MGMT MFE 406 – Derivative Markets (4 units)

Part 0: Introduction

Prof. Eric S. Reiner

UCLA Anderson

Winter 2025

Outline

1. Instructional Resources and Class Schedule

- Instructor and TAs
- Course Schedule
- Course Website(s) and eResources

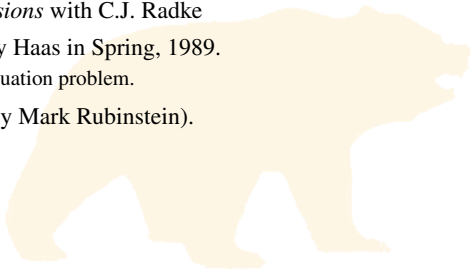
1.1. Instructor and TAs

- Instructor: Eric Reiner ("Prof. Eric" aka 🦏)
- Email: eric.reiner@anderson.ucla.edu
  - I'm generally quite responsive, but please be reasonable in your use of (and expectations for) email communications.
- Office Hours: W 14:00∼15:00 @ C401a (my office in the MFE suite)
  - I normally operate an 'open' office hours model:
    all are welcome to attend and listen as questions are posed and discussed.
  - Generally: first-come, first-served.
    Let me know if you would like to set up a Google sign-up sheet to establish priority.
  - I will usually make an announcement on the course slack channel: #mfe-406-25w
    if I need to move, curtail, or cancel my office hours for a particular day.
  - Please reach out if you would like to arrange to meet individually.
- Course Assistants (TAs):
  - Anand Systla, MFE '19, Anderson Finance Ph.D. Candidate (asystla92@g.ucla.edu)
  - Brian Park, Anderson Finance Ph.D. Candidate (jwbpark.teaching@gmail.com)

1.1. Instructor and TAs (2) – About the Instructor

Education

- S.B., Chemical Engineering; Concentration (Minor), Economics – M.I.T.
  - Emphases: classical & statistical thermodynamics, non-linear optimization
- Ph.D., Chemical Engineering – UC Berkeley
  - Emphases: statistical mechanics, interfacial phenomena, analytical & numerical methods for linear & non-linear PDEs
  - Thesis: *Equilibrium Theory of Concentrated Colloidal Suspensions* with C.J. Radke
  - Met Phelim Boyle when he was a visiting professor at Berkeley Haas in Spring, 1989.
    - He suggested I work on the (at that time unsolved) Asian option valuation problem.
  - Audited Haas' one derivatives course in Spring, 1990 (taught by Mark Rubinstein).



1.1. Instructor and TAs (3) – About the Instructor (continued)

Professional Employment

- Leland O'Brien Rubinstein Associates, Incorporated (LOR), 1990∼1993
  - Senior Associate, Dec 1990∼Jun 1991; Vice President, Jun 1991∼June 1992; Senior Vice President, June 1992∼June 1993
  - Various derivatives modeling and consulting assignments
  - Authored/co-authored several early papers on exotic option valuation
  - Developed what became BARRA's and SunGard's exotic options valuation suites
- Union Bank of Switzerland, UBS Warburg Dillon Read, ... UBS AG, 1993∼2013
  - Vice President, Jul 1993∼Dec 1995; Executive Director, Jan 1996∼Dec 1997; Managing Director, Jan 1998∼Dec 2013
  - Equity Derivatives Sales & Trading, Jul 1993∼Feb 2003:
    - Desk quant, Jul 1993∼Dec 1997
    - Partner MD in equities trading, Jun 1998∼Feb 2003: Global Head of Equities Quantitative Strategies, Deputy Head of Trading & Execution IT; responsible for all models and systems for equity derivatives and related products
  - UBS Group (Corporate) Risk Control, Feb 2003∼Dec 2013
    - Managing Director reporting at Group Executive Board (GEB) or GEB-1 level throughout
    - Developed firm-wide risk aggregation frameworks (earnings- and capital- at-risk, firm-wide stress testing); oversaw firm-wide investment risk
  - Requested and was granted (Full-Career) Retirement at end-2013

