

# Georgia State University, Fall Semester 2012

## Econ 8780: Financial Econometrics

**Class location:** General Classroom Building, Room 229

**Class hours:** Wednesday, 4:30–7:00 pm

**Instructor:** Richard Luger <rluger@gsu.edu >

**Office:** Robinson College of Business, Room 1133

**Office hours:** Tuesday, 3:30–5:00 pm (or by appointment)

### 1. Description

This course covers econometric models and methods for financial markets data. It is designed for those who want to learn about the theoretical background and implementation details of important models used in financial econometrics. In particular, the course covers the modeling of univariate and multivariate distributions, copulas, basic time series models, and time-varying conditional volatility and correlation modeling. We will also see how to program each of these models. The specific learning objectives are:

1. to identify empirical features and characteristics of various types of financial data;
2. to learn about various econometric models that can capture those features;
3. to develop your own computer programs implementing these models.

We will make extensive use of the open-source R programming language, which is freely available at [www.r-project.org](http://www.r-project.org).<sup>1</sup> I will be walking you through various programming techniques during almost every class. **If you have a laptop computer, I suggest you bring it to class so you can follow along and try things out by yourself.** Although it has its own (and very intuitive) syntax, R is in the same class of interpreted languages as GAUSS and MATLAB, so by learning proper programming techniques in R you will then be well positioned to either continue using R or switch to another programming language for your own work. **Note that learning to program (in R) is an integral part of the course, meaning that questions related to programming will be on the exams.**

### 2. Prerequisites

Students are assumed to have had a prior course in econometrics at the level of GSU's Econ 8740. In particular, you should be familiar with the basics of probability and statistics, and estimation and inference in the classical linear regression model.

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<sup>1</sup>R is immensely popular in the statistics and econometrics community. The January 6, 2009 edition of the New York Times even had an article entitled “Data Analysts Captivated by R’s Power” about R’s ever-growing popularity.

### 3. References

The course is based on:

Ruppert, D. (2011) *Statistics and Data Analysis for Financial Engineering*, Springer.

### 4. Grading

The grades will be based on: (i) homework assignments, (ii) a “midterm” exam (closed-book and held in class toward the end of the semester), and (iii) a final project. Your grade will be determined as 50% HWs, 25% exam, and 25% final project.

- The HWs and the final project may be done in teams of two. You will undoubtedly learn from each other by working together, but the decision whether to team up is yours to make.
- The date of the exam will be announced in class and on uLearn.

### 5. Attendance

You are expected to attend classes. This subject matter is not one that is easy to learn on your own. Hopefully, by attending class you will benefit from my explanations and the class interactions. In fact, you are strongly encouraged to ask questions and participate in class discussions.

### 6. Course outline

The following list of topics maps directly into the Ruppert book, except for Topic # 7 on correlation modeling for which notes will be posted on uLearn. In fact, a lot of supplementary materials will be posted to fill in some gaps. **So keep an eye on uLearn for those materials, HWs, and announcements.**

*Note: The outline merely provides a general plan for the course; deviations may be necessary depending on how things go.*

#### Topics

1. **Returns:** net returns; gross returns; log returns; adjusting for dividends; multi-period returns; the random walk model.
2. **Modeling univariate distributions:** skewness, kurtosis, and moments; tests of normality; heavy-tailed distributions; maximum likelihood estimation; likelihood ratio tests; AIC and BIC; validation data and cross-validation; profile likelihood.
3. **Multivariate statistical models:** covariance and correlation matrices; linear combinations of random variables; multivariate normal and Student- $t$  distributions; fitting the multivariate Student- $t$  distribution by maximum likelihood; multivariate skewed Student- $t$  distribution.

4. **Copulas:** Gaussian and Student- $t$  copulas; Archimedean couplas; rank correlation; tail dependence; calibrating copulas by maximum and pseudo-maximum likelihood.
5. **Time series models:** stationary processes; autoregressive models; moving average models; ARMA and ARIMA models; information criteria for model selection; forecasting.
6. **GARCH models:** J.P. Morgan's RiskMetrics EWMA model; ARCH, GARCH, and IGARCH models; Asymmetric GARCH models; forecasting with GARCH models; simulating GARCH models; numerical optimization; estimation of GARCH models via the methods of maximum likelihood and quasi-maximum likelihood; imposing positivity and stationarity constraints; variance targeting; practical issues in the analysis of GARCH models.
7. **Correlation modeling:** multivariate RiskMetrics EWMA model of covariances; some multivariate GARCH models; constant conditional correlation (CCC) model; dynamic conditional correlation (DCC) model; correlation targeting; copula-GARCH models.

## 7. Academic honesty

Academic standards are in effect as per GSU's "Policy on Academic Honesty," Section 409.