

DEPARTMENT OF MATHEMATICS, UNIVERSITY OF UTAH  
**Introduction to Mathematical Finance**  
**Math 5760 Section 001/6890 Section 002 – Fall 2023**  
**Course Information and Syllabus**  
Updated September 12, 2023

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**Instructor:** Akil Narayan  
**Email:** [akil@sci.utah.edu](mailto:akil@sci.utah.edu)  
**Phone:** 801-581-8984  
**Office:** WEB 4666, LCB 116

**Office hours:** Mondays 12-1pm, WEB 4666  
Thursdays 12pm-1pm, WEB 4666

**Class type:** In Person

**Class time and location:** TR, 9:10am-10:30am, WEB L126  
Virtual: Zoom, see Canvas for link

**Attendance policy:** Attendance during lectures is *not* a part of your grade. However, I strongly recommend that you attend the lectures; attendance is an essential ingredient for success in this course.

**Section webpage:** <http://www.sci.utah.edu/~akil/math5760>

**Note:** Scores for graded assignments and any recorded videos will be posted on Canvas.

**Course Information:** This is a 3-credit course.

**Learning objectives:** This course serves to introduce students to concepts in the field of mathematical finance. This will include general knowledge about the financial system and corresponding products, as well as rigorous and mathematically principled models for financial securities. One major goal will be the translation of valuation and investment strategies into mathematical objects and concepts that we can probe, investigate, and optimize. An introductory-level discussion of diversification, capital allocation, and financial portfolio evaluation will also be provided.

**Prerequisites:** MATH 5010 (Introduction to probability) and MATH 2250 or 2270 (Linear algebra).

**Course description:** A basic introduction to the theory of financial derivative pricing. Topics include no arbitrage principle, risk-neutral measure, Black-Scholes theory, numerical model implementation and parameter calibration.

**Text:** Required: *An Introduction to Mathematical Finance with Applications*, 1st Edition (2016), A. Petters and X. Dong, Springer Undergraduate Texts in Mathematics and Technology, ISBN-13:978-1493937813, ISBN-10: 1493937812.

Optional supplement: *Stochastic Calculus for Finance I: The Binomial Asset Pricing Model*, (2005), S. E. Shreve, Springer, ISBN-13: 978-0387249681, ISBN-10: 0387249680.

Class lectures will be *heavily* based on textbook material. The textbook provides additional details and alternative interpretations that cannot be covered in class due to time constraints. Homework will be assigned mostly from problems in the textbook. Access to the textbook is mandatory for success in this class.

**Class meetings:** This class meets in person thrice per week. Class meetings will primarily be lecture-based, which will include a discussion of theory and practice examples. I encourage you to participate in class, in particular with questions and related discussions.

**Homework:** Problem sets will be announced in-class and subsequently posted on the course website. Homework will be assigned approximately weekly and collected in class on the due date. Late homework assignments will be accepted, but with a 25% penalty per day late. This penalty will be enforced on Canvas, and can be waived if you provide me documentation demonstrating extenuating circumstances.

Each homework assignment is worth equal weight and your lowest homework score over the semester will be dropped. You are welcome (and encouraged) to work on the homework assignment in groups, but each student must submit individual work.

**Projects:** There will be two take-home projects involving programming and numerical computation. Each of the two projects will carry equal weight in determining your final grade. The due dates for these projects are October 19 and December 7.

**Exams:** This course will have a single in-class comprehensive final exam. The final exam will be held on Friday, December 15 from 8am-10am in WEB L126, in accordance with university policy. The final exam will be open-book and open-notes.

**Students enrolled in MATH 6890:** Extra work beyond that assigned for students in 5760 will be expected. This will typically take the form of 1 or 2 extra problems in some assignments, and in some extra investigations in the projects. I also have elevated expectations for such students in terms of scientific, mathematical, and writing skills.