1.1. Instructor and TAs (4) – About the Instructor (continued)

Professional Employment, continued

- Haas School of Business, University of California, Berkeley, 2009∼2022
  - Lecturer in the Haas MFE Program, responsible for:
    - MFE 230O, Applied Finance Project, 2009∼2013, 2015∼2022
    - MFE 230D, Derivatives: Quantitative Methods, 2015∼2022
  - "Club Six" most years 2016-2022; Earl F. Cheit Teaching Prize 2018-19, 2021-22
- Anderson School of Management, UCLA, 2022∼present
  - Faculty Director of the MFE Program, also teaching the Applied Finance Project (AFP)
  - This is a subject that I'm passionate about and have always wanted to teach.
  - I'm looking forward to making this a challenging and rewarding experience for everyone!

Other Professional Activities

- Editorial Boards
  - *Journal of Derivatives,* 1993∼
  - *International Journal of Theoretical and Applied Finance,* 1997∼2011
  - *Quantitative Finance,* 1999∼
- Member, FASB Option Valuation Group, 2003∼4
  - Advisor to the FASB on employee stock option valuation and revision of FAS 123 (2003∼2004)
  - Sole representative of the Broker-Dealer community on the panel

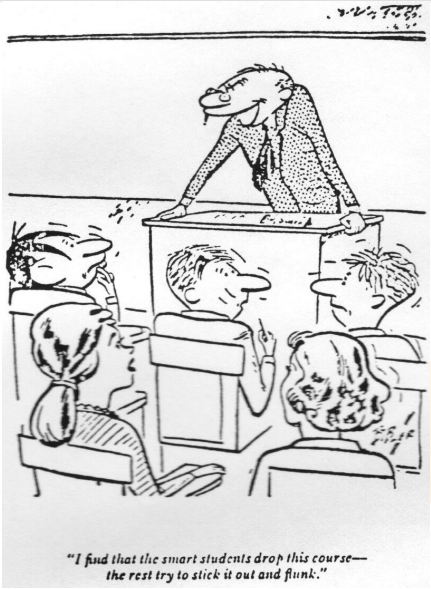
1.2. Course Schedule

- Lectures (all @ B313):
  Section 1: Tu 10:00∼11:30, Th 14:30∼16:00
  Section 2: Tu 14:30∼16:00, Th 10:00∼11:30
- We will meet for a total of 30 instructional hours (∼20 lectures, not including exams or review sessions) between now and Th 14 Mar.
  - In the last week, we might also have an extra session for review
- We will seek to begin at the stated class start time
  - The first 5-10 minutes or so will be dedicated to warming up via reviewing and answering questions about the previous lecture, discussing upcoming problem sets, etc.
  - We will then cover new material until the stated class end time, possibly running over by a few minutes if absolutely necessary to complete a thought.
- TA-led Discussion Session followed by TA's Office Hours:
  - Friday afternoons 14:30∼16:00 @ G304, except 24 Jan and 21 Feb @ A201
  - Brian will cover the first half of the sessions; Anand will cover the second half.
    - We are considering moving the second half of the sessions to Wednesday afternoons
  - Anand may also conduct an extra review session before the final exam.

1.3. Course Website(s) and eResources

- Bruin Learn site: https://bruinlearn.ucla.edu/courses/201516
  - Assignments, instructor/TA solutions, lecture/discussion handouts, etc. will be posted on Bruin Learn.
  - Archived copies of last year's lecture notes, midterm, and final exam are already there, and the course syllabus will be there shortly.
  - All assignment submissions should be uploaded to Bruin Learn (and not to Slack nor sent by email) since Bruin Learn provides integrated management of the entire process.
- Slack channel: #mfe-406-25w
  - Occasional announcements will be posted here as well as slide updates, homework instructions, clarifications, etc.
  - You are advised to monitor the channel frequently since you will be held responsible for any content or instructions posted there.
  - Use of the channel for discussion of course logistics, questions to clarify homework, good-natured rapport, etc. is welcomed.

