# *Economics 4360 Empirical Finance – Spring 2024*

- *Tuesday, Thursday 8:00-9:15 am, Wilson Hall 238*
- *Professor: Steven Peterson (speterson@virginia.edu)*
- *Office hours: Zoom 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. Econometric methods will range from OLS to GMM (as well as IV estimation and GLS). We will use vector and matrix representations and conduct our quantitative work in **MATLAB** and Excel. 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 Canvas.

***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 with all available toolboxes 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 based on your progress through a cumulative semester-long "Portfolio" (please see **Portfolio Outline** for details).

I take attendance. Please find a permanent seat by Wednesday, Jan 24 so that I can make a seating chart. You get two absences for free. Every unexcused absence thereafter will cost you 5% off your final grade.

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**: **Time Value of Money, Pricing Assets with Deterministic Cash Flows and Matlab tutorial**. **[5 lectures, Jan 18-Feb 1]**

- Chapters 1-4 Peterson: Essentials.pdf ***(read ahead of first class)***.
- Matlab.htm ***(review ahead of first class)***.
- **Part 1**: Time Value of money (Ch. 1, Exercise Set 1)
- **Part 2**: Pricing Deterministic Cash Flows (Ch. 2)
    - Fixed income securities, duration (risk), convexity
    - Liability driven investment (duration matching application, Exercise Set 2)
- **Part 3**: Term structure (forward rates, short rates, rate forecasts – Ch. 3, Exercise Set 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, (Exercise Set 4)
    - MatlabOLStutorial.docx (see also html, m)
    - Building Matlab functions (examples provided)

**Module 2, Part 1**: Stochastic discount factor pricing model, CAPM, CCAPM **[ Feb 6-13]**

- 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 **[ Feb 15-22]**

- Chapter 6 Peterson: Portfolio basics, CAPM

**Module 3, Part 1**: Portfolio Construction **[Feb 27- Mar 12]**

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

**Midterm Exam ~ Feb 29 ; Spring Break ~ Mar 2-10**

**Module 3, Part 2**: Optimization with constraints, Risk Budgeting, Factor Models **[Mar 14-21]**

- Chapter 7 Peterson: Portfolio Optimization, Attribution (Exercise Set 5)
    - 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
    - Factor decomposition, risk/return attribution. (optional)
- Chapter 10 Peterson: Active Management (optional)

**Module 4, Part 1**: Options pricing. **[7 lectures, Mar 26 – Apr 11]**

- Chapters 16 Peterson: Options and Chapter 17 Peterson: Stock Price Dynamics
- Valuing the firm (with applications)
- Protective covered options (notes)
- Implied volatility, volatility surface and skew
- Hedging - Gamma trading and dynamic delta hedge (Exercise Set 6)
- Chapter 12 Peterson: Monte Carlo Methods and applications (Exercise Set 7)

**Module 4, Part 2**: Models of stock price dynamics. Brownian motion, Black-Scholes, Greeks, Monte Carlo simulation. **[5 lectures, Apr 16 – Apr 30]**

- Chapter 17 Peterson: Models of Stock Price Dynamics (Exercise Set 9, 10)
- Brownian motion, Black-Scholes pricing, binomial trees, the Greeks
- Assorted MATLAB functions
    - bineurcall.m, bineurput.m, blsprice.m, callOption.m, putWrite.m
- PutWrite application
- Portfolio Insurance, dynamic delta hedging (gamma trading)
- CIR, Vasicek interest rate simulations and GMM tests (vasicek.m, cir_gmm.m). (optional)

I recorded MP4 videos that cover most all the course material and I will post these as needed to Canvas. 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 exercise sets.

Office hours will be held online through Zoom (by appointment). I am flexible on hours. Just let me know when you would like to meet and I will send you a link. 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.