Course Syllabus

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Course Time: Mondays and Wednesdays, 10:30-12:20PM THO 119.

Office Hours: M 1:30-2:30 via zoom.

Instructor: Eric Zivot (ezivot@uw.edu)

Course Description

This course is an introduction to computational finance and financial econometrics - *data science applied to finance*. The course covers computer programming and data analysis in R, econometrics (statistical analysis), financial economics, microeconomics, mathematical optimization, and probability models. A free online version of this course was available on **Coursera** (https://www.coursera.org/course/compfinance) from 2013-2015 and has been taken by over 100,000 students world-wide. Archived videos from this course are available **here** (https://archive.org/details/academictorrents_f07203f2eedb4792c351ba0e28406dab9ab54d7d) .

The emphasis of the course will be on making the transition from an economic model of asset return behavior to an econometric model using real data. This involves: (1) exploratory data analysis; (2) specification of models to explain the data; (3) estimation and evaluation of models; (4) testing the economic implications of the model; (5) forecasting from the model. The modeling process requires the use of economic theory, matrix algebra, optimization techniques, probability models, statistical analysis, and statistical software.

Topics in financial economics that will be covered in the class include:

- asset return calculations
- risk concepts
- portfolio theory
- risk budgeting
- index (factor) models
- capital asset pricing model (if time permits)

Mathematical topics covered include:

- optimization methods involving equality and inequality constraints
- basic matrix algebra

- matrix differential calculus (sounds hard but it isn't)

Statistical (Econometric) topics to be covered include:

- probability and statistics with the use of calculus
    - expectation, univariate and joint distributions, covariance, normal distribution, etc.
- Monte Carlo simulation
- time series models concepts and basic time series models
- descriptive statistics and data analysis
- estimation theory and hypothesis testing
- resampling methods (e.g., bootstrapping)
- linear regression
- data analysis and coding using the open source R programming language

This course is an elective for the *Undergraduate Certificate in Economic Theory and Quantitative Methods* and one of the core courses for the *Certificate in Quantitative Managerial Economics*. It is also included in the *Advanced Undergraduate Economic Theory and Quantitative Methods Courses* list for the *Bachelor of Science* degree in Economics.

ECON 424 is cross-listed with CFRM 462. Students entering the *Professional MS in Computational Finance and Risk Management* program or the *Computational Finance Certificate* program will benefit from being familiar with this ECON 424/CFRM 462 course material.

Learning Objectives

- Use statistical software to describe, manipulate and visualize financial data
- Formulate and estimate econometric models to describe the behavior of asset returns for risk and portfolio analysis
- Critically evaluate the applicability and usefulness of econometric models for asset returns
- Create reproducible research reports

Evaluation

- Homework and Computer labs 25%: due every Monday by 8 pm PST (submitted online via Canvas)
- 1 Midterm exam 25% (Tentative date: Monday May 5, 2025, THO 119)
- Class project 25% - (Due Friday June 6, 2025, at 8 on via Canvas). W credit will be given if you receive a grade of 3.3 or higher on the class project.
- Final Exam 25% (Monday, June 9, 2025, 8:30-10:20, THO 119)

The homework, computer labs and project comprise the core of the course and have been weighted accordingly for grading purposes. I believe that one cannot obtain an adequate knowledge and appreciation of model building, finance and econometrics without "getting one's hands dirty" in the computer lab.

Course Management

- All course material, including a detailed week-by-week schedule (under modules), is available on the course Canvas site: **https://canvas.uw.edu**.
- All homework/lab assignments and the class project will be submitted electronically via Canvas.
- The midterm and final exam will be in-class.
- Please use the Canvas discussion board for homework and lecture questions. Students often email me regarding these questions. Very often several students have the same questions, and with the discussion board, everyone can see my responses.