2. Grading, Assignments, and Exams



2. Grading, Assignments, and Exams (2)

Grading

- 30∼33% Group problem sets / mini-projects
- 20∼22% In-class mid-term
- 40∼45% Final examination
- up to 10% Class attendance/participation and good citizenship
- Subject to UCLA Anderson grading policy for MFE courses, my past teaching experience suggests the majority of MFE 406 grades can be expected to lie within the A-/B+ range.
  - Marks of A/A+ and B/B-/below reflect notably stronger or weaker ($\pm$ 1 or 2 s.d.) performance.
  - Typical final grading approach starts with identifying the mean, $\pm 1\sigma$, and $\pm 2\sigma$ points and then looking for natural breakpoints within the data.
  - I also use a 'voting' method amongst several rescalings of the grading inputs to reduce outlier effects.
  - Typically, the role of class participation, etc. is to differentiate amongst students near one of the breakpoints: If I know who you are and can recall/recognize your effort, I am MUCH more likely to give you the benefit of the doubt!

2.1. Homework – Exercises

- I may assign exercises consisting of a brief problem (or two) after class
  - no due date: not to be handed in
  - aim to build 'muscle memory' through practice/application of concepts covered in class and/or groundwork for material (soon) to be covered
  - To maximize your benefit from these assignments you are encouraged to work on your own as much as possible.
  - I'll aim to post solutions on Bruin Learn a week or so later.

2.2. Homework – Group Problem Sets

- Problem sets, each consisting of 1-4 multi-part questions, will be assigned every week (or two).
  - Due approximately one week later, usually on Sunday evenings.
    - We are considering moving the due dates to Friday evenings in the second half of the quarter.
  - Emphasis early in the term will typically be on relatively simple problems, but will evolve toward deeper analytical methods and programming- (and possibly data-) intensive assignments.
  - (Later) questions should be expected to consume several hours each, and are designed to provide you with hands-on experience implementing, applying, and fine-tuning the methods we have discussed in class.
  - Some problems later in the term will resemble guided R&D projects.
    - Regrettably, this often necessarily requires multiple, repetitive calculations and not just a single, proof-of-concept "see mom, I can do it" result.
    - Rather, the objective is reaching an understanding of the pros and cons of various approaches through experimentation and testing, just as in the real-world model development process.
  - You may work in (pre-assigned) teams of 4 or 5 students, but teams are required to work independently of each other.
  - Team solutions (clearly marked at the top of the first page with the names of all team members) should be uploaded to Bruin Learn by the required submission time.
    - Team assignments will be pre-loaded onto Bruin Learn.
    - It is also a good idea to identify the problem set, question, and your team number in the file name of your submission, e.g. MFE 406_PS3_Q1_Cohort1_Team11.pdf

2.3. Homework – General Guidelines

- Assignments, along with due date information, will be posted on Bruin Learn by or shortly after the end of class sessions.
- We will endeavor to have office hours and TA discussion sessions occur before assignments are due so that you have ample opportunities to seek clarification and ask questions.
- You may use any programming language or environment available to you (e.g. – but not limited to – C++, Python, Matlab, etc.) to complete the assignments.
  - You are **encouraged** but not **required** to use C++.

    Some of our graduates who have gone on to work at large, global firms report back that they *wish* we had made them develop the code for the homework assignments in C++.
  - Nevertheless, we recognize the likely reality that the vast majority of you will choose to work in the Python jupyter notebook environment.
- In general, you should expect problems to require you to apply and extend the material covered in lectures and not merely regurgitate or practice it.
  - While this may appear new to some of you, it is entirely appropriate for graduate-level coursework.
  - Corollary: Unlike (some) other courses you have experienced, you can't really master this material via passive learning (e.g., study and review of your notes). Rather, you'll need to roll up your sleeves and actively engage with the concepts and methods by doing the homework.

