

Quantitative Finance
Course Number: 22:839:609
Course Title: Derivatives

COURSE DESCRIPTION

This course is designed to introduce finance students to the theory and practical use of derivative instruments such as futures, options, and swaps. Over the last 40 years, the markets for these versatile instruments have grown enormously, and they now provide corporate and portfolio managers with an efficient means to hedge, arbitrage, and speculate. The emphasis of this course is on the arbitrage-based pricing method for derivative securities. Although I will emphasize intuition rather than math, there is no getting round the fact that the subject is inherently analytical. You should be comfortable with, for example, continuous compounding, solving two equations in two unknowns, and basic probability. By the end of the course, students will have good working knowledge of how these derivatives instruments work, how they are priced, and how they are used by institutions to hedge their risks. Real world examples will be used whenever possible to enhance students understanding of both futures and options.

COURSE MATERIALS

- The required textbook is:
 - *Derivatives Markets* by Robert L. McDonald, Addison Wesley, 3rd ed., 2013
- Reference textbooks:
 - *Options, Futures and Other Derivatives* by John C. Hull, Pearson, 10th ed., 2017
 - *Fundamentals of Futures and Options* by John C. Hull, Pearson, 9th ed., 2016
 - *Fixed Income Securities: Valuation, Risk and Risk Management* by Pietro Veronesi, Wiley, 1st ed., 2010
- Check Canvas (canvas.rutgers.edu) and your official Rutgers email account regularly.

LEARNING GOALS AND OBJECTIVES

- The main purpose of this course is to provide students with an analytical overview of futures, options, swaps, and other derivatives. Students will learn how derivatives are used in the real world to solve particular problems, as well as the underlying pricing methodologies. In particular, students will: analyze different kinds of derivative instruments; understand the arbitrage restrictions in the derivatives context; understand how to use futures and options contracts for hedging, and/or speculation.

- Students who complete this course will demonstrate an understanding of basic concepts, as well as theoretical and practical aspects of futures, options, and swaps. The topics include derivative contracts on equity, interest rates, currencies, and commodities.
 - Students develop these skills and knowledge through lectures, homework assignments, and two tests.
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PREREQUISITES

For students to take this course, they need to complete an investment analysis course. This course will approximately spend 20 percent of the time to review their knowledge learned from Investment Analysis and it will use about 20 percent of the time to build upon their knowledge from Investment Analysis. In addition, we will spend about 60 percent of the time discussing new topics such as the valuation of futures /options instruments and their application in hedging.

Calculus (01:640:135 or analog), basic probability and statistics

ACADEMIC INTEGRITY

I do NOT tolerate cheating. Students are responsible for understanding the RU Academic Integrity Policy <http://academicintegrity.rutgers.edu/>

I will strongly enforce this Policy and pursue *all* violations. On all examinations and assignments, students must sign the RU Honor Pledge, which states, “On my honor, I have neither received nor given any unauthorized assistance on this examination or assignment.” I will screen all written assignments through *SafeAssign* or *Turnitin*, plagiarism detection services that compare the work against a large database of past work. Don’t let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PREPARATION POLICY

- Expect me to attend all class sessions. I expect the same of you. If I am to be absent, my department chair or I will send you notice via email and Canvas as far in advance as possible. If you are to be absent, report your absence in advance at <https://sims.rutgers.edu/ssra/>. If your absence is due to religious observance, a Rutgers-approved activity, illness, or family emergency/death and you seek makeup work, also send me/TA an email with full details and supporting documentation within 3 days of your first absence. For job interviews students can be also excused.
- For weather emergencies, consult the campus home page. If the campus is open, class will be held.
- Expect me to arrive on time for each class session. I expect the same of you. If you are going to be tardy, then your grade will be penalized.
- Expect me to remain for the entirety of each class session. I expect the same of you. If you are going to leave early, then you will be counted as absent, unless you have a good excuse and tell me in advance.

