MIT Sloan
Hui Chen

15.450
Spring 2023

Analytics of Finance

Course Description

With increased data availability and complexity comes the need for finance professionals who are not only able to work with data, but can separate insights from noise. This course introduces a core set of modern analytical tools that specifically target finance applications. Students gain exposure to statistical inference; financial time series modeling; event study analysis; and machine learning techniques for forecasting and working with big data. As applications, we will use real-world data to build models for financial and macro forecasting, quantitative trading, and dynamic risk management. We will also look behind the curtain of some fintech innovations, such as Kensho's "financial answer machine" and big-data lending platforms.

15.450 vs. 15.457: 15.457 is a more advanced version of 15.450. It covers additional topics on Bayesian inference, stochastic volatility, and deep learning, while 15.450 spends more time covering topics such as the basics of statistical inference and regression models. 15.457 also puts more emphasis on theory. Students with solid background in statistics and proficient in programming might want to consider taking that course instead. 15.457 meets on TTh 2:30 – 4:00 PM.

Pre-requisites

15.401 Finance Theory I (or *15.415*) is a pre-requisite for this course. Homework assignments will involve intensive data analysis and computer implementation of quantitative methods (in Python, R, or other comparable languages). Tutorial sessions on the basics of data analysis using Python will be provided. In addition, this course assumes undergraduate-level background in calculus and probability.

Course Materials

Lecture notes and additional course materials (problem sets and solutions, recitation schedule, announcements, etc.) will be posted on Canvas. I will also post additional reading materials on Canvas, including research papers and newspaper articles, which can provide useful background information or add depth to the materials covered in class. ISL and T are available online.

Recommended textbooks:

(CLM) Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay. The Econometrics of Financial Markets. Princeton, NJ: Princeton University Press, 1996.

(ISL) James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. An Introduction to Statistical Learning: with Applications in R. 2nd ed. Springer, 2021.

(T) Tsay, Ruey S. Analysis of Financial Time Series. 3rd ed. New York, NY: John Wiley & Sons, 2010.

Course Requirements

- Lectures: TTh 1:00 – 2:30 PM, E51-315
- Homework assignments: There are 6 problem sets. The problem sets can be done in groups of 2 to 4 students.
- Final exam: One written exam, closed book; two 8.5"×11" sheets of notes (two-sided) are allowed. The exam will be during the final's week.
- Grading:

$$\text{Grade} = 20\% \times \text{Class participation} + 40\% \times \text{HW} + 40\% \times \text{Exam}$$

Office Hours and Recitations

- Office Hours: M 12:30 – 1:30 PM, or by appointment
- Recitations: See schedule for recitation dates.
- The TAs for this course are Quentin Batista (qbatista@mit.edu) and Joanne Im (joanneim@mit.edu). They will hold weekly office hours (TBA).

Contact Information

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Conduct

Professional conduct is built upon the idea of mutual respect. Please read the MIT Mind and Hand Book for the policy on Academic Integrity. Below are items related to attending lectures:

- Attending classes. The lectures are required for a reason, and each class benefits from the attendance and contributions of all students.
- Arriving on time. Late arrivals are disruptive to both lectures and class discussion, and show disrespect to those who are on time.
- Participating in class. Please use the raise-hand button to ask questions or make comments. Usage of the chat to ask clarifying questions is also recommended.
- Focusing on the class. Please try to leave your camera on and refrain from unrelated activities during class hours.
- Being prepared for class. You should be ready to discuss any assigned readings and to answer any assigned questions for each day's class.
- Respect. You should act respectfully toward all class participants.

15.450 Tentative Schedule

No.	Date	Topic	Readings	Examples	Assignments
1	2/7/23	Introduction	Articles on Canvas		
2	2/9/23	Modeling, inference, forecasting I	ISL.2	Modeling fat-tailed stock returns	
R1	2/10/23	Recitation: Intro to Python and Colab			
3	2/14/23	Modeling, inference, forecasting II			HW1 assigned
4	2/16/23	Linear models I	ISL.3, CLM.5	CAPM; Fama-French 3-factor model; executive compensation	
R2	2/17/23	Recitation			
5	2/23/23	Linear models II			HW1 due
6	2/28/23	Estimation and hypothesis testing I	CLM.6	Evaluating portfolio managers; back-testing trading strategies	HW2 assigned
7	3/2/23	Estimation and hypothesis testing II			
R3	3/3/23	Recitation			
8	3/7/23	Estimation and hypothesis testing III			HW2 due
9	3/9/23	Event studies I	CLM.4	Post-earnings announcement drift; Stock market performance around FOMC announcements; Kensho	
10	3/14/23	Event studies II			HW3 assigned
11	3/16/23	**Guest Lecture**			
R4	3/17/23	Recitation			
12	4/4/23	Financial time series I	T.1, T.2.1-2.7	Modeling interest rates and other macro variables; forecasting corporate earnings	HW3 due
13	4/6/23	Financial time series II	T.2.8		
14	4/11/23	Financial time series III	T.8.2		HW4 assigned
15	4/13/23	Financial time series IV	T.8.6, 8.8		
R5	4/14/23	Recitation			
16	4/18/23	Classification I	ISL.4	Predicting credit card defaults; technical analysis	HW4 due
17	4/20/23	Classification II			
18	4/25/23	Model selection I	ISL.5, 6	The factor zoo; credit scoring with too many features	HW5 assigned
19	4/27/23	Model selection II			
R6	4/28/23	Recitation			
20	5/2/23	Model selection III			HW5 due
21	5/4/23	**Guest Lecture**			HW6 assigned
R7	5/5/23	Recitation			
22	5/9/23	Tree-based methods I	ISL.8	Nonlinear models to predict market returns; real estate pricing model	
23	5/11/23	Tree-based methods II			HW 6 due
24	5/16/23	Class summary	Articles on Canvas		
R8	5/19/23	Recitation: Final Review			