**Grading:** Your course grade will be computed as follows.

- Homework ..... 50%
- Projects ..... 25%
- Final exam ..... 25%

Final letter grades will be assigned based on the following scheme:

- 92% - 100% — A
- 90% - 91% — A-
- 88% - 89% — B+
- 82% - 87% — B
- 80% - 81% — B-
- 78% - 79% — C+
- 72% - 77% — C
- 70% - 71% — C-
- 68% - 69% — D+
- 62% - 67% — D
- 60% - 61% — D-
- 0% - 59% — E

## Important dates:

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<b>Sep 1</b>	Last day to add, drop, elect CR/NC or audit classes
<b>Oct 19</b>	Project 1 due
<b>Oct 20</b>	Last day to withdraw from classes
<b>Dec 1</b>	Last day to reverse CR/NC option
<b>Dec 7</b>	Project 2 due
<b>Dec 8</b>	Reading Day
<b>Dec 15 8:00am</b>	Final exam

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**Class communication:** An email list is set up with which I shall send out information not communicated during class. This email list will also be used to communicate class information in the case of unusual circumstances affecting the the logistics of the class. If you are not officially registered for the class but wish to be on the roster, please discuss it with me.

*If you are registered for the course, but do not receive the course email announcements to your University of Utah email address, please notify me immediately.* You can forward your Utah emails to other email addresses. (Navigate to <http://www.cis.utah.edu>, login, and change your UMail settings.)

The section website will be used to communicate more technical matter of the class (e.g. problem sets, lecture summaries, etc.).

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to change that may be necessitated by a revised semester calendar or other circumstances. The above two methods, in addition to the coursewide website, are reliable means of getting information about changes to the course.

**Communication with the instructor:** The most reliable and preferred means of contacting me is via email, and I typically respond in less than 24 hours. Communication through the messaging system in Canvas will also work, but possibly with a slightly longer response time. One-on-one meetings can also be set up with me outside of office hours; please set up such meetings with me via email.

**COVID-19 considerations:** All class activities will take place in person. University leadership continues to monitor the COVID-19 pandemic, and will follow guidance from the CDC. University leadership has urged all faculty, students, and staff to model the vaccination, masking, testing and self-reporting behaviors we want to see in our campus community. These include:

**Vaccination:** Get a COVID-19 vaccination if you have not already done so; see <https://alert.utah.edu/covid/vaccine/>.

**Masking:** Masks are no longer required outside of Health Sciences facilities. Indoor masking recommendations are based on current conditions and health department recommendations.

**Testing:** Self-reporting positive COVID-19 test results. Regardless of your status regarding COVID-19, I **strongly urge** you to take advantage of university COVID-19 testing services at <https://alert.utah.edu/covid/testing>, including free asymptomatic testing.

**Student responsibilities and integrity:** All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully

and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, and I will do so, beginning with verbal warnings and progressing to dismissal from and class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

<http://regulations.utah.edu/academics/6-400.php>

**Inclusivity:** It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

**Discrimination and Harassment:** If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or Office of the Dean of Students, 270 Union Building, 801-581-7066. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS). Please see Student Bill of Rights, section E <http://regulations.utah.edu/academics/6-400.php>. I will listen and believe you if someone is threatening you.

**Classroom Social Equity:** Canvas allows students to change the name that is displayed AND allows them to add their pronouns to their Canvas name. Class rosters are provided to the instructor with the student's legal name as well as "Preferred first name" (if previously entered by you in the Student Profile section of your CIS account, which managed can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center: [https://lgbt.utah.edu/campus/faculty\\_resources.php](https://lgbt.utah.edu/campus/faculty_resources.php)

**English Language Learners:** If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include: the Writing Center (<http://writingcenter.utah.edu/>); the Writing Program (<http://writing-program.utah.edu/>); the English Language Institute (<http://continue.utah.edu/eli/>). Please let me know if there is any additional support you would like to discuss for this class.

**Undocumented Student Support:** Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801-213-3697 or visit [dream.utah.edu](http://dream.utah.edu).

**Veterans:** If you are a student veteran, the University of Utah has a Veterans Support Center located in Room 161 in the Olpin Union Building. Hours: M-F 8-5pm. Please visit their website

for more information about what support they offer, a list of ongoing events and links to outside resources: <http://veteranscenter.utah.edu/>.

