Course Syllabus

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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 is available on **Coursera** (https://www.coursera.org/course/compfinance) and has been taken by over 100,000 students world-wide.

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

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
- basic time series models
- descriptive statistics and data analysis
- estimation theory and hypothesis testing
- resampling methods (e.g., bootstrapping)
- linear regression
- data analysis 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 new *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.

Course Requirements

- Homework and Computer labs 25%: due every Tuesday by 8 pm PST (submitted online via Canvas)
- 1 Midterm exam 25% (tentatively scheduled for Thursday July 23rd)
- Class project 25% - W credit will be given if you receive a grade of 3.3 or higher on the class project.
- Final Exam 25% (Thursday August 20 from 1:10 - 3:20 in DEM 104)

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.

Prerequisites

Formally, the prerequisites are Econ 300 and an introductory statistics course (Econ 311 or equivalent). Econ 482 (Econometric Theory) *is not* a prerequisite. More realistically, the *ideal* prerequisites are 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 (Econ 422 would be helpful).

Required Texts

- *An Introduction to Computational Finance and Financial Econometrics* by Eric Zivot, manuscript in preparation (see the **Notes** (http://faculty.washington.edu/ezivot/econ424/424notes.htm) page on the course website for preliminary chapters)
- ***Statistics and Data Analysis for Financial Engineering*** *(http://www.springerlink.com/content/978-1-4419-7786-1/#section=810826&page=1)* by David Ruppert, 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 direct link to *Statistics and Data Analysis for Financial Engineering* is **here** (http://www.springerlink.com/content/978-1-4419-7786-1/#section=810826&page=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.

Recommended Texts

- ***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.
- ***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 and Microsoft Excel for spreadsheet modeling.

Excel is included with all version of Microsoft office, and is available on all PC computers around campus.

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 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* and is available on R-Forge **here** (https://r-forge.r-project.org/R/?group_id=1465). 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.

Videos

The lectures are video recorded using mediasite. They can be viewed live, streamed on demand, and saved to disk. The link to the videos is **here** (https://mediasite6.pce.uw.edu/Mediasite/Catalog/catalogs/15CFRM462).

Lecture links are added to the catalog two hours before the live lecture feed begins.

Note: Please **wait 4 hours to download the recording** after the live lecture feed has finished. You can **stream the recording** during this processing time.

Attempting to download recordings less than 4 hours after the live lecture feed ends leads to the creation of a corrupted download file containing no video content. These corrupted download files become the only lecture download available to the class until they are reported and fixed. If you find a corrupted download file, **notify our Mediasite Team (Links to an external site.)** (http://outreach.washington.edu/ol/studentForms/videohelp.html) so they can fix the download file.

You should **test your device (Links to an external site.)** (http://www.sonicfoundry.com/site-requirements) to make sure you can play Mediasite recordings before the first lecture.

Check out our **Using Mediasite** (https://canvas.uw.edu/courses/937475/pages/using-mediasite-at-the-university-of-washington) page for more information.

If you need help accessing lecture videos, please **contact our Mediasite Team (Links to an external site.)** **(http://outreach.washington.edu/ol/studentForms/videohelp.html)** .

Date	Details	
Tue Jun 21, 2016	**Homework 1** (https://canvas.uw.edu/courses/1048698/assignments/3301488)	due by 8pm
Tue Jun 28, 2016	**Homework 2** (https://canvas.uw.edu/courses/1048698/assignments/3301489)	due by 8pm
Tue Jul 5, 2016	**Homework 3** (https://canvas.uw.edu/courses/1048698/assignments/3301490)	due by 8pm
Tue Jul 12, 2016	**Homework 4** (https://canvas.uw.edu/courses/1048698/assignments/3301491)	due by 8pm
Thu Jul 21, 2016	**Midterm** (https://canvas.uw.edu/courses/1048698/assignments/3301496)	due by 3:20pm
Thu Jul 28, 2016	**Homework 5** (https://canvas.uw.edu/courses/1048698/assignments/3301492)	due by 8pm
Tue Aug 2, 2016	**Homework 6** (https://canvas.uw.edu/courses/1048698/assignments/3301493)	due by 8pm
Tue Aug 9, 2016	**Homework 7** (https://canvas.uw.edu/courses/1048698/assignments/3301494)	due by 8pm
Tue Aug 16, 2016	**Homework 8** (https://canvas.uw.edu/courses/1048698/assignments/3301495)	due by 8pm
Thu Aug 18, 2016	**Final** (https://canvas.uw.edu/courses/1048698/assignments/3301487)	due by 3:20pm
Fri Aug 19, 2016	**Class Project** (https://canvas.uw.edu/courses/1048698/assignments/3301486)	due by 8pm