

Syllabus

FIN 451 – Options, Futures and Derivative Securities (3.0 Units)

Sections 01 / 02 – Spring 2025

Instructor:	Lorenzo Naranjo
Office:	Simon Hall 281
Office Hours:	Monday / Wednesday (10:00am – 12:00pm)
Email:	naranjo@wustl.edu
Classroom:	Simon Hall 113
Meeting Times:	Monday / Wednesday (1:00 – 2:20pm / 2:30 – 3:50pm)
Class Modality:	In-person

Class Information

Course Description

Examines the theory and practical application of derivative securities such as futures, options and swaps. Central to the theory of derivative security pricing is arbitrage and payoff replication. In practice, derivative securities provide a principal route to manage and, in particular, hedge financial risk. Futures, options and swaps on different types of underlying assets are examined with emphasis on pricing and application.

Prerequisite: FIN 340, Math 131 and DAT 121.

Learning Goals

1. Knowledge

- Describe the characteristics of futures, forwards and option contracts.
- Identify different option's trading strategies commonly used in practice.

2. Comprehension

- Describe how different option's strategies can be used to achieve a desired payoff.
- Classify the risk of different financial derivatives.
- Explain the notion of no-arbitrage pricing.

3. Application

- Compute no-arbitrage forward and futures prices.

- Compute the price of European and American call and put options using binomial trees.
- Compute the price of European call and put options using the Black-Scholes formula.
- Compute different sensitivities of option prices such as Delta, Gamma, and Theta.

4. Analysis

- Illustrate how an investor can use financial derivatives to achieve a specific payoff.
- Question the validity of the assumptions used to compute derivative prices.
- Model the evolution of stock prices in discrete and continuous time.

5. Synthesis

- Create new payoffs using call and put options.
- Summarize the main ideas behind the Black-Scholes model.
- Collect real financial data to value traded options.

6. Evaluation

- Value the merits of a derivative pricing model.
- Choose between discrete and continuous time models to price and hedge financial options.
- Extend the binomial and Black-Scholes models to price and hedge exotic derivatives.

Office Hours

I will host regular office hours on Monday and Wednesday from 10am to 12pm.

Attendance and Participation Policy

Class participation, classroom interaction, and collaboration are a signature of the Olin culture and Code of Conduct. Class time is critical to learning, and prompt attendance during our class times is expected.

If you are on time and remain in class for its duration you earn full attendance credit. Everyone is allowed **three** unexcused absences. If you have already used your unexcused absences, further absences may be excused by the instructor for illness, emergency, religious holiday, participation in a Washington University related Sport or Club (with note from coach or faculty supervisor) or military deployment. Please email the instructor to request an excused absence. I reserve the right to ask for additional documentation such as a doctor's note to grant an excused absence.

Student missing more than 20 minutes of a class are considered absent.

All students are expected to attend **in person**. All classes will be recorded using Kaltura. If you miss a class please make sure to watch the corresponding recording and ask me questions if you need help. There will be no hybrid option via Zoom.

Classroom Etiquette

The class starts and ends on time. It is disruptive for me and your classmates when students arrive after the class has started.

You can use your personal computer to take notes and view the slides. Using a computer for anything else is forbidden. I will ask you to stop using your computer if I notice loud clicks because you are writing a lengthy document unrelated to the class.

In addition,

- You cannot use a computer or a tablet in an upside position if you sit in the last row. Taking notes using your tablet staying flat on the table is okay.
- Using an external mouse, wired or wireless, is forbidden.
- Using an additional platform to raise your computer is not allowed.
- Using headphones in class is forbidden.

Class Materials

All slides, lecture notes, practice problems and solutions are available at lorenzonaranjo.com/fin451.

I will link each module on Canvas with the respective slides and notes.

In addition, you may complement the lecture notes with the following textbook:

- Options, Futures, and Other Derivatives by John Hull, 11th Edition, Pearson

Probably the most standard and popular text on derivatives among academics, students, and practitioners, this book serves as a useful reference not only for this course but also for years to come in your finance profession. Older editions (5th-10th) of the book are fine to use, too.

While our lectures present topics in a self-contained manner, reading the textbook will reinforce your learning from the lectures. The class covers chapters 1 to 5, and 10 to 13 from the textbook.