2.3. Homework – General Guidelines (2)

- Bruin Learn will be set to accept only .pdf or .txt files, since the system often has difficulty parsing other file types.
  - In particular, you will not be able to upload .doc[x], .htm[l], .ipynb, .zip, or .rar files.
  - You need to submit a written report (pdf generated from LaTeX or Overleaf preferred) answering all the questions.
    - If you want to highlight code or implementation, please add it to the report.
    - To encourage high-quality submissions, a bonus of 5% of the points earned on each assignment will be awarded for timely uploading of typeset (e.g., MS-Word, LaTeX, or Overleaf) solutions to Bruin Learn.
  - Your code should be attached as a separate file.
    - Please append .txt to jupyter notebook filenames (i.e., MFE 406_PS3_Q1_Cohort1_Team11.ipynb.txt) before uploading.
  - A jupyter notebook-only submission will receive a 10% deduction.
- I urge caution with the submission of mobile 'phone scans of handwritten solutions. Although the technology and resolution have greatly improved in recent years, these are still frequently illegible.
  - The TAs have the authority to reject or penalize submissions that they find difficult to parse.

2.3. Homework – General Guidelines (3)

- **Unexcused** submissions of up to 24 hours late will be penalized up to 50%. After 24 hours, no credit will be awarded at the TAs' and instructor's discretion.
  - We are much more likely to grant an extension if the TAs and I are approached with a good reason **well** in advance of the deadline.
  - That said, if something happens, submit what you have on time and contact the TAs and me ASAP with an explanation. Stuff happens to everyone sometimes and, while strict, we are not monsters.
- Academic Integrity:
  - The MFE learning process is inherently collaborative.
  - We are also not unrealistic – we do expect you to discuss the homework assignments with your colleagues.
  - Nevertheless, we must balance rational expectations vs. the requirement that the work be your own.
  - You are welcome to discuss and share hints, but are forbidden from sharing answers *per se* or code.
  - Where the assignment's objective is the implementation of a particular method or technique, you may **not** use a canned package, online source, or previous year's solution instead of writing the code yourself.
  - Submissions displaying evidence of copying will be penalized up to 100% (applied to both copied and non-plagiarized parts). The penalty will apply to **all members** of both source and destination teams.
  - We make use of a software tool called turnitin to assist in detecting such situations.
    - Avoid using notebooks "inherited" from others, even if only as templates. These carry enough of a footprint to trigger the turnitin software.
    - Your own notebooks from previous MFE 406 assignments are fine.

2.3. Homework – General Guidelines (4)

Use of AI Tools

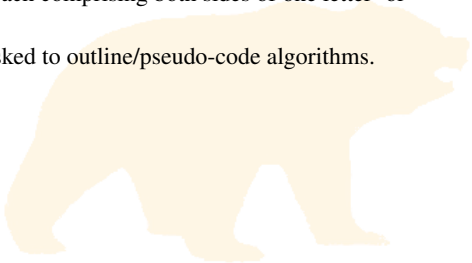
- UCLA Anderson AI Usage Policy
  - This course will allow the use of AI (Large Language Models, including ChatGPT, Copilot, Gemini, and others) to enhance your learning, not replace it! The goal is to expand student capabilities and output in research and analysis, providing greater time to contemplate, analyze, and develop more sophisticated analyses, recommendations, and leadership imperatives.
  - To facilitate the achievement of this goal, every assignment in the class will state whether using AI is appropriate. If you are confused about what is allowed, please ask the instructor or the course assistant for clarification. When using AI for individual or group assignments, you must acknowledge the tool's name and how it was used using the following style.
    - No content generated by AI technologies has been presented as my own work.
    - I acknowledge the use of [insert AI system(s)] to generate materials for background research and self-study in the drafting of this assessment.
    - I acknowledge the use of [insert AI system(s)] to generate materials that were included within my final assessment in modified form.
- I do not object to your using AI tools for formatting purposes, but not for problem solving, analysis, or code generation.
- Echoing the Academic Integrity bullets on the previous slide, where the assignment's objective is the implementation of a particular method or technique, you may **not** use code obtained from generative AI sources like ChatGPT instead of writing the code yourself.

