MATH-UA 250, MA-UY 4324 – Mathematics of Finance - Fall 2019

4 points. Fall and Spring terms.

Course Description

Introduction to the mathematics of finance. Topics include: Linear programming with application pricing and quadratic. Interest rates and present value. Basic probability: random walks, central limit theorem, Brownian motion, lognormal model of stock prices. Black-Scholes theory of options. Dynamic programming with application to portfolio optimization.

Prerequisites

MATH-UA 123 Calculus III or MATH-UA 213 Math for Economics III (for Economics majors), and an introductory course in probability or statistics (MATH-UA 233 Theory of Probability, MATH-UA 235 Probability and Statistics, ECON-UA 18 Statistics, ECON-UA 20 Analytical Statistics, STAT-UB 103 Statistics for Business Control and Regression/Forecasting Models, or equivalent) with a grade of C+ or better.

Sections

1. Section 001/Section A – Mon, Wed 9:30-10:45am – CIWW 102 - Instructor: Professor Leon Tatevossian (lt56@nyu.edu)
2. **Section 003/Section B – Tue, Thu 5:30-6:45pm – CIWW 517**
    a. **Instructor: Professor Amir Sadr (as73@nyu.edu), Office Hours: Fri, 1:00-2:00pm, CIWW 518, or by Appointment**
    b. **Recitation (Section 004) Leader: Nate Huang (fh980@nyu.edu), Fri, 2:00-3:15pm, CIWW 517 – First Recitation: Sep 13th**
    c. **Grader: Zihan Liu (zihan.liu@nyu.edu)**

Textbook

Required: *Mathematics for Finance: An Introduction of Financial Engineering* – Marek Capinski and Tomasz Zastawniak, Second Edition, Nov 25, 2010

Supplementary (Optional): *Interest Rate Swaps and Their Derivatives: A Practitioner's Guide* – Amir Sadr, Sep 9, 2009

Grading

- 50% based on Quizzes (in class, take-home) and homework assignments, including Python programs
- 20% In-class Midterm
- 30% In-Class Final

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Section 003 Syllabus

Session	Week	Date	Syllabus	Test, Assignment	Grade %
1	1	Tue, Sep 03, 2019	Money landscape		
2	1	Thu, Sep 05, 2019	Time value of money		
3	2	Tue, Sep 10, 2019	Rate vs. Yields		
4	2	Thu, Sep 12, 2019	Bond math	In-class Quiz # 1	1%
5	2	Fri, Sep 13, 2019	Recitation: HW # 1, 3rd Wed of each quarter end	HW # 1	1%
6	3	Tue, Sep 17, 2019	Random returns, probability review, mean, variance		
7	3	Thu, Sep 19, 2019	Markowitz bullet, Modern portfolio theory (MPT)	In-class Quiz # 2	3%
8	3	Fri, Sep 20, 2019	Recitation: HW # 2, Graph a feasible set	HW # 2	3%
9	4	Tue, Sep 24, 2019	Efficient Frontier, Risk-free asset		
10	4	Thu, Sep 26, 2019	CAPM, Market portfolio	In-class Quiz # 3	3%
11	4	Fri, Sep 27, 2019	Recitation: HW # 3, Stats on returns, Sharpe ratio	HW # 3	3%
12	5	Tue, Oct 01, 2019	Spot vs. forward, cash and carry		
13	5	Thu, Oct 03, 2019	Forwards vs. futures	In-class Quiz # 4	3%
14	5	Fri, Oct 04, 2019	Recitation: Review		
15	6	Tue, Oct 08, 2019	Probability review: Normal, LogNormal		
16	6	Thu, Oct 10, 2019	Random walk, Brownian Motion	In-class Quiz # 5	3%
17	6	Fri, Oct 11, 2019	Recitation: HW # 4, Generate sample paths for Brownian	HW # 4	3%
	~~7~~	~~Tue, Oct 15, 2019~~	~~Legislative Day - Classes will meet according to a Monday~~		
18	7	Thu, Oct 17, 2019	1-step model for derivatives		
19	7	Fri, Oct 18, 2019	Recitation: Review		
20	8	Tue, Oct 22, 2019	1-step to 2-step to …, no arbitrage, risk-neutral paradigm		
21	8	Thu, Oct 24, 2019	Self-financing, risk-neutral probabilities	In-class Quiz # 6	3%
22	8	Fri, Oct 25, 2019	Recitation: HW # 5 - Fully worked out 2-step model	HW # 5	3%
23	9	Tue, Oct 29, 2019	Black-Scholes PDE, Black-Scholes via Risk-Neutral		
24	9	Thu, Oct 31, 2019	Quick review	In-class Midterm	**20%**
25	9	Fri, Nov 01, 2019	Recitation: Review		
26	10	Tue, Nov 05, 2019	Black Normal vs LogNormal, Put-call parity, Greeks		
27	10	Thu, Nov 07, 2019	Strategies: Straddles, strangles, call-spreads, …	In-class Quiz # 7	3%
28	10	Fri, Nov 08, 2019	Recitation: HW # 6 - Option PL explanation	HW # 6	3%
29	11	Tue, Nov 12, 2019	forward rates, interest rate swaps		
30	11	Thu, Nov 14, 2019	Interest rate option formulae	In-class Quiz # 8	3%
31	11	Fri, Nov 15, 2019	Recitation: Review		
32	12	Tue, Nov 19, 2019	Interest rate models: Short rate		
33	12	Thu, Nov 21, 2019	Mean-reversion, Z-Score	In-class Quiz # 9	3%
34	12	Fri, Nov 22, 2019	Recitation: HW # 7 - Regression-weighted butterfly	HW # 7	3%
35	13	Tue, Nov 26, 2019	Interest rate products: Cap/floors, Swaptions		
	~~13~~	~~Thu, Nov 28, 2019~~	~~Thanksgiving recess - No classes~~		
	~~13~~	~~Fri, Nov 29, 2019~~	~~Thanksgiving recess - No classes~~		
36	14	Tue, Dec 03, 2019	American options, Backward induction		
37	14	Thu, Dec 05, 2019	Asian options, Path-dependent	In-class Quiz # 10	3%
38	14	Fri, Dec 06, 2019	Recitation: HW # 8 - Backward induction	HW # 8	3%
39	15	Tue, Dec 10, 2019	Value at Risk		
40	15	Thu, Dec 12, 2019	Course Review		
41	15	Fri, Dec 13, 2019	Last day of Fall 2019 classes - Course review		
42	16	Tue, Dec 17, 2019	Exam week - Final Exam - In Class	In-class Final	**30%**
					100%