- Expect me to prepare properly for each class session. I expect the same of you. Complete all background reading and assignments. You cannot learn if you are not prepared. The minimum expectation is that for each 80-minute class session, you have prepared by studying for at least twice as many hours.
- Expect me to participate fully in each class session. I expect the same of you. Stay focused and involved. You cannot learn if you are not paying attention.

ASSIGNMENTS, COMPUTER EXERCISES, AND PROJECTS

Homework assignments will be a component of the total grade. Periodically, students are required to hand in printed or handwritten solutions to homework for grading. No email submission will be accepted. The due dates will be announced in class. Students must turn in the hard copy of their homework on time or in advance. Late homework will receive *zero* automatically.

Overall, homework assignments will count for 10% of the total grade.

CLASSROOM CONDUCT

When you are in class you cannot use either cell phones or notebooks to perform activities that are not related to class materials.

EXAM DATES AND POLICIES

There are 2 exams in this course. The attached class schedule indicates when each exam will occur. The final exam will be cumulative, covering all topics of the course. Overall, exams will count for 90% of the total grade.

All exams are closed book. Each exam contains a mix of multiple-choice questions and problem-solving questions. The best way to prepare for exams is to attend class, solve homework problems, and review lecture materials. Part of each exam will be questions similar to problems discussed in class or in the homework.

Students should bring a financial or scientific calculator, and pen to the exam. You may also bring *one* double-sided, letter-sized, “formula” sheet to the exams. Formulas and graphs (but no words) are allowed on the formula sheet. Penalty will be assessed for violating this policy. Students need to turn in his/her formula sheet after each exam. Therefore, if you want to keep a copy of the formula sheet for later usage, you must make a photocopy of it before the exam.

- If you have a disability that influences testing procedures, provide me an official letter from the Office of Disability Services at the start of the semester.
- No cell phones or other electronics like laptop are allowed in the testing room.
- You must show a valid Rutgers photo ID to enter the room and to turn in the exam.
- Alternate seating; do not sit next to another student or in your usual seat.

- Use the bathroom prior to the exam start; bathroom breaks, if essential, will be escorted.
- Your exam will not be accepted unless you sign the Honor Pledge.

CLASS PARTICIPATION

Class participation is important because it enhances the classroom environment and allows student to practice public speaking in a supportive, low-risk environment. Good public speaking is arguably the most valuable skill of a business leader. Like any other skill, it can only be improved through practice.

GRADING POLICY Course grades are determined as follows:

- 1st Exam 40%
- 2nd Exam 50%
- Homework10%

Other grading policies:

1. No extra credits will be given in this class.
2. Grade distribution will be used if necessary.
3. I will try to finish my grading within 48 hours after the test.

Your final grade is not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your grade. Clarify the precise error I made and provide all due supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error. I cannot and will not adjust grades based on consequences, such as hurt pride, lost scholarships, lost tuition reimbursement, lost job opportunities, or dismissals. Do not ask me to do so. It is dishonest to attempt to influence faculty in an effort to obtain a grade that you did not earn, and it will not work.

COURSE SCHEDULE

Tentative Class Schedule (Subject to change*)

<u>Topic</u>	<u>Items Due</u>
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<p>Course Overview Forwards and Futures - Introduction</p>	<p>Overview: McDonald, Chapter 1</p> <p>Risk management: Reasons to manage (or not to manage) risk — McDonald, Sections 4.1-4.4</p>
<p>Forwards and Futures - Pricing</p>	<p>Forwards: definitions and diagrams — McDonald, Section 2.1</p> <p>Forwards: pricing — McDonald, Sections 5.1-5.3</p> <p>Futures contracts — McDonald, Section 5.4</p> <p>Commodity forward and futures contracts — McDonald, Chapter 6</p>
<p>Options - Introduction</p>	<p>Calls and puts: definitions and diagrams — McDonald, Sections 2.2-2.4, 12.4</p> <p>Calls and puts as insurance — McDonald, Section 2.5</p> <p>Put-call parity — McDonald, Section 3.2</p> <p>Spreads, collars, and other strategies — McDonald, Section 3.3</p>