2.4. "In-class" Mid-term Examination

- Tentatively scheduled for 11:00∼12:30 W 12 Feb.
- Emphasis will be on basic concepts and tools, assessed via *relatively* short, simple problems.
- We will permit use of a NON-PROGRAMMABLE calculator and one (1) two-sided page of notes, but no access to the internet or any other resources.
- Further details will be provided in late Jan / early Feb.

2.5. Final Examination

- A comprehensive 3-hour final exam is scheduled for 11:30∼14:30 M 17 Mar.
- Format will comprise several multi-part problems, each typically focussed on one broad topic but requiring integration of concepts from throughout the course.
- Further details, including scheduling of review sessions, permissible resources, etc. will be provided as the course progresses.
  - Last year, a non-programmable calculator + two cheat sheets, each comprising both sides of one letter- or A4- sized page were permitted.
  - I do not expect live coding questions, although you might be asked to outline/pseudo-code algorithms.



3. Etiquette and Attendance

In-class Rules/Etiquette

- We will be operating in a primarily in-person instructional mode.
- Please arrive to class on time and plan to remain for the entire scheduled period.
- If you must arrive late (or leave early), please do so quietly and sit near the exit to minimize the disruption to your classmates.
  - The pinnacle of politesse would be to inform the instructor beforehand.
- Set all devices to silent mode.
  - Do not make/take calls during class; if you must, leave the room quietly.
  - Please avoid any other side conversations; these are distracting to both the instructor and your colleagues.
- Please do not work on assignments, surf the internet, answer emails, etc. during class.
- Please bring (and display) your name cards **throughout the term** so that we can learn your names.
  - If you forget your name card, please introduce yourself when asking/answering a question.

3. Etiquette and Attendance (2)

Attendance

- Personally, I am "libertarian" about such matters – different students have different learning styles and preferences.
- Nevertheless, it is well understood that learning is enhanced through group and student-teacher interactions.
- Furthermore, international students are expected to attend classes in-person as a condition of their visas.
- I do not intend to impose a Draconian policy like that established for the MBA programs.
  - However, attendance and participation will affect your grade as discussed above.
  - I reserve the right to restrict or delay access to class recordings if attendance falls below 50%.

4. Course Objectives and FAQs

Objectives

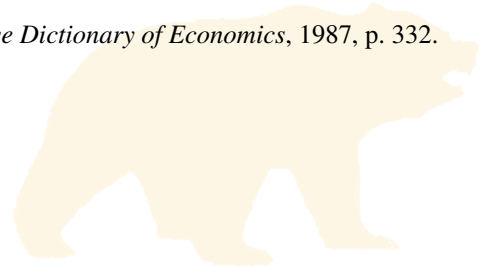
- MFE 406 is designed to familiarize the MFE cohort with the derivatives markets, products, and features that they are most likely to encounter across a variety of financial engineering careers.
- We will also introduce some of the common modelling techniques that you are most likely to find useful during your careers. In many cases, these techniques will be explored in greater depth and expanded in MFE 405.
- In addition to guiding students' development and implementation of their own (portable) toolkits of approaches and methods, the course aims to provide a sound foundation for their future, independent extension of those toolkits as they encounter new products, requirements, and techniques.
- While the course carries a strong "**Q**-measure" flavor, most of the techniques and insights are fully applicable to "**P**-measure" problems.
- Finally, and just as importantly, the course seeks to solidify students' understanding of the thinking processes underlying stochastic process, derivatives valuation, and risk analysis (which are very much at the core of modern finance, extending well beyond options *per se*), as well as the language and characteristics of derivatives markets.

4. Course Objectives and FAQs (2)

"This does not mean, however, that there are no important gaps in the (option pricing) theory. Perhaps of most importance, beyond numerical results. . . , very little is known about most American options which expire in finite time. . . .

Despite such gaps, when judged by its ability to explain the empirical data, option pricing theory is the most successful theory not only in finance, but in all of economics."

– Stephen A. Ross in *The New Palgrave Dictionary of Economics*, 1987, p. 332.



