THE WHARTON SCHOOL

Prof. Winston Dou FNCE717

Spring 2021

Course Syllabus
Financial Derivatives

Course Description

This course covers one of the most exciting yet fundamental areas in finance: derivative securities. In the modern financial architecture, financial derivatives can be the most challenging and exotic securities traded by institutional specialists, while at the same time, they can also be one of the most basic securities commonly traded by retail investors such as S&P 500 Index Options. Beyond trading, the basic ideas of financial derivatives serve as building blocks to understand a much broader class of financial problems, such as complex asset portfolios, strategic corporate decisions, and stages in venture capital investing.

The global derivatives market is one of the most fast-growing markets, with over $600 trillion notional value in total. It is as important as ever to understand both the strategic opportunities offered by these derivative instruments and the risks they imply.

The main objective of this course is to help students gain the intuition and skills on (1) pricing and hedging of derivative securities, and (2) using them for investment and risk management. In terms of methodologies, we apply the non-arbitrage principle and the law of one price to dynamic models through three different approaches: the binomial tree model, the Black-Scholes-Merton option pricing model, and the simulation-based risk neutral pricing approach.

We discuss a wide range of applications and real-life cases, including the use of derivatives in asset management, the valuation of corporate securities such as stocks and corporate bonds with embedded options, interest rate derivatives, credit derivatives, as well as crude oil derivatives and currency derivatives. In addition to theoretical discussions, we also emphasize practical considerations of implementing strategies using derivatives as tools, especially when no-arbitrage conditions do not hold.

The breakout of the novel coronavirus (COVID-19) as a pandemic has caused global stock markets to plummet and led to a global economic recession. It further highlights the importance of advanced derivatives trading techniques for hedging the left-tail disaster risk. Meanwhile, the emergence of the pandemic has seen countries around the world take measures to try to stop its spread, including the imposition of travel restrictions, distancing restrictions, business cessation orders, and national lockdowns. The impact of these measures on businesses and the financial markets is causing concern among market participants about the ability of their counterparties to meet their payment and delivery obligations under derivatives transactions.

Pre-requisites

There are no formal prerequisites for this course. However, basic knowledge to linear algebra, calculus, statistics, and probability is expected. The introductory finance courses can also be helpful. Thus, if any, the following courses are recommended but not required: FNCE 100, FNCE 101, STAT 101-102.

Course Materials

Lecture Notes & Readings:

They will be posted on CANVAS (https://canvas.upenn.edu/) before each class. I will also post additional reading materials on CANVAS, including research papers and newspaper articles, which can provide useful background knowledge or add depth to the materials covered in lectures. I will not distribute hardcopies of lecture notes in classes.

Readings and practice problems will be regularly assigned from textbook (M). Neither Book (M) nor book (H) is cheap, but they have become standard references among wall-street practitioners, and thus they can be valuable long-term investments.

Required Textbook:

(M) McDonald, *Derivatives Markets*, 3rd ed., Pearson 2012.

Recommended Textbook:

(H) Hull, *Options, Futures and Other Derivatives*, 8th ed. (7th also works), Pearson Prentice Hall 2011.

Some Optional Materials:

(D) Das, *Traders, Guns & Money*, 3rd ed. Financial Times/Prentice Hall 2006.
(V) Veronesi, *Fixed Income Securities: Valuation, Risk, and Risk Management*, Wiley 2010.

Course Requirements

Lecture Participation:
TR 12:00 - 1:30 p.m. Virtual.

Assignments:
There are six group problem sets. These problem sets should be finished in groups of 2-4 students with group discussions. However, you are required to write down your own solutions and submit individual copy of solutions separately. Only electronic submission is acceptable through the provided link.

Please put down the names of your teammates clearly at the beginning of each submission. You must submit before the **beginning** of the session in which you have enrolled.

Each problem set is graded up to 10 points for timely submission, correctness of your derivations and solutions, and clarity of your explanations. If you really wish to submit a spreadsheet, please make label entries clearly and explain them carefully.

Please do not be late for your problem set solution submission; otherwise, at least 4 points out of 10 have to be deducted, and no submission is acceptable 24 hours after the corresponding deadline. The following are the strict deadlines for all problem sets (tentatively):

- Problem set 1: Tuesday, February 9th
- Problem set 2: Tuesday, February 23rd
- Problem set 3: Tuesday, March 16th

- Problem set 4: Thursday, April 1th
- Problem set 5: Tuesday, April 13th
- Problem set 6: Tuesday, April 27th

The graded solutions will be returned via emails. I will post the grade and the solution for each problem set on CANVAS. Please find me if you feel there are any potential grading errors within two weeks of the problem set's due date. It's unfair to consider any inquiries afterwards.

Exams:

There are two exams: midterm and final.

