ECON 424/AMATH 462: Computational Finance and Financial Econometrics

Course Description

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Office Hours: TuTh 11:00-12:00 (after class)

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This course is an introduction to data analysis and econometric modeling using applications in finance. Equivalently, this course is an introduction to computational finance and financial econometrics. As such, the course utilizes concepts from microeconomics, finance, mathematical optimization, data analysis, probability models, statistical analysis, and econometrics.

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) specification of an economic model; (2) estimation of an econometric model; (3) testing of the assumptions of the econometric model; (4) testing the implications of the economic model; (5) forecasting from the econometric model. The modeling process requires the use of economic theory, probability models, optimization techniques and statistical analysis.

Topics in financial economics include asset return calculations, portfolio theory, index models, the capital asset pricing model and investment performance analysis. Mathematical topics covered include optimization methods involving equality and inequality constraints and basic matrix algebra. Statistical topics to be covered include probability and statistics (expectation, joint distributions, covariance, normal distribution, sampling distributions, estimation and hypothesis testing etc.) with the use of calculus, descriptive statistics and data analysis, linear regression, basic time series methods, the simulation of random data and resampling methods.

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.

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ECON 424 is cross-listed with AMATH 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/AMATH 462 course material.

Course Requirements

- Homework and Computer labs 25%: due every Tuesday by 8 pm PST (submitted online via Canvas)
- 2 Midterm exams 25% each
- Class project 25%

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 page for preliminary chapters)
- *Statistics and Data Analysis for Financial Engineering* by David Ruppert, Springer-Verlag. Book website. 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.

- *A Beginner's Guide to R* by Alain Zuur, Elena Ieno and Erik Meesters, Springer-Verlag. A direct link to *A Beginner's Guide to R* is here
- *R Cookbook* by Paul Teetor, O'Reilly.

Recommended Texts

- *Introductory Statistics with R, Second Edition* (Statistics and Computing, Paperback), by Peter Dalgaard, Springer-Verlag, New York.
- *Modern Portfolio Theory and Investment Analysis*, by E.J. Elton et al., Wiley, New York. This text gives a very detailed treatment of portfolio theory.
- *Financial Modeling,* by Simon Benninga. MIT Press. This textbook covers financial modeling using Microsoft Excel.
- *Statistical Analysis of Financial data in S-PLUS*, by Rene Carmona, Springer-Verlag, 2004. This is a great book but is a bit too advanced for this course and uses S-PLUS instead of R. It is used at Princeton in the Masters Program in Financial Engineering.

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. 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) 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.