4. Course Objectives and FAQs (3) – Frequently Asked Questions

I thought derivatives aren't important and nobody cares about them anymore

- "The reports of my death are greatly exaggerated" – Mark Twain
- Typically, around 1/4-1/3 of MFE students find careers in major investment or commercial banks and about 1/3-1/2 in asset management firms, hedge funds, fintech companies, risk consultants, etc.
  - The majority of these roles are ones in which the thinking processes and techniques to implement them (Monte Carlo simulation, tree methods, variance reduction, evaluations of time- and multi-asset- dependent outcomes, ...) that we develop in this course are considered fundamental skills, if not for a particular initial assignment or role, certainly as part of one's professional toolkit.
  - Remember that that derivatives concepts have come to pervade much of financial markets, from fixed income, to ABS, to corporate finance, to asset management.
  - Even at firms where derivatives are of little importance, they are still a frequent interview question topic because the subject is considered so fundamental.
  - Many of my past students have discovered these points during their interviews, internships, and first jobs.
  - I even receive reports from former students now in data science roles that they have needed to develop and implement some of these techniques, especially Monte Carlo, within their work assignments.

4. Course Objectives and FAQs (4) – Frequently Asked Questions

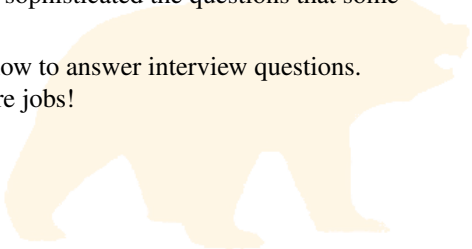
I want a "front-office" job. Will any of this stuff help me to get one of those?

- At the risk of sounding arrogant, I'm the one instructor @ Anderson MFE who spent his career as a "front-office" financial engineer and manager.
- The contents of this course are based on observations and experiences from a 25-year career spanning everything from pricing and structuring deals on a trading desk to advising board members on bank-wide strategy during their formal meetings, adapted for the UCLA Anderson MFE curriculum.
- I will supplement the technical material with lots of comments, advice, and "war-stories" from real financial markets experience.
- Beyond that, it's up to your current discernment as well as your future experiences to determine whether we're sufficiently "front-office" for your tastes.
- p.s. The fact that some of the math(s) and computation are difficult doesn't mean you can't apply them in the real world... quite the contrary!

4. Course Objectives and FAQs (5) – Frequently Asked Questions

Can we cover (more) interview-type questions?

- Sure! Actually, a lot of the short post-class problems correspond to typical interview questions.
- I will also try to point out common questions and strategies for answering them as we discuss the relevant material in class.
- I'll do my best to give you some insights into the sorts of things different types of market participants are likely to ask you about during interviews.
- That said, I'm sometimes surprised at how challenging and sophisticated the questions that some students report back from their interviews are.
- That all said, I do view my job as teaching more than just how to answer interview questions. Ideally, I'd like to help prepare you to succeed in your future jobs!



4. Course Objectives and FAQs (6) – Frequently Asked Questions

Why do we need to learn all this stuff? I can just download code from QuantLib or github and/or use NumPy/SciPy/Open AI functionality if I ever need to do any of it.

- Some inconvenient truths that might contrast with what you've heard anecdotally or read on some blogs/message boards:
  - Most firms maintain multiple distinct, segregated programming environments / code bases.
    - At a minimum, there are two such environments: dev (development) and prod (production).
    - Strict segregation is required and enforced by firms' IT departments, their auditors, and their regulators.
    - To be used "in production" (i.e. to make trades happen, mark P&L, and manage risk), most firms require that code be free of any open-source components.
  - This all means that once you are beyond the prototyping phase, you will be required to build and test your own code unless that functionality already exists within an internal library accessible to you.
  - Each year, several of your colleagues – even in data science roles – discover this (usually the hard way) during their internships. For example, see the quotation on the next slide.
  - So, if someone tells you that you can open-source your way to fame and fortune at a major firm, they either: 1) don't really know, 2) aren't working at such a firm, or 3) aren't in a role that actually connects with the $$$.
- Beyond that: REALLY?