Options - Binomial Pricing	<p>One-period binomial pricing — McDonald, Sections 10.1</p> <p>Multi-period binomial pricing — McDonald, Sections 10.2-10.3</p>
Options - Black-Scholes model, Extensions, and the Greeks	<p>The Black-Scholes Formula— McDonald, Sections 12.1-12.2, 12.6</p> <p>Option greeks — McDonald, Sections 12.3</p>
Delta-hedging and market-making	Risk management for market makers — McDonald, Sections 13.1-13.3
Historical and Implied Volatility	<p>Historical and Implied Volatility — McDonald, Section 12.5</p> <p>Implied volatility, the volatility smile, the VIX Index — McDonald, Section 24.1</p> <p>Hedging and pricing Volatility — McDonald, Section 24.3</p> <p>Recent events in the volatility derivatives market — see Carr, P., and R. Lee (2009), “Volatility Derivatives,” <i>Annual Review of Financial Economics</i> 1:1–21. Read Sections 1 and 2 in particular.</p>
Midterm Exam	

Interest Rates Derivatives - Caps, Floors, Swaps	Interest rate swaps — McDonald, Section 8.3, Section 25.1-25.2 Also, Veronesi, Chapters 9-11
Interest Rates Derivatives - American Options	See Lecture notes Also, Veronesi, Chapter 12
Corporate applications and Real options	Compensation — McDonald, Section 16.2 Mergers — McDonald, Section 16.3 What are real options — McDonald, Sections 17.1-17.5 Examples — McDonald, Sections 17.5-17.6
Corporate applications and Real options	See above
Credit Risk: Introduction to valuation of defaultable securities	Valuing corporate securities — McDonald, Section 16.1 Credit Risk and the Merton model — McDonald, Section 27.1-27.3 See Lecture notes

Credit-risk shifting derivatives and structured products	<p>Credit Risk and the Merton model — McDonald, Section 27.4-27.5</p> <p>Coval, J. D., Jurek, J. W. and E. Stafford (2009), “The Economics of Structured Finance,” <i>Journal of Economic Perspectives</i> 23:1:3–25</p>
<p>Final Exam (Check webpage https://finalexams.rutgers.edu/course/1139770 for exact date and time)</p>	

SUPPORT SERVICES

If you need accommodation for a *disability*, obtain a Letter of Accommodation from the Office of Disability Services. The Office of Disability Services at Rutgers, The State University of New Jersey, provides student-centered and student-inclusive programming in compliance with the Americans with Disabilities Act of 1990, the Americans with Disabilities Act Amendments of 2008, Section 504 of the Rehabilitation Act of 1973, Section 508 of the Rehabilitation Act of 1998, and the New Jersey Law Against Discrimination. More information can be found at ods.rutgers.edu.

[Rutgers University-New Brunswick ODS phone (848)445-6800 or email dsoffice@echo.rutgers.edu]

[Rutgers University-Newark ODS phone (973)353-5375 or email ods@newark.rutgers.edu]

If you are *pregnant*, the Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy.

[Rutgers University-New Brunswick Title IX Coordinator phone (848)932-8200 or email jackie.moran@rutgers.edu]

[Rutgers University-Newark Office of Title IX and ADA Compliance phone (973)353-1906 or email TitleIX@newark.rutgers.edu]

If you seek **religious accommodations**, the Office of the Dean of Students is available to verify absences for religious observance, as needed.