**The Americans with Disabilities Act:** The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, 801-581-5020, <https://disability.utah.edu>. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

**Student wellness:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at [www.wellness.utah.edu](http://www.wellness.utah.edu) or 801-581-7776.

**University Counseling Center (UCC):** The UCC staff is committed to supporting the mental health needs of our campus community. Their phone number is 801-581-6826. Their hours are Monday-Friday, 8:00am-5:00pm. For after-hours emergencies, contact the 24/7 Crisis Line: 801-587-3000 . More information is at <https://counselingcenter.utah.edu/>. **Student Success Advocates:** The mission of Student Success Advocates is to support students in making the most of their University of Utah experience ([ssa.utah.edu](http://ssa.utah.edu)). They can assist with mentoring, resources, etc. Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact a Student Success Advocate for support (<https://asuu.utah.edu/displaced-students>).

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, office for equal opportunity and affirmative action including sexual orientation or gender identity/expression, you are encouraged to report it to the University's Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, <https://oeo.utah.edu/contact-us/index.php> or to the Office of the Dean of Students, 270 Union Building, 801-581-7066, <https://deanofstudents.utah.edu>. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677(COPS), <https://police.utah.edu>.

**Campus Safety:** The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit [safeu.utah.edu](http://safeu.utah.edu).

**Office of the Dean of Students:** The Office of the Dean of Students is dedicated to being a resource to students through support, advocacy, involvement, and accountability. It serves as a support for students facing challenges to their success as students, and assists with the interpretation of University policy and regulations. To contact the Office of the Dean of Students, please email [deanofstudents@utah.edu](mailto:deanofstudents@utah.edu) or call 801-581-7066. There is more information at <https://deanofstudents.utah.edu>.

## Semester calendar

(Subject to change!)

DAY	DATE	TEXT SECTION(S)	TOPIC
Tuesday	August 22, 2023	1.1	Hello + basics
Thursday	August 24, 2023	1.2, 1.3	Securities and markets
Tuesday	August 29, 2023	2.1-2.4	Interest
Thursday	August 31, 2023	2.5-2.7	Net present value
Tuesday	September 5, 2023	2.8-2.10	Stocks and bonds
Thursday	September 7, 2023	—	Review: Probability, linear algebra, and differential equations
Tuesday	September 12, 2023	—	Review: Probability, linear algebra, and differential equations
Thursday	September 14, 2023	3.1	Markowitz portfolios
Tuesday	September 19, 2023	3.1-3.4	Markowitz portfolios
Thursday	September 21, 2023	3.4-3.7	$N$ -security portfolios
Tuesday	September 26, 2023	3.4-3.7	$N$ -security portfolios
Thursday	September 28, 2023	3.4-3.7	$N$ -security portfolios
Tuesday	October 3, 2023	4.1	Capital market theory
Thursday	October 5, 2023	4.2	Risk measures
Tuesday	October 10, 2023	—	<u>No class: Fall Break</u>
Thursday	October 12, 2023	—	<u>No class: Fall Break</u>
Tuesday	October 17, 2023	4.3	Linear factor models
Thursday	October 19, 2023	—	<u>No class</u>
Tuesday	October 24, 2023	5.1	Binomial tree models
Thursday	October 26, 2023	5.1-5.2	Binomial tree models
Tuesday	October 31, 2023	5.2-5.3	Continuous-time models
Thursday	November 2, 2023	5.3-5.4	Continuous-time models
Tuesday	November 7, 2023	5.4	Continuous-time models
Thursday	November 9, 2023	6.7-6.8	The Itô integral
Tuesday	November 14, 2023	6.7-6.8	Itô's formula
Thursday	November 16, 2023	6.9	Geometric Brownian motion
Tuesday	November 21, 2023	7.2-7.3	Forward and futures
Thursday	November 23, 2023	3.4-3.7	<u>No class: Thanksgiving break</u>
Tuesday	November 28, 2023	7.5	Options
Thursday	November 30, 2023	8.1	The Black-Scholes-Merton model
Tuesday	December 5, 2023	8.2	Options pricing
Thursday	December 7, 2023	8.4	Risk-neutral pricing
Friday	December 15, 2023	8:00am-10:00am	<b><u>FINAL EXAM</u></b>