5. Text and Selected Bibliography

Text

- We will cover a broad range of topics using a variety of approaches and no single text treats all of them comprehensively.
- Required text (primarily for background reading): John Hull, *Options, Futures, and Other Derivatives (11th ed.)*, Prentice-Hall (2021), ISBN: 013693997X.
  - Hull's gift for making the most difficult topics approachable and his nearly continuous updates to and expansion of his material has made this the nearly ubiquitous introductory-level derivatives text.
  - Almost every financial engineer owns a copy; you should too!
  - There is also an "International" edition that is identical apart from a difference in page numbering.
  - Lifetime access to an electronic copy (epub) of the text is being provided via the UCLA Inclusive Access program for a BruinBill charge of ∼$36.14.
- Handouts of the lecture slides will serve as the primary text for the course.
  - Slides will be posted on Slack and Bruin Learn at least 45 minutes before class each day.
  - Both that day's "chunk" of the notes as well as a "roll-up" comprising all the slides up to that point for that course module will usually be posted.
- From time to time I will also provide references to the original literature.
- When possible, cross-references to Hull and the resources listed below will be provided.

5. Text and Selected Bibliography (2)

Other Foundational Texts

- Robert L. McDonald, *Derivatives Markets (3rd ed.)*, Pearson (2012), ISBN: 9780321543084.
  - Previously used as the textbook for MFE 406.
  - More of an MBA text: light on the mathematics but full of helpful explanations, illustrations, and examples.
- Mark Rubinstein, *Rubinstein on Derivatives: Futures, Options, and Dynamic Strategies*, Risk Books (1999), ISBN: 9781899332533.
  - Based on Rubinstein's many years of teaching derivatives to MBAs and MFEs, this text emphasizes intuition and market structure over mathematics.
  - Likely out of print, but available on the secondary market or in electronic (scanned) form.
- Sheldon Natenberg, *Option Volatility and Pricing: Advanced Trading Strategies and Techniques (2nd ed.)*, McGraw Hill (2014), ISBN: 0071818774.
  - Long considered the option traders' "bible," it emphasizes (vanilla) option strategies, positions, and hedging.
- John C. Cox and Mark Rubinstein, *Options Markets*, Pearson (1985), ISBN: 0136382053.
  - While dated, this book was remarkably advanced for its time. It's one of those texts that contains results that researchers frequently re-derive as "new."
  - Also likely out of print, but available on the secondary market or in electronic (scanned) form.

5. Text and Selected Bibliography (3)

Quantitative and Computational Finance

- Thomas W. Epps, *Pricing Derivative Securities (2nd ed.)*, World Scientific (2007), ISBN: 9812700331.
  - Not a recent text, but it is still one that stands out for its balance of rigor vs. readability and its coverage of topics beyond those usually covered in academic texts.
- Jherek Healy, *Applied Quantitative Finance for Equity Derivatives (2nd ed.)*, (2019), ISBN: 1791546641.
  - Although a bit "cookbook-ish" at times, this is a remarkably approachable presentation of a wide collection of practitioners' tools, including many beyond the scope of this course.
- Domingo Tavella, *Quantitative Methods in Derivatives Pricing: An Introduction to Computational Finance*, Wiley (2002), ISBN: 0471394475.
  - Tavella originated Berkeley's MFE 230D in 2001-2; this is the text he wrote for it.
  - Still a good introduction even if it doesn't always reflect a practitioner's perspective.
- Raymond H. Chan, Yves ZY. Guo, Spike T. Lee, Xun Li, *Financial Mathematics, Derivatives and Structured Products (2nd ed.)*, Springer (2024), ISBN: 9819995337.
  - A relatively new entry to the field, this covers a broad variety of topics, mostly at a fairly introductory level.

