UNIVERSITY OF
WATERLOO

Department of Economics
Economics 405: Quantitative finance

Course Outline
(Winter 2013)

Instructor: Chaussé, Pierre
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Lecture Time: T-Th 5:30 to 6:50   **Lecture Location:** PAS 1241

Office Hours: Monday, 10:00 to 12:00

Course description

The course covers a broad spectrum of empirical finance, including: the statistical properties of stock returns, fixed income securities, the Capital Asset Pricing Model, the Arbitrage Pricing Theory, the predictability of stock returns through several tests of the Random-Walk Hypothesis, forecasting using ARIMA models, nonlinear financial models such as ARCH, and the Value-at-Risk. An introduction to bootstrapping methods, which is a way to improve inference, will also be covered

Although the course is meant to be a quantitative course, a good portion of it will cover the theoretical aspects of financial economics. It is essential to know the assumptions behind each model in order to use or interpret the empirical results correctly.

The exams will measure the level of understanding of the theoretical part of the course while assignments will test the ability of students to apply the theory through numerical examples. I do not require any specific statistical software for the assignments, but I strongly recommend that you use R (http://www.r-project.org/). It includes several tools that facilitate the analysis of financial data. Furthermore, the main textbook of the course is based on R. I'll provide you with the support that you need through many examples.

Here is a small description of your applied project. You have one empirical project which is divided in multiple assignments that you can do in groups of 1 to 3 students. I strongly suggest that you don't work alone. In the first assignment, you are asked to select 10 stocks and 1 index (from the same stock exchange) for which the time series of

daily prices are available from the first open day of January 2008 to the last open day of Juin 2012. Throughout the semester, you will be asked to analyze different properties of your dataset including the forecastability of stock returns, the shape of the portfolio frontier, and much more. You will see how easy it is to download the series using R. A detailed explanation will be given during the first lecture.

Textbook

• The course is almost entirely based on the following textbook. The library has purchased the online license, which means that you have access to it for free. Some copies are available at the bookstore for those of you who prefer a printed version. Students are required to read the chapters mentioned in the Topics section below. However, I may tell you to skip some sections when I consider that it is too advanced for an undergraduate course. Details will be given in class.

　○ Ruppert, David, *Statistics and Data Analysis for Financial Engineering*, Springer (2011)

　○ Website: http://legacy.orie.cornell.edu/ davidr/SDAFE/index.html

• The following links provide free manuals on how to use R. Choose the one that suits you most.

　○ R for beginners:
　　http://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf

　○ Econometrics in R:
　　http://cran.r-project.org/doc/contrib/Farnsworth-EconometricsInR.pdf

　○ Several other manuals are available at http://cran.r-project.org/other-docs.html in many different languages. Of course, you can download the official manual on the main R web site.

• The following textbooks are additional references that I may use. Those of you interested in a career in finance may find them useful.

　○ Ruppert, David, *Statistics and Finance: An Introduction*, Springer (2004) (In reserve at Dana Porter library)

　○ Campbell, J.Y., A.W. Lo et A.C. Mackinlay , The Econometrics of Financial Markets, Princeton: Princeton University Press, 1997.

　○ Tsay, Ruey S., *Analysis of Financial Time Series*, Wiley (2002)

○ Paquet, A., A Guide to Applied Modern Macroeconometrics, 2nd edition, Centre de recherche sur l'emploi et les fluctuations économiques, UQAM. (Also, Fiscal Policy and Economic Analysis Branch Working Paper, Minister of Finance, Government du Canada), 2000. (Available online)

Topics

1. Introduction: (Chap1 of Ruppert(2004