum methods. In addition, three applications are introduced, i.e. 'Empirical Market Microstructure', 'Dynamic Macroeconomics', and 'Financial Risk Management'.

Essential Course Textbooks:

Baaquie, B.E., "Quantum Finance: Path Integrals and Hamiltonians for Options and Interest Rates," Cambridge University Press, 2007

Hull, J., "Options, Futures and Other Derivatives," Prentice Hall, 2006

Gut, A., "An Intermediate Course in Probability Theory," Springer, 2009

Liboff, R.L., "Introductory Quantum Mechanics," Addison-Wesley, 1980

Ljungqvist, L., Sargent, T.J., "Recursive Macroeconomic Theory," MIT Press, 2012

Merton, R., "On the Pricing of Corporate Debt: The risk structure of interest rates," J.F., 2012

Nielsen, L.T., "Pricing and Hedging of Derivative Securities," Oxford University Press, 1999

Shreve, S., "Stochastic Calculus for Finance II: Continuous-Time Models," Springer, 2007

Prerequisites:

Advanced Calculus, Probability Theory and Mathematical Statistics

Lecture Notes:

<http://www.econ.re.kr/>

Grading:

Quiz (60%), Assignments (20%), and Group Project (20%)

Assignments:

Students are required to submit 7 assignments (hardcopy) to a TA. This is an individual task, not a group work. These assignments will help students keep track of key ideas of the courses. Late submission does not count towards the final mark.

Attendance:

The weight (no absence: 1, one absence: 0.99, two absences: 0.98, and more than two absences: 0.7) will be used for the final GPA adjustment.

Extra Help:

Do not hesitate to come to my office during office hours or by appointment to discuss any aspect of the course.

Course Outline

	Date	Time	Topics Covered
01	14 th Nov, 03:30-5:20pm Friday	Part 1. Probability Theory	Intermediate Probability Theory Gut, A. (Chapters 1, 2 and 3)
02	18 th Nov, 03:30-5:20pm Tuesday		Random Walk Shreve, S. (Chapter 8)
03	21 st Nov, 03:30-5:20pm Friday		Measure, Probability and Integration Nielsen, L.T. (Appendices A and B)
04	25 th Nov, 03:30-5:20pm Tuesday	Part 2. Stochastic Calculus	Brownian Motion Nielsen, L.T. (Chapter 1) and Hull, J. (Chapter 13)
05	28 th Nov, 03:30-5:20pm Friday		Ito's Lemma Nielsen, L.T. (Chapter 2) and Hull, J. (Chapter 13)
06	2 nd Dec, 03:30-5:20pm Tuesday		Black-Scholes PDE Nielsen, L.T. (Chapters 5 and 6)
07	5 th Dec, 03:30-5:20pm Friday		Heat Equation Nielsen, L.T. (Appendix C)
08	9 th Dec, 03:30-5:20pm Tuesday	Parts 1 & 2	Quiz 1 (20%) & (i) Demo – MATLAB
09	12 th Dec, 03:30-5:20pm Friday	Part 3. Empirical Market Microstructure	Price as Martingale Plus Noise Glosten and Milgrom (1985)
10	16 th Dec, 03:30-5:20pm Tuesday		Trading costs Bertsimas and Lo (1998) and Hasbrouck (Chapter 15) Estimating quadratic variation despite the market microstructure Zhou (1998)
11	19 th Dec, 03:30-5:20pm Friday	Part 4. Dynamic Macroeconomics	Recursive Macroeconomic Theory, 2 nd Edition Ljungqvist and Sargent (Chapter 24)
12	23 rd Dec, 03:30-5:20pm Tuesday	Part 5.	On the Pricing of Corporate Debt Aspachs et al. (2006, 2007), Merton (1974)
13	26 th Dec, 03:30-5:20pm Friday	Financial Risk management	The Risk Structure of Banks Lau and Amadou (2007), Ahn et al. (2014)
14	30 th Dec, 03:30-5:20pm Tuesday	Parts 3 & 4 & 5	Quiz 2 (20%) & (ii) Demo – MATLAB
15	6 th Jan, 03:30-5:20pm Tuesday	Part 6. Quantum Finance	Operators, Eigenfunctions and Eigenvalues Liboff, R.L. (Chapter 3)
16	7 th Jan, 03:30-5:20pm Wednesday		Function Spaces and Hermitian Operators Liboff, R.L. (Chapter 4)
17	9 th Jan, 03:30-5:20pm Friday		Hamiltonians and Stock Options Baaquie, B.E. (Chapter 4)
18	13 th Jan, 03:30-5:20pm Tuesday	Parts 5 & 6	Quiz 3 (20%) & (iii) Demo – MATLAB

These are subject to change.