5. Text and Selected Bibliography (4)

Quantitative and Computational Finance (continued)

- Paul Glasserman, *Monte Carlo Methods in Financial Engineering*, Springer (2003), ISBN: 0387004513.
  - Glasserman is an exceptionally talented teacher and researcher; this deep yet clear book reflects those talents.
- Peter Jäckel, *Monte Carlo Methods in Finance*, Wiley (2002), ISBN: 047149741X.
  - While a bit dated, this book conveys invaluable practitioner experience and perspective.
- Rüdiger Seydel, *Tools for Computational Finance (5th ed.)*, Springer (2012), ISBN: 1447173376.
  - Mathematically rigorous yet clear coverage of a wide variety of numerical methods for derivatives valuation.
- Robert L. Navin, *The Mathematics of Derivatives: Tools for Designing Numerical Algorithms*, Wiley (2007), ISBN: 0470047259.
  - Written from the perspective of a theoretical physicist turned quantitative developer, and particularly approachable for those comfortable with PDEs, this contains many insights from the O'Connor brain trust of the 1980s-1990s.

5. Text and Selected Bibliography (5)

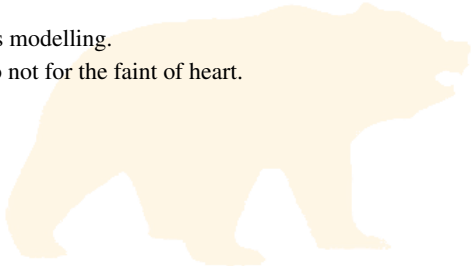
Quantitative and Computational Finance (continued)

- Ali Hirsa, *Computational Methods in Finance (2nd ed.)*, Chapman and Hall / CRC (2024), ISBN: 1498778607.
  - More of a collection of pricing methodologies than a text to be followed sequentially, but a thorough, excellent collection nevertheless.
- Philip Maymin, *Financial Hacking: Evaluate Risks, Price Derivatives, Structure Trades, and Build Your Intuition Quickly and Easily*, World Scientific (2012), ISBN: 9814322555.
  - Not a textbook to learn about derivatives in a linear, structured way, but rather a discursive guide for building your intuition afterwards through a series of thought and numerical experiments.
- Tom Hyer, *Derivatives Algorithms: Bones (2nd ed.)*, World Scientific (2015), ISBN: 9814699519.
  - If you are interested in the OOP and systems implications of derivatives modelling, this is an excellent reference to learn from.

5. Text and Selected Bibliography (6)

Advanced Derivatives References

- Leif Andersen and Vladimir Piterbarg, *Interest Rate Modeling (volumes 1-3)*, Atlantic Financial Press (2010), ISBN: 0984422102, 0984422110, 0984422129.
  - Two masters of fixed-income derivatives modeling have assembled a comprehensive encyclopedia. Not for the faint of heart.
- Alexander Lipton, *Mathematical Methods For Foreign Exchange: A Financial Engineer's Approach*, World Scientific (2001), ISBN: 9810248237.
  - Lipton is (deservedly) recognized as a master of FX derivatives modelling.
  - This comprehensive tome is heavy on the applied math(s): also not for the faint of heart.



5. Text and Selected Bibliography (7)

General References on Numerical Methods and Special Functions

- William Press et al., *Numerical Recipes: The Art of Scientific Computing (3rd ed.)*, Cambridge University Press (2007), ISBN: 0521880688.
  - The first edition of this book was revolutionary when it first appeared (in Fortran!) in 1986, bridging the gap between numerical analysis textbooks that emphasized rigor over utility vs. "cookbooks" that provided little understanding of their code. Still essential 35 years later!
- Milton Abramowitz and Irene Stegun (eds.), *Handbook of Mathematical Functions: with Formulas, Graphs, and Mathematical Tables*, Dover (1964/5), ISBN: 0486612724.
  - A collection of almost every widely useful result about probability distributions and other special functions known at the time. Still a valuable reference 55 years later!
- Frank Olver et al. (eds.), *NIST Handbook of Mathematical Functions*, Cambridge University Press (2010), ISBN: 0521140633.
  - An updated, even more comprehensive version of Abramowitz and Stegun.
  - Also available online (continuously updated and expanded) at: http://dlmf.nist.gov