SYST/OR 538/438 Analytics for Financial Engineering and Econometrics

Fall 2014

George Mason University
Department of Systems Engineering and Operations Research

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Class hour: Tuesday 4:30-7:10 PM, Eng. Building #2241
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Course Description: This course introduces the basic analytics for financial engineering and econometrics, topics include financial transactions and econometric data management, correlation, linear and multiple regressions for financial and economic predictions, stochastic dynamic models and financial time series analysis. It will provide a foundation of basic theory and methodology as well as applied examples with techniques to analyzing large financial and econometric data. Hand-on experiments with *R* will be emphasized throughout the course.

Prerequisites: Graduate standing (Undergraduate engineering math: Calculus, probability theory, statistics, and some basic computer programming skills. Some background in stochastic process and differential equation would also be helpful.)

For OR438, co-requisite: STAT 354

Textbooks:
Required:

1. David Ruppert, "*Statistics and Data Analysis for Financial Engineering*," Springer, 2011.

Recommended References:

2. Chris Brooks, "*Introductory Econometrics for Finance*," 3rd edition, Cambridge, 2014.
3. W. N. Venables, D. M. Smith, and the R Core Team, "*An Introduction to R*," http://cran.r-project.org/doc/manuals/R-intro.pdf, CRAN, 2014.
4. Ruey Tsay, "*Introduction to Analysis of Financial Data with R*," Wiley, 2013.
5. Rene Carmona, "*Statistical Analysis of Financial Data in R*," Springler, 2014.
6. Argimiro Arratia, "*Computational Finance – An Introductory Course with R*," Atlantis Press, 2014.
7. John. C. Hull, "*Options, Futures, and Other Derivatives*"; 9th edition, Prentice-Hall, 2014.

8. Jeffrey M. Wooldridge, "*Introductory Econometrics: A Modern Approach*," South-Western College Pub, 2012.
9. Paolo Brandimarte, "*Numerical Methods in Finance and Economics*," 2nd edition, Wiley, 2006.

Optional Readings:

1. Emaneul Derman, "*My Life as a Quant: Reflections on Physics and Finance*," Wiley, 2004.
2. William Poundstone, "*Fortune's Formula*," Hill and Wang, 2006.
3. Burton G. Malkiel, "*A Random Walk Down Wall Street: The Time-Tested Strategy for Successful Investing*," Norton, 2011.
4. Michael Lewis, "*Flash Boys*," Norton, 2014.

Assignments and Exams:

There will be five hand-in assignments during the semester, a mini term project, as well as a mid-term exam and a final exam, both in-class. The exams will not be open book. However, you will be permitted a two-sided "cheat sheet" with notes and/or formulae.

Grading:

The assignments, mini project, mid-term, and final exams constitute 30%, 25%, 20% and 25% of the grades respectively.

Schedule:

Unit #1:	Introduction; review of elementary inferential statistics and *R* lab
Unit #2:	Basic financial transactions; returns and fixed income securities;
Unit #3:	Exploratory financial data analysis; transformation and kernel density
Unit #4:	Univariate distributions: heavy-tailed and mixture financial models
Unit #5:	Multivariate statistical models: covariance and correlation in financial data
Unit #6:	Linear regression: LSE, MLE, linear prediction in econometrics
Unit #7:	Mid-term exam
Unit #8:	Financial time series modeling: autocorrelation, ARMA, forecasting
Unit #9:	Multivariate models: vector autoregressive, simultaneous eqns in finance
Unit #10:	Portfolio theory: risky assets and efficient portfolio
Unit #11:	Capital asset pricing model: CAPM for portfolio analysis
Unit #12:	Financial volatility and correlation: volatility models, ARCH, GARCH
Unit #13:	Bayesian data analysis and simulation methods: MCMC in finance
Unit #14:	Course Review
Unit #15:	Term project presentation
Unit #16:	Final exam