Course Requirements and Grading

Grading

Your grade for the course will be determined by two midterm exams, the final exam, nine problem sets, a group presentation, and class attendance. Following is the summary of weights on the various components that I will use to evaluate your performance in this course:

Assignment	Weight
Midterm #1	20
Midterm #2	20
Final Exam	20
Problem Sets	20
Group Project	10
Class Attendance	10
Total	100

Grades are non-negotiable. If you feel I have graded one of the course requirements incorrectly, please bring it to my attention immediately. Grade appeals (e.g., because your points were not added up correctly) must be submitted within a week after the grades are released. I certainly want all of you to receive the grades you have earned.

Exams

There will be three exams, two midterms and a final exam, to test your understanding of the concepts and methods covered in the course. Each exam is worth 20% of the final grade. The exams are written, in-person, closed-book and closed-notes. You are allowed to bring your financial or scientific calculator. I will provide with a formula sheet, a blue book and scratch paper. Any form of collaboration including discussing quiz questions and sharing answers with anyone during an exam or quiz is strictly prohibited and will be considered as a violation of academic integrity.

The dates of the exams are as follows:

Assignment	Date
Midterm #1	2/24
Midterm #2	4/2

Assignment	Date
Final Exam	5/2

Midterms 1 and 2 will be held during class time in Simon Hall 113 on the days indicated above. The final exam is scheduled on 5/2 at 10:30 am CST and will be held in Simon Hall 110 for Section 1 and Simon Hall 113 for Section 2.

Problem Sets

There will be eight problem sets due at 11:59 pm CST on the dates indicated below. All problem sets are individual and must be handwritten. You can either write them in paper and scan them for submission, or you can use a tablet that allows you to write using an electronic pen. You must submit your work via Canvas as a pdf file.

Assignment	Due Date
PS #1	1/27
PS #2	2/5
PS #3	2/17
PS #4	3/7
PS #5	3/28
PS #6	4/14
PS #7	4/21
PS #8	4/27

There is a 5% grade deduction per day for late submissions.

Group Project

There will be a graded group project that will allow you to work with real data and see how the theory works in practice. The deliverable will be a well formatted pdf document with answers to the questions, and a Microsoft Excel spreadsheet or Python code that will be uploaded to Canvas. The project will be done in groups of up to three students. The deadline to submit the project will be Sunday, April 27 at 11:59pm CST.

Honor Code and Code of Conduct

This course will follow the standards specified in the Code of Conduct and Code of Academic Integrity, which were presented to faculty and students of the Olin Business School. Students are expected to be familiar with the codes. Some relevant parts of the code are included in Section .

Course Schedule

The tentative course schedule for different sections is given below. The topics covered on each proposed date may change as the course progresses, but the main content and the general order should not vary.

Session	Date	Topic	Assignment
1	1/13	Introduction	
2	1/15	Interest Rates	
–	1/20	Martin Luther King Jr Day	
3	1/22	Forward Contracts on Non-Dividends Paying Assets	
4	1/27	Forward Contracts on Dividend Paying Assets	PS1
5	1/29	Futures Markets	
6	2/3	Options Contracts	
7	2/5	Options Strategies	PS2
8	2/10	Options Spreads	
9	2/12	Put-Call Parity	
10	2/17	European Option Pricing Bounds	PS3
11	2/19	Review for Midterm Exam #1	
12	2/24	In-class Exam	Midterm 1
13	2/26	Binomial Option Pricing by Replication	
14	3/3	Risk-Neutral Binomial Option Pricing	
15	3/5	Multi-Period Binomial Option Pricing	PS4
–	3/10	Spring Break	
–	3/12	Spring Break	
16	3/17	Impact of Dividends	
17	3/19	American Options	PS5
18	3/24	The Log-Normal Distribution	
19	3/26	Modeling Stock Prices in Continuous-Time	PS6

Session	Date	Topic	Assignment
20	3/31	Review for Midterm Exam 2	
21	4/2	In-class Exam	Midterm 2
22	4/7	The Black-Scholes Model	
23	4/9	Options on Indices, Currencies and Futures	PS7
24	4/14	The Greeks	
25	4/16	Exotic options in Discrete Time	
26	4/21	Exotic options in Continuous Time	PS8
27	4/23	Review for the Final Exam	
28	5/2	Final Exam from 10:30am until 12:00pm	Final Exam

University-Wide Guidelines & Policies

Reporting Sexual Assault and Harassment

If a student discusses or discloses an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if a faculty member otherwise observes or becomes aware of such an allegation, the faculty member will keep the information as private as possible, but as a faculty member of Washington University, they are required to immediately report it to the Department Chair or Dean or directly to Ms. Cynthia Copeland, the University's Associate Title IX Coordinator, at (314) 935-3411, cmcopeland@wustl.edu. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards or by contacting WUPD at (314) 935-5555 or your local law enforcement agency. See: [Title IX](#).