Prerequisites

Formally, the prerequisites are: minimum grade of 2.0 in ECON 300; either ECON 311/STAT 311, STAT 341, MATH 390/STAT 390, or Q SCI 381. ECON 482 (Econometric Theory)/ECON 382 (Introduction to Econometrics) and ECON 422 (Investment, Capital, and Finance) are not prerequisites but provide very useful background material for this course. Ideally, students should have a year of calculus (through partial differentiation and constrained optimization using Lagrange multipliers), some familiarity with matrix algebra, a course in probability and statistics using calculus, intermediate microeconomics, and an interest in financial economics.

Required Texts

- *An Introduction to Computational Finance and Financial Econometrics with R,* by Eric Zivot, CRC Press forthcoming (someday). **Here (https://canvas.uw.edu/courses/1800515/files/132253340?wrap=1)** is a draft copy (updated June 11, 2021) of the book in pdf format. The book is under continuous revision so please check for updates. **Here (https://bookdown.org/compfinezbook/introFinRbook/)** is a link to the dynamic html version of the book on bookdown.org. This version is updated more regularly than the .pdf version of the book.

Recommended Texts

- ***Statistics and Data Analysis for Financial Engineering with Examples in R, Second Edition (http://www.springerlink.com/content/978-1-4419-7786-1/#section=810826&page=1)*** by David Ruppert and David Matteson, Springer-Verlag. **Book website. (http://legacy.orie.cornell.edu/~davidr/SDAFE/index.html)** The UW library has access to the UseR series of books from Springer-Verlag. If you have a UW net ID then you can get access to these ebooks through the UW library page. If you are connecting from a computer that is off campus be

sure to use the Off Campus login link. A pdf version of *Statistics and Data Analysis for Financial Engineering* is **here (https://canvas.uw.edu/courses/1800515/files/132253318/download?wrap=1)** .

- ***A Beginner's Guide to R*** *(http://www.springer.com/statistics/computational/book/978-0-387-93836-3)* by Alain Zuur, Elena Ieno and Erik Meesters, Springer-Verlag. A direct link to *A Beginner's Guide to R* is **here (http://www.springerlink.com/content/978-0-387-93836-3/#section=79195&page=1)**
- ***R Cookbook*** *(http://oreilly.com/catalog/9780596809164)* by Paul Teetor, O'Reilly.
- ***Introductory Statistics with R, Second Edition*** *(http://staff.pubhealth.ku.dk/~pd/ISwR.html)* (Statistics and Computing, Paperback), by Peter Dalgaard, Springer-Verlag, New York.
- *R for Data Science*, by Garrett Grolemund and Hadley Wickam, O'Reilly. Free online version is available **here (https://r4ds.had.co.nz/)** .
- ***Modern Portfolio Theory and Investment Analysis*** *(http://jws-edcv.wiley.com/college/bcs/redesign/instructor/0,,_0471238546_BKS_1387____,00.html)* , by **E.J. Elton** **(http://www.stern.nyu.edu/~eelton/)** et al., Wiley, New York. This text gives a very detailed treatment of portfolio theory.
- ***Financial Modeling*** *(http://finance.wharton.upenn.edu/~benninga/mit.html)* *,* by Simon Benninga. MIT Press. This textbook covers financial modeling using Microsoft Excel.
- ***Statistical Analysis of Financial data in R*** **(http://www.springer.com/us/book/9781461487876)** , by Rene Carmona, Springer-Verlag, 2014. This is a great book but is a bit too advanced for this course. It is used at Princeton in their Masters Program in Financial Engineering. The UW library has access to the UseR series of books from Springer-Verlag. If you have a UW net ID then you can get access to these ebooks through the UW library page.

Software

The course will utilize R for data analysis and statistical modeling.

