

Class Syllabus: Programming in R-Finance Application

Course information:

Class 26701/26702: Programming in R-Finance Application

Monday 6 pm to 9 pm

210B, Melcher Hall, University of Houston

Instructor:

Yu Li, PhD Student in Finance.

Office: 210J Melcher hall, University of Houston

Email: yli@bauer.uh.edu or lyjade40@gmail.com

Office hour: by appointment.

Objective:

1. Learn how to program in R.
2. Learn how to implement common quantitative analyses.
3. Learn how to find data (common databases & publicly available data).

Teaching Method:

Each class will consist of two parts: lecture and hands-on

Textbook:

No required textbook. Handouts would be distributed before each class.

Useful reference:

"An Introduction to Analysis of Financial Data with R" by Ruey S. Tsay

"The Art of R Programming" by Norman Matloff

"Financial Modeling using R" by Yuxing Yan

Grade Policy:

8 Assignments (40%), 1 Midterm Exam (30%), 1 Final Project (30%).

Tentative Schedule:

Week 1 (Jan 16): Martin Luther King holiday.

Week 2 (Jan 23): Introduction.

Topics: overview the course, overview R, install R, introduce R console, interactive and functional programming, write the first R program, where to find help, other useful resources.

Week 3 (Jan 30): Data Type and Basic Manipulation.

Topics: data frame, lists, vector, matrix, input data, use defined functions, plot, export, write and save the programming file.

Tasks: plot some time-series data.

Week 4 (Feb 6): Define functions.

Topics: define functions, run functions, input, output, default value, matrix operation, summary statistics, and normality.

Week 5 (Feb 13): Define functions (continued).

Topics: directory, import packages, debugging, handling error, missing values.

Tasks: does election result affect the market return?

Week 6 (Feb 20): Move the dates.

Topics: moving dates with R, calculate returns of different frequencies, basic time-series analysis.

Week 7 (Feb 27): Merge data.

Topics: merge data, linear regression, and hypothesis testing.

Tasks: can we predict stock returns?

Week 8 (Mar 6): Midterm Exam.

Week 9 (Mar 13): Spring break.

Week 10 (Mar 20): Optimization.

Topics: portfolio theory, portfolio optimization, Markowitz algorithm.

Tasks: calculate the optimal weights of a 2 stock portfolio.

Week 11 (Mar 27): Structure Control.

Topics: Loop, if/else, rolling regression, CAPM, alpha and beta.

Week 12 (Apr 3): Structure Control (continued).

Topics: Fama-French 3 factors, portfolio sorting, anomalies.

Tasks: do stock returns have seasonal patterns?

Week 13 (Apr 10): Simulation.

Topics: probability theory, generate random numbers, stochastic process, Monte Carlo.

Week 14 (Apr 17): Risk management.

Topics: Credit risk, VaR, volatility models.

Tasks: can we predict firm defaults?

Week 15 (Apr 24): Futures.

Topics: Commodity futures, term structure of interest rates, principal component analysis.

Tasks: does the futures price predict the price in future?

Week 16 (May 1): Options.

Topics: Black-Scholes, implied volatility, Greeks, volatility smile.

Tasks: Fear index.

Week 17 (May 8): Final Project Presentation.

Potential Topics for the Final Project

Market Returns:

1. Does any variable predict the market return?

Portfolio Management:

1. How shall we allocate money among different ETFs/mutual funds?

Stock Returns:

1. Is there a January effect?
2. Is there a weekend effect?
3. Is the momentum trading strategy profitable?
4. Which model is better? CAPM, FF3, or FF4?

Credit Risk:

1. Calculate the Z-score of different firms.
2. Analyze the volatility of SP500.

Futures:

1. Conduct PCA to commodity futures.
2. Conduct PCA to the term structure of interest rates.

Options:

1. Reproduce the volatility smile.