Disability Resources (DR)

WashU supports the right of all enrolled students to an equitable educational opportunity, and strives to create an inclusive learning environment. In the event the physical or online environment results in barriers to the inclusion of a student due to a disability, they should notify the instructor as soon as possible.

Disabled students requiring adjustments to equitably complete expectations in this course should contact WashU's Disability Resources (DR), and engage in a process for determining and communicating reasonable accommodations. Because accommodations are not applied retroactively, DR recommends initiating requests prior to, or at the beginning of, the academic term to avoid delays in accessing accommodations once classes begin. Once established, responsibility for disability-related accommodations and access is shared by

Disability Resources, faculty, and the student. You can contact [Disability Resources](#) at (314) 935-5970 or disabilityresources@wustl.edu.

Military Service Leave

Washington University recognizes that students serving in the U.S. Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or veterans@wustl.edu and their academic dean for guidance and assistance. See: [Veterans](#).

Preferred Name and Gender Inclusive Pronouns

Washington University in St. Louis recognizes that many students prefer to use names other than their legal ones to identify themselves. In addition, in order to affirm each person's gender identity and lived experiences, it is important that we ask and check in with others about pronouns. This simple effort can make a profound difference in a person's experience of safety, respect, and support See: [Pronouns Information](#), [Preferred Name](#).

Emergency Preparedness

Before an emergency, familiarize yourself with the building(s) that you frequent. Know the layout, including exit locations, stairwells and the Emergency Assembly Point (EAP). Review the "Quick Guide for Emergencies" that is found near the door in many classrooms and main lobby areas of buildings for specific emergency information and instructions. For additional Information and EAP maps, visit emergency.wustl.edu. To ensure that you receive emergency notifications, make sure your information and cell phone number is updated in SIS, and/or download the WashU Safe app and enable notifications.

To report an emergency:

- Danforth Campus: (314) 935-5555
- School of Medicine Campus: (314) 362-4357
- North/West/South and Off Campus: 911 then (314) 935-5555

Academic Integrity

Effective learning, teaching and research all depend upon the ability of members of the academic community to trust one another and to trust the integrity of work that is submitted for academic credit or conducted in the wider arena of scholarly research. Such an atmosphere of mutual trust fosters the free exchange of ideas and enables all members of the community to achieve their highest potential.

In all academic work, the ideas and contributions of others (including generative artificial intelligence) must be appropriately acknowledged and work that is presented as original must be, in fact, original. Faculty, students and administrative staff all share the responsibility of ensuring the honesty and fairness of the intellectual environment at WashU.

For additional details on the university-wide Undergraduate Academic Integrity policy, please see: <https://wustl.edu/about/compliance-policies/academic-policies/undergraduate-student-academic-integrity-policy/>.

Academic integrity is a serious offense that may lead to warning, probation, suspension, or expulsion from the University. All instances of academic integrity allegations will be reported to Academic Integrity in the Office of the Provost, who will hold an initial meeting and then determine next steps with the student. For more information on the academic integrity policy, procedures, frequently asked questions, and who to contact, visit [Academic Integrity in the Office of the Provost](#). The academic integrity policy, process, and information listed there applies to undergraduate students enrolled in all Schools and programs and master's level students in the McKelvey School of Engineering, the Sam Fox School of Design and Visual Arts, and the School of Continuing and Professional Studies. For all other programs, please see the Contacts page.

In all cases of academic integrity violations, the instructor shall make an academic judgment about the student's grade on that work and in that course, which shall not be considered a sanction for prohibited conduct under this policy.

In taking this course, students may be expected to submit papers and assignments through Turnitin for detection of potential plagiarism and other academic integrity concerns. If students do not have an account with Turnitin and/or do not utilize Turnitin when submitting their papers and assignments, the instructor may upload your paper or assignment to Turnitin for processing and review.

Religious Holidays

As home to students, faculty, and staff of all the world's major religions and as a non-sectarian institution, WashU values the rich diversity of spiritual expression and practice found on campus. It is therefore the policy of the university that students who miss class, assignments, or exams to observe a religious holiday should be accommodated. To ensure

that accommodations may be made, students who plan to miss class for a religious holiday must inform their instructors in writing before the end of the third week of class, or as soon as possible if the holiday occurs during the first three weeks of the semester. Instructors should inform students on their syllabus and/or at the start of the class how they would like students to notify them of any accommodation needs related to religious observance. The university's Religious Holiday Class Absence Policy can be found [here](#).