R is a free open-source statistical modeling and graphical analysis language built upon the S language developed at Bell Labs and is available on many computers throughout the UW campus. It can be downloaded from **www.r-project.org** **(http://www.r-project.org/)** . There are versions available for the PC, Mac and various forms of LINIX. The CSSCR lab, on the 1th floor of Savery Hall, has R on most of the PCs. I highly recommend using RStudio (**www.rstudio.org** **(http://www.rstudio.org/)**) as a free integrated development environment (IDE) for R (runs on windows, MAC and LINUX).

We will be using several user-created packages (libraries of R functions) specifically designed for the analysis of financial time series data. R packages are maintained on the web and can be automatically downloaded from with R. The R package **IntroCompFinR** is the companion package for my book *An Introduction to Computational Finance and Financial Econometrics with R* and is available on GitHub

here. This package contains data for all of the examples in the book as well as a number of useful functions for data, portfolio and risk analysis.

Usage of GenAI

TBD

Academic Integrity

The University takes academic integrity very seriously. Behaving with integrity is part of our responsibility to our shared learning community. If you're uncertain about if something is academic misconduct, ask me. I am willing to discuss questions you might have.
Acts of academic misconduct may include but are not limited to:

- Cheating (working collaboratively on quizzes/exams and discussion submissions, sharing answers and previewing quizzes/exams)
- Plagiarism (representing the work of others as your own without giving appropriate credit to the original author(s))
- Unauthorized collaboration (working with each other on assignments)
  Concerns about these or other behaviors prohibited by the Student Conduct Code will be referred for investigation and adjudication by (include information for specific campus office).

Students found to have engaged in academic misconduct may receive a zero on the assignment (or other possible outcome).

Religious Accommodations

"Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (**https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/ (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/)**). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (**https://registrar.washington.edu/students/religious-accommodations-request/ (https://registrar.washington.edu/students/religious-accommodations-request/)**)."

Medical Excuse Notes

Students are expected to attend class and to participate in all graded activities, including midterms and final examinations. To protect student privacy and the integrity of the academic experience, students will not be required to provide a medical excuse note to justify an absence from class due to illness. A

student absent from any graded class activity or examination due to illness must request, in writing, to take a rescheduled examination or perform work judged by the instructor to be the equivalent. Students are responsible for taking any number of examinations for which they are scheduled on a given day and may not request an adjustment for this reason alone.

Course Summary:

Date	Details	Due
Thu May 4, 2023	Midterm (https://canvas.uw.edu/courses/1800515/assignments/10175593)	due by 3:20pm
Thu Jun 8, 2023	Final (https://canvas.uw.edu/courses/1800515/assignments/10175583)	due by 3:20pm
	Class Project (https://canvas.uw.edu/courses/1800515/assignments/10175581)	due by 8pm
	Class Project 2022 (https://canvas.uw.edu/courses/1800515/assignments/10175582)	due by 8pm
Mon Apr 7, 2025	Homework 1 (https://canvas.uw.edu/courses/1800515/assignments/10175584)	due by 8pm
Mon Apr 14, 2025	Homework 2 (https://canvas.uw.edu/courses/1800515/assignments/10175585)	due by 8pm
Mon Apr 21, 2025	Homework 3 (https://canvas.uw.edu/courses/1800515/assignments/10175586)	due by 8pm
Mon Apr 28, 2025	Homework 4 (https://canvas.uw.edu/courses/1800515/assignments/10175587)	due by 8pm
Mon May 5, 2025	Homework 5 (https://canvas.uw.edu/courses/1800515/assignments/10175588)	due by 8pm
Mon May 12, 2025	Homework 6 (https://canvas.uw.edu/courses/1800515/assignments/10175589)	due by 8pm
Mon May 19, 2025	Homework 7 (https://canvas.uw.edu/courses/1800515/assignments/10175590)	due by 8pm

Date	Details	Due
Mon May 26, 2025	Homework 8 (https://canvas.uw.edu/courses/1800515/assignments/10175591)	due by 8pm
	Homework 9 (https://canvas.uw.edu/courses/1800515/assignments/10175592)	due by 8pm