

Economics 4360 Empirical Finance – Spring 2021

- *Monday, Wednesday 8:30-9:45 am, Monroe 130*
- *Professor: Steven Peterson (speterson@virginia.edu; speterson@varetire.org)*
- *Office hours: 7 – 8 pm Zoom, MW and by appointment.*

In this course, we will derive theoretical asset pricing models, develop tests of the implications of such models, and apply these models empirically. The topical coverage will extend to fixed income and equity instruments, European options, portfolio construction and optimization, risk analysis and hedging, and various simulation methods including Monte Carlo techniques using normal as well as fat-tailed distributions, copulas, and principal components. Econometric methods will range from OLS to GMM (as well as IV estimation and GLS) and applications of appropriate probability distributions (for non-normal distributions and copulas). We will use vector and matrix representations and conduct most of our quantitative work in Matlab. I will provide you all the Matlab code. I will review econometric methods. I will facilitate any use of linear algebra.

Course Reading:

Lectures come from the following two texts. You are not required to purchase these texts; Cochrane, though advanced, is especially useful for the Stochastic Discount Factor and GMM. Peterson was developed over the past several years teaching this material and so will be my focus. I will post assigned chapters and spreadsheets to Collab.

Asset Pricing (2001 or 2005). John Cochrane. Princeton University Press.

Investment Theory and Risk Management (2012). Steven Peterson. Wiley Finance.

You can also download all the spreadsheets developed in Peterson at:

<http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118129598,descCd-DOWNLOAD.html>

We will be making heavy use of the software package **Matlab**. I will do most of the initial work here as I will be operating under the assumption that you used Stata as your econometrics platform and that Matlab is new to you. Over time, I will hand over more of the coding to you. Matlab is an excellent programming platform that is relatively easy to learn and comes with online support. Please have Matlab installed ASAP. I will post tutorials which I cover during class. I will provide all the data we will use in this course.

Grading:

Your grade in the course will be a function of three parts: (1) homework (2) midterm and (3) final. All will be either online or take-home. Grades will be weighted as follows (this could change depending on circumstances):

- Homework 50%
- Midterm 25%
- Final 25%

This is a challenging course. My objective is to develop the theory and then apply it to real-world problems ranging across the spectrum of portfolio management. What you learn here will be useful in both your professional and personal lives. I will do most of the initial heavy lifting leaving more and more to you as the semester proceeds. We will adhere expressly to the University of Virginia honor code. As always, there are topics omitted (e.g., FX, Swaps, CDS, Structured Credit, etc.). The outline below is subject to change.

Course Outline

Module 1: Essentials: Time Value of Money, Pricing Assets with Deterministic Cash Flows and Matlab tutorial. [5 lectures, Feb 1-Feb 15]

- Chapters 1-4 Peterson: Essentials.pdf (*review ahead of first class*).
- Matlab.htm (*review ahead of first class*).
- **Part 1:** Time Value of money (Ch. 1, Homework 1)
- **Part 2:** Pricing Deterministic Cash Flows (Ch. 2)
 - Fixed income securities, duration (risk), convexity
 - Liability driven investment (duration matching application, Homework 2)
- **Part 3:** Term structure (forward rates, short rates, rate forecasts – Ch. 3, Homework 3)
- **Part 4:** Dividend Discount and Gordon growth models (risky asset pricing models – Ch. 4)
- OLS Review (notes, slides)
 - Matrices, vectors, estimation and hypothesis testing, (Homework 4)
 - MatlabOLStutorial.docx (see also html, m)
 - Building Matlab functions (examples provided)

Module 2, Part 1: Stochastic discount factor pricing model, CAPM, CCAPM [Feb 22, 24]

- Chapter 5 Peterson: Stochastic Discount Factor Notes.pdf
 - Utility functions, Euler equations, CAPM, CCAPM

Module 2, Part 2: CAPM pricing and the Efficient Set, Sharpe ratios [Mar 1, 3]

- Chapter 6 Peterson: Portfolio basics, CAPM

Module 3, Part 1: Portfolio Construction [Mar 8, 10]

- Chapter 6 Peterson: Portfolio basics (continued)
 - Two asset case algebra, risk, return, diversification, risk budgeting

Module 3, Part 2: Optimization with constraints, Risk Budgeting, Factor Models [Mar 15, 17, 22]

- Chapter 7 Peterson: Portfolio Optimization, Attribution (Homework 6A, B)
 - Alternative Beta (see Alternative Beta. MP4)
 - Minimum variance portfolios
 - Maximum Sharpe ratio portfolios
 - Risk Parity
 - Caps and Floors, Short positions, general constraints.
- Chapter 8 Peterson: Asset Pricing Models and Behavioral Finance (optional)
 - Connecting traditional paradigm and EMH to anomalies literature
- Chapter 8 Peterson, Appendix: Tests of CAPM and CCAPM
 - GMM, Fama-MacBeth (optional)
- Chapter 9 Peterson: Factor Models
 - Extending CAPM to APT (Homework 6C)
 - Factor decomposition, risk/return attribution. (optional)
- Chapter 10 Peterson: Active Management (optional)

Midterm Exam (posted online) ~ March 22

Module 4, Part 1: Options pricing. [8 lectures, Mar 24 – Apr 21]

- Chapters 16 Peterson: Options and Chapter 17 Peterson
- Valuing the firm (with applications)
- Protective covered options (notes)
- Implied volatility, volatility surface and skew
- Hedging (Gamma trading and dynamic delta hedge)

Module 4, Part 2: Models of stock price dynamics. Brownian motion, Black-Scholes, Greeks, Monte Carlo simulation. [4 lectures, Apr 26 – May 5]

- Chapter 17 Peterson: Models of Stock Price Dynamics
- Brownian motion, Black-Scholes pricing, binomial trees, the Greeks, (**Homework 7A**)
- Assorted Matlab functions
 - bineurcall.m, bineurput.m, blsprice.m, callOption.m, putWrite.m
- PutWrite application
- Chapter 12 Peterson: Monte Carlo Methods and applications, (**Homework 7B**)
- Portfolio Insurance, dynamic delta hedging (gamma trading). (**Homework 8**)
- CIR, Vasicek interest rate simulations and GMM tests (vasicek.m, cir_gmm.m). (optional)

Final Project/Exam (posted online) – May 5

Additional notes: Since my day office is in Richmond, VA I am reached more quickly at speterson@varetire.org. I will conduct class in person from 8:30 am – 9:45 am on M, W in Room 130. I recorded MP4 videos that cover most all the course material and I will post these on Collab. Since this is a largely quantitative course, I thought these recordings would be a valuable resource for students. I plan to use the in-class time to review notes and work through applications and homework.

Office hours will be held online through Zoom M, W from 7 pm – 8 pm. I am also available during the day for one-on-one Zoom sessions. Just let me know when you would like to meet and I'll see what I can do. If you have problems with Matlab (which is common especially at the start), then don't hesitate to attach your code to an email and I'll debug and send it back to you. This is not a coding class so don't hesitate to ask for help.