The [Office of Religious, Spiritual and Ethical Life](#) maintains a [calendar](#) of many religious holidays observed by the WashU community.

Unauthorized Recording and Distribution of Classroom Activities and Course Materials

Except as otherwise expressly authorized by the instructor or the university, students may not record, stream, reproduce, display, publish or further distribute any classroom activities or course materials. This includes lectures, class discussions, advising meetings, office hours, assessments, problems, answers, presentations, slides, screenshots or other materials presented as part of the course. If a student with a disability wishes to request the use of assistive technology as a reasonable accommodation, the student must first contact the Office of Disability Resources to seek approval. If recording is permitted, unauthorized use or distribution of recordings is also prohibited.

COVID-19 Health and Safety Protocols

Students experiencing symptoms consistent with COVID-19 or concerned about a possible exposure should contact the Student Health Center (314 935-6666) to arrange for testing as indicated. If a student tests positive for Covid-19, they will receive a letter with instructions about any necessary isolation that they can share with their instructors. Any accommodation needs for COVID-related absence not covered in an instructor's standard course policies should be discussed between the student and instructor.

- During periods of high transmission, it may not be feasible for all students to receive documentation from SHC. In these instances, please extend grace to students who indicate a need to isolate and allow their absence so that we may reduce the likelihood of illnesses being transmitted in our classrooms.

While on campus, it is imperative that students follow all public health guidelines established to reduce the risk of COVID-19 transmission within our community.

Masking: Masking remains a valuable tool in the mitigation of COVID-19, and all respiratory illnesses. Students and instructors are encouraged to treat requests to mask with care and

consideration, keeping in mind that some individuals may be at a higher risk, caring for others at a higher risk, or feeling less comfortable in a mask-optional environment. Based on monitoring of regional and campus conditions, a mask requirement may be implemented as needed.

Students with disabilities for whom masked instructors or classmates create a communication barrier are encouraged to contact Disability Resources (www.disability.wustl.edu) or talk to their instructor for assistance in determining reasonable adjustments. Adjustments may involve amplification devices, captioning, or clear masks but will not allow for the disregard of mask policies should a requirement be in place.

Resources for Students

Confidential Resources for Instances of Sexual Assault, Sex Discrimination, Sexual Harassment, Dating Violence, Domestic Violence, or Stalking

The University is committed to offering reasonable academic accommodations (e.g. a no-contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If a student needs to explore options for medical care, protections, or reporting, or would like to receive individual counseling services, there are free, confidential support resources and professional counseling services available through the Relationship and Sexual Violence Prevention (RSVP) Center. If you need to request such accommodations, please contact RSVP to schedule an appointment with a confidential and licensed counselor. Although information shared with counselors is confidential, requests for accommodations will be coordinated with the appropriate University administrators and faculty. The RSVP Center is located in Seigle Hall, Suite 435, and can be reached at rsvpcenter@wustl.edu or (314) 935-3445. For after-hours emergency response services, call (314) 935-6666 or (314) 935-5555 and ask to speak with an RSVP Counselor on call. See: [RSVP Center](#).

Bias Reporting

WashU has a non-punitive process through which students, faculty, staff, and community members who have experienced or witnessed incidents of bias, prejudice, or discrimination against a student can report their experiences to the University's [Bias Report and Support System \(BRSS\)](#) team.

Center for Career Engagement (CCE)

The Center for Career Engagement provides one-on-one coaching, resources, programs and events to support the lifelong career success of all students and alumni. In addition to having your resume reviewed or fine-tuning your interviewing skills, the CCE invites you to work with us as partners at every stage of your career development as you reflect, learn and experiment. Our Certified Career Management Coaches will listen, ask questions, and provide resources to help you understand yourself, envision possibilities, prepare, search and apply, and engage in your career development.

You can select a career coach based on availability and alignment with one of our industry-aligned [career communities](#) or you can choose a coach in the Career Exploration community.

To make an in-person or virtual appointment:

1. Log in to Handshake
2. Click Career Center (left side tool bar)
3. Click Appointments.

The CCE is conveniently located in the Danforth University Center, Suite 110 with several additional office spaces across campus in Knight Hall 210, Bauer Hall 250, Steinberg Hall and Brown Hall.

Counseling and Psychological Services

The Center for Counseling and Psychological Services' professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect a student's academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety, depression, and thoughts of suicide. Individual, Conjoint, and Group therapy are all provided in addition to referrals for off-campus support. Information can be found on the [CCPS webpage](#).

The Division of Student Affairs also offers a telehealth program to students called [TimelyCare](#). While students are encouraged to visit CCPS during business hours, this additional service also provides after-hours access to medical care and 24/7 access to mental telehealth care across the United States, with no cost at the time of the visit. 12 counseling visits are provided at no charge as well as a limited number of psychiatry appointments. Students who pay the Health and Wellness fee are eligible for this service.

Additionally, see the mental health services offered through the [RSVP Center](#).

WashU Cares

WashU Cares specializes providing referrals and resources, both on, and off campus for mental health, medical health, financial and academic resources by using supportive case management. WashU Cares also receives reports on students who may need help connecting to resources or whom a campus partner is concerned about. If you are concerned about a student or yourself, you can file a report here: [WashU Cares](#).

The Writing Center

The Writing Center offers free writing support to all WashU undergraduate and graduate students. Staff members will work with students on any kind of writing project, including essays, writing assignments, personal statements, theses, and dissertations. They can help at any stage of the process, including brainstorming, developing and clarifying an argument, organizing evidence, or improving style. Instead of simply editing or proofreading papers, the tutors will ask questions and have a conversation with the writer about their ideas and reasoning, allowing for a higher order revision of the work. They will also spend some time looking at sentence level patterns to teach students to edit their own work.

The Center is located in Mallinckrodt, and appointments are available days and evenings Sunday through Friday. Office staff hours are Monday through Friday 10:00am to 4:00pm. Students are seen primarily by appointment, with walk-ins accepted as the schedule allows. They also have dedicated walk-in hours for undergraduates on Tuesday and Wednesday afternoons. Both in-person and online appointments are available. To make an appointment, go to writingcenter.wustl.edu. Email: writingcenter@wustl.edu.

The Learning Center

The Learning Center provides [support programs](#), including course-specific mentoring and academic skills coaching (study and test-taking strategies, time management, etc.), that enhance undergraduate students' academic progress. Contact them at learningcenter@wustl.edu or visit ctl.wustl.edu/learningcenter to find out what support they may offer for your classes.

Center for Diversity and Inclusion (CDI)

The Center for Diversity and Inclusion (CDI) supports and advocates for all undergraduate, graduate, and professional school students. We foster belonging for all! Visit our website for more information and resources. The CDI consists of the following offices and is physically

located in the Danforth University Center (DUC) Suite 150 and the Women's Building Room 102.

- Cross-Cultural Connections (CCxN) – DUC 150
- Office for International Student Engagement (OISE) – Women's Building 102
- Office for Religious, Spiritual and Ethical Life (ORSEL) – DUC 150
- Spectrum Office (LGBTQIA+ Support) – DUC 150

The [Dialogue Across Difference \(DxD\)](#) program at WashU prepares students to engage in dialogue across perspectives. Students use dialogue to understand each other and see differences as learning opportunities. DxD offers 1 credit 8-week dialogue courses for undergraduate students and workshops and programs open to all graduate, undergraduate, and professional students. Visit us in DUC 340 or our [website](#) to learn more about DxD.

Gephardt Institute

Students play an essential role in a vibrant and functioning democracy. State and local elections take place throughout the year and have a direct impact on our communities. Visit vote411.org to find dates and details of upcoming elections in every state. You can register to vote, request an absentee ballot, confirm your polling location, and get Election Day reminders at wustl.turbovote.org for any of the 50 states and Washington D.C. WashU students are considered Missouri residents, and eligible student voters can register to vote in the state of Missouri or their home state. You need to update your voter registration every time you move, even within the same city.

Whether or not you're eligible to vote, you can participate by encouraging your friends to register and vote, engaging your peers in local issues, and taking part in other civic and community engagement activities. For more resources on voting and other civic and community engagement opportunities, including Civic Action Week, please visit washuvotes.washu.edu and gephardtstitute.washu.edu.

University Libraries

WashU Libraries include [seven unique locations](#) across the Danforth Campus, but they are much more than just beautiful, quiet spaces for studying and group work. The Libraries include [librarians for every discipline on campus](#), with the expertise to work with you to develop research ideas and find the best resources to meet your needs; you are also encouraged to explore our [research guides](#), tailored for each subject and available online. The Libraries hold over five million items in the collections—print books, journals, electronic resources, databases, and millions more accessible through interlibrary loan—and you can find it all at the [search on our home page](#). Additional resources for students include special collections, data services, citation help, digital publishing, and more. Visit [the Libraries website](#) for more

details about these and other ways that the Libraries are here to support your academic success.