ISE 563 Financial Engineering -

Time: M 6:00 PM PST to 9:40 PM PST

Professor: Gordon Delianedis, Ph.D.   TA: Xiaocheng Liu

Office Hours: Online W 6:00 to 7:00 PM   Office Hours: TUE 2:30-3:30

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Gordon.delianedis@pacificlife.com (preferred)

Textbooks Required

Hull, J, *Options, Futures, and Other Derivatives, 11th ed., Prentice Hall, 2020*

Grading

Homework 20%
Midterm 25%
Project 15%
Final 40%

Software

Examples will be presented in MATLAB. Any structured programming language such as VBA, Python, *R* … can be used though the built-in functionality may not be the same

Course Objectives

Familiarize the student with the financial background and mathematical tools necessary to analyze and solve financial and investment problems. Problems will include the use of derivatives for hedging financial risk, valuation of financial derivatives and strategies, and risk measurement and control. Areas of study will include equity, interest rate, credit, volatility, and real options.

Requirements: Familiarity with economic or finance terms and concept. Homework and project to be done in a structured language such as MATLAB, Python, or VBA.

Course Project

Project is an extended exercise where you will be given a complex derivative to value, hedge, and perform a risk assessment. Project will utilize the methods and concepts learned in the class and will involve more in-depth programming in a structured language (as noted above) beyond the basic homework. Project will be distributed the week after the midterm. A short writeup of how the problem was solved, the methods utilized, and explanation of the results and why the results are reasonable and meaningful will be required. You may work in groups up to three people.

Learning Objectives

After completing this course, students will be able to:

- Understand a wide range of financial derivatives relates to equity, interest rate, credit, and volatility and how to use these instruments to solve business problems.
- Value standard derivatives and more complex customized derivatives using analytical and numerical techniques
- Assess the risk profile of financial positions and strategies and propose derivative strategies to mitigate those economic risks.

Description and Assessment of Assignments

Week	Topic	Readings
1	**Interest Rates**	
	- Discount curves and basic fixed income	Ch 4, 6, 7
	- Term structure construction (Bootstrapping)	
	- Interest rate swap	
2	**Futures-Forwards-Options**	
	- Definitions and properties	Ch 2, 3, 5, 11, 12
	- Parity relationships	
	- Option strategies	
2,4	**Binomial Model**	
	- Spot and futures	Ch 13, 21.1-21.5, 27.4
	- Time varying parameters	
	- Analytical representation	
5-6	**Black-Scholes Framework**	
	- Black-Scholes Model derivation	Ch 14, 15, 21.6-21.7, 27.8,28
	- Spot and futures options	
	- Generalized Black-Scholes framework (Expanded)	
		HW1 Due
5-6	**Black-Scholes Framework**	
	- Monte-Carlo Methods	Ch 14, 15, 21.6-21.7, 27.8,29
	- American options (Least Squares Monte-Carlo)	
7-8	**Black-Scholes: Greeks and Hedging**	
	- Standard B-S Greeks	Ch 17, 18, 19
	- Static and dynamic hedging (Expanded)	
	- Numerical methods (Finite Difference and Quadrature)	
7-8	**Implied Volatility/Exotic Options**	
	- Implied volatility	Ch 20, 26, 27.1-27.3, 27.6 - 27.8, 30.4
	- Extended volatility models	
	- Non-standard options	
	- Variance swaps	
		HW2 Due
9	Midterm	
10-11	**Credit Risk**	
	- Credit risk measures (Rating agency)	Ch 24
	- Historic Default and credit	
	- Merton model of the firm	
	- Simulating credit events	
10-11	**Credit Derivatives**	
	- Credit Default Swaps (CDS)	Ch 25
	- Credit Derivatives (CDS options,	

	- Structured Credit	
12-13	**Interest Rate Derivatives**	Ch 29, 31
	- Black's model	
	- Caps and Floors	
	- Swaptions	
	- Convexity/Timing Adjustments	
		HW3 Due
12-13	**Interest Rate Models**	Ch 30, 32, 33
	- No arbitrage models	
	- Forward rate models (HJM/LMM)	
	- Trinomial tree methods	
14-15	**Real World Applications**	Ch 22, 23, 35
	- Volatility modeling	
	- Value at Risk (VaR)	
	- Commodity Derivatives	
	- Real Options	Ch 36
	- Review	
		HW4 Due
16	Final Exam	Project Due

Statement on Academic Conduct and Support Systems

Academic Integrity:
The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

Counseling and Mental Health - *(213) 740-9355 – 24/7 on call*
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) *- 988 for both calls and text messages – 24/7 on call*
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services (RSVP)](#) *- (213) 740-9355(WELL) – 24/7 on call*
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX (EEO-TIX)](#) *- (213) 740-5086*
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) *- (213) 740-5086 or (213) 821-8298*
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services (OSAS)](#) *- (213) 740-0776*
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) *- (213) 740-0411*
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) *- (213) 740-2101*
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) *- UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) *- UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call*
Non-emergency assistance or information.

[Office of the Ombuds](#) *- (213) 821-9556 (UPC) / (323-442-0382 (HSC)*
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - *(323) 442-2850 or* otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.