The midterm exam takes place on **Tuesday, March 23rd, in class**. All students have to take the exam in the session they are registered for. The exam is a closed-book and closed-notes one. However, students can bring in an 8.5"-by-11" (A4-letter) cheat sheet. Students are not allowed to use cell phones, touchpads, or laptops during the exam.

The final exam takes place on **TBA**. The exam is also a closed-book and closed-notes one. Students can also bring in an 8.5"-by-11" (A4-letter) cheat sheet. No cell phones, touchpads, or laptops are allowed during the exam.

Re-grading must be applied to all questions, if requested. No re-grading inquiries will be considered a week after solutions and grades are returned.

Students who are unable to take the exam during the given time periods must petition their dean's office for a makeup exam.

Both exams are based only on materials covered in lectures and problem sets.

Final Grades:
The final grade is based on the performance on participation, problem sets, and exams. It is a weighted average of each performance evaluations with a full score of 100. The more favorable weighting scheme is picked for each student between the following two:

	Weighting 1	Weighting 2
Participation	10%	10%
Assignments	20%	20%
Midterm	30%	10%
Final	40%	60%

Office Hours and Review Sessions

Office Hours: Fridays 2:00 – 3:00 p.m. or by appointment
TA Office Hours: Fridays 3:00 – 5:00 p.m.
Review Sessions: TBA

Contact Information

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Academic Integrity

University of Pennsylvania's Code of Academic Integrity. A copy can be found at

http://provost.upenn.edu/policies/pennbook/2013/02/13/code-of-academic-integrity

Classroom Policy

- Zero participation score if late for classes more than twice.
- Please do not surf the web.
- Please do mute your cell phone in lectures.
- Please do not leave the classroom to take a phone call.
- Please do not chat around during lectures.
- Please do turn on your camera.

Mark Your Calendar

- **Thursday, January 21st, First Class**
- Tuesday, March 23rd, Midterm Exam
- Tuesday, April 27th, Last Class
- TBD, Final Exam

Course Schedule (Tentative)

Class	Date	Topic	Reading (M)
1	01/21	Introduction to Derivative Securities & Syllabus	Ch. 1
2	01/26	Forward Contracts on Financial Assets and Indices	Ch. 5, 7
3	01/28	Future Contracts on Financial Assets and Indices	Ch. 5, 7
4	02/02	Forward Contracts on Commodities	Ch. 6
5	02/04	Future Contracts on Commodities	Ch. 6
6	**02/09**	Forward and Futures Contracts on Currency	Ch. 5.6, 5.7

7	02/11	Forward and Futures Contracts on Interest Rates	Ch. 7
8	02/16	Swaps: Total Return Swaps, Commodity Swaps, Variance Swaps	Ch. 8.1, 8.4, 8.5, 8.6
9	02/18	Currency Swaps and Interest Rate Swaps: Applications *Examples: Greece currency swaps and interest rate swaps with Goldman Sachs*	Ch. 8.2, 8.3
10	**02/23**	Other Popular Swaps	Ch. 8
11	02/25	Introduction to Options *Examples: short sales constraints and synthetic stocks, Collar strategies, and Barring/Leeson*	Ch. 9
12	03/02	Option Trading Strategies	Ch. 9
13	03/04	Binomial Trees and Risk Neutral Pricing	Ch. 10.1
14	03/09	Binomial Trees: Two-Period Model	Ch. 10.2, 10.3
15	**03/16**	Binomial Trees: Multi-Period Model *Examples: option prices around FDA approvals, implied binomial trees*	Ch. 10.2, 10.3
16	03/18	The Black-Scholes-Merton Formula	Ch. 12
17	**03/23**	**Midterm Exam (in class)**	
18	03/25	Options' Greeks and Dynamic Replications *Examples: replicating the S&P 500 index option, portfolio insurance,*	Ch. 12.3, 13
19	**04/01**	Delta-Gamma Hedging and Option Returns	Ch. 12.3, 13
20	04/06	Limitations and Extensions of The Black-Scholes-Merton Model	Ch. 20.8, 21.5
21	04/08	American Options	Ch. 9.3, 10.4, 11.1
22	**04/13**	Exotic Options: Examples	Ch. 14
23	04/15	Pricing with Monte Carlo Simulations: A Simple Study	Ch. 19
24	04/20	Introduction to Credit Derivatives *Examples: KMV Model, credit default swaps, collateralize debt obligations, copula, Amherst, AIG, Paulson's "Big Short"*	Ch. 27
25	04/22	Default and Credit Risk	Ch. 16, 17

26	**04/27**	Theory v.s. Reality: Failures of Non-Arbitrage Conditions *Examples: TIPs arbitrage, Chinese warrants, convertible arbitrage, covered interest rate parity*
27	04/29	Wrap up