

DATA 5690/6690: Computational Methods for FinTech

Fall 2025

Course Information

- Dates: Aug 26 – Dec 13
- Time: M/W 12:00 – 1:15 pm
- Room: Huntsman Hall 132

Instructor Information

- [Tyler J. Brough](#)
- Office: BUS 719
- Office Hours: By appointment
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Course Description

Computational finance is an interdisciplinary pillar of modern FinTech, at the intersection of data science, computer science, and economics. In this course students apply tools from computational science and statistics to identify and exploit arbitrage opportunities for entrepreneurial financial innovation. We will view the core concepts of the course through the perspectives of history, philosophy, and quantitative methods and technology.

Course Mechanics

The orientation of this course is unapologetically philosophical. The main mode of course delivery will be the [Socratic Method](#). I will typically play the role of the questioner, but not exclusively. You are highly encouraged to play this role when appropriate. The Socratic method revolves around asking and answering questions. Ward Farnsworth gets at the essence of this mode better than anyone I know with these quotations:

“The Socratic method is a style of thought. It is a help toward intelligence and an antidote to stupidity. This has to be said right away because many people consider the Socratic method, if they consider it at all, to be a technique for teaching. It is that; but the reason the Socratic method is useful in the classroom is that it’s a style of thought better than the one we tend to apply naturally to important things. Socrates didn’t question people in order to teach us how to question people. He did it to teach us how to think. That is what makes his method a matter of general interest, not a device for specialists or special occasions.”

*“As an inhabitant of a university, I especially mean this book to broadly suggest the ethic by which such institutions function best. Their health requires Socratic commitments: to reason, to refutation, and to not flinching when hard questions are put on the table. **A university should be a Socratic gymnasium.**”*

*Treating the characters as sides of Plato’s own mind is a helpful way to think about the value of the dialogues now. It lets them serve as a model for the same in anyone else: **a way to think about things on your own.** Granted, any philosopher’s writings – in a treatise or essay, say – might be viewed as a thought process that the reader is invited to internalize. But a dialogue is distinctly well suited for the purpose. **Questions and answers are the sound of thought happening.** An essay or lecture is usually the sound of thought **having** happened, then polished up so the result is clear and the process of getting there is no longer visible. Ordinarily that’s good. If you know what you think and want someone else to know it, explaining it straight out makes sense. But if you want to provide a model for getting there – for what to do before you know what you think – a dialogue is ideal because it illustrates the process of figuring that out. In Plato’s case the dialogues are studies in how to think about hard things. They show him doing it. And writing out your own little dialogues is, in fact, a good way to sort out your thinking and to develop ability with the Socratic method.”*

At the heart of FinTech is entrepreneurial financial innovation (and arbitrage!). This means *per force* doing something that has never been done before and that means *per force* thinking in a way that has never been thought in before. No FinTech entrepreneur can be successful without mastering the Socratic method! Full stop. There are many who have done so without knowing it explicitly. So much the better if you figure it out explicitly! This course will present the Socratic method in several levels and in many of its aspects: including quantitative and technological ones!

Course Communications, Materials, Etc

- This course will use Canvas minimally
- We will communicate mostly via the Microsoft Teams channel
- I will create a Box drive and share all readings, data, etc with you
- There will be a GitHub repo for the course through which I will share course artifacts and content
- Students will be expected to submit all of their work via GitHub

Assessment

- Course participation (50%)

- Course discussions and lessons are meant to help you complete your exams.
- I expect students to drive this process with questions, and problems based upon their preparation and study.
- Midterms and final (50%)
 - Each exam will have essays focusing on philosophical, historical and theoretical concepts.
 - Additionally, the exams will have core quantitative and programming problems to help students develop skills in computational financial modeling.

Outline of Topics

1. Module 1: Microfoundations

- Review of probability and mathematical statistics
 - The subjective and objective interpretations
 - The Columbia Statistical Research Group, Bletchley Park, and the origins of decision theory
 - *Savage Bayesian* models in economics?
 - An introduction to sampling theory and the Monte Carlo method
- Economic calculation under conditions of uncertainty
 - Foundations of Austrian *catallactics*
 - Ludwig von Mises's *economic calculation*
 - Hayekian knowledge-and-coordination problems
 - The socialist calculation debate
- Forwards and futures markets
 - Institutional foundations
 - Williams and the historical origin of futures markets
- **Deliverable:** take-home midterm 1

2. Module 2: Arbitrage Theory & Options Pricing, Hedging, and Market-making

- The binomial option pricing model
- The Black-Scholes-Merton option pricing model
- The Fundamental Theorem of Asset Pricing and risk-neutral finance
- Monte Carlo methods for option pricing & hedging
- **Deliverable:** take-home midterm 2

3. Module 3: Options Market-Making & Dynamic Trading Strategies

- Options arbitrage in imperfect markets a la Figlewski
- The Longstaff-Schwartz least squares method for American options (dynamic programming)
- The Hedged Monte Carlo (HMC) method
- **Deliverable:** take-home final exam

Important Dates

- First day of classes: August 25
- Labor Day - no class: September 1
- Fall break: October 10
- Thanksgiving Holiday: November 26 – 28
- No-test week: December 1 – 5
- Last day of classes: December 5
- Final examinations: December 8 – 12