[Rutgers University-New Brunswick Dean of Students phone (848)932-2300 or email deanofstudents@echo.rutgers.edu]

[Rutgers University-Newark Dean of Students phone (973)353-5063 or email DeanofStudents@newark.rutgers.edu]

If you have experienced any form of **gender or sex-based discrimination or harassment**, including sexual assault, sexual harassment, relationship violence, or stalking, the Office for Violence Prevention and Victim Assistance provides help and support. More information can be found at <http://vpva.rutgers.edu/>.

[Rutgers University-New Brunswick incident report link: <http://studentconduct.rutgers.edu/concern/>. You may contact the Office for Violence Prevention and Victim Assistance at (848)932-1181]

[Rutgers University-Newark incident report link: https://cm.maxient.com/reportingform.php?RutgersUniv&layout_id=7 . You may also contact the Office of Title IX and ADA Compliance at (973)353-1906 or email at TitleIX@newark.rutgers.edu. If you wish to speak with a staff member who is confidential and does **not** have a reporting responsibility, you may contact the Office for Violence Prevention and Victim Assistance at (973)353-1918 or email run.vpva@rutgers.edu]

If students who have experienced a temporary condition or injury that is adversely affecting their ability to fully participate, you should submit a request via <https://temporaryconditions.rutgers.edu> .

If you are a military **veteran** or are on active military duty, you can obtain support through the Office of Veteran and Military Programs and Services. <http://veterans.rutgers.edu/>

If you are in need of **mental health** services, please use our readily available services.

[Rutgers University-Newark Counseling Center: <http://counseling.newark.rutgers.edu/>]

[Rutgers Counseling and Psychological Services–New Brunswick: <http://rhscaps.rutgers.edu/>]

If you are in need of **physical health** services, please use our readily available services.

[Rutgers Health Services – Newark: <http://health.newark.rutgers.edu/>]

[Rutgers Health Services – New Brunswick: <http://health.rutgers.edu/>]

If you are in need of *legal* services, please use our readily available services: <http://rusls.rutgers.edu/>

Students experiencing difficulty in courses due to *English as a second language (ESL)* should contact the Program in American Language Studies for supports.

[Rutgers–Newark: PALS@newark.rutgers.edu]

[Rutgers–New Brunswick: eslpals@english.rutgers.edu]

If you are in need of additional *academic assistance*, please use our readily available services.

[Rutgers University-Newark Learning Center: <http://www.ncas.rutgers.edu/rlc>

[Rutgers University-Newark Writing Center: <http://www.ncas.rutgers.edu/writingcenter>]

[Rutgers University-New Brunswick Learning Center: <https://rlc.rutgers.edu/>]

[Optional items that many faculty include:

- Students must sign, date, and return a statement declaring that they understand the RU Academic Integrity Policy.

- Students must sign, date, and return a statement declaring that they understand this syllabus.]

Copyright Notice to Students

Due to changes in the manner in which classes are now being conducted here at RBS and at Rutgers in general, you will have access to a significant number of learning resources through any number of media and on-line platforms, many of which have not been available or offered before in this manner.

In light of this, you should be cognizant of the realities concerning the use of intellectual property.

Virtually all original work that is made available to you is subject to claims of copyright by either the original creator of the works, or by the owners of the rights in those works. These copyright holders may include publishers, authors, professors, the University, RBS, and in some cases perhaps even your fellow students. The protected materials may include but are not limited to syllabi, lectures (both audio and video), PowerPoint/PDF presentations, and other recorded, printed or electronically stored media.

Unauthorized use of these materials can potentially subject you to disciplinary action by the University, significant civil penalties, and in some cases even severe criminal sanctions. Most of the information provided to you, (in my class for example), is intended to be restricted to use by the individual student in completing the requirements of the class. Unauthorized use would include such things as the copying, sharing, forwarding, sale, rental, online posting of any kind, (including on social media platforms),

publication, or other any other form of distribution of these materials without the express written permission of the copyright holder.

The source of pirated material is easily traced. Do not put yourself in a situation that may cause you significant problems. Please be respectful of the property rights of those who work hard create, publish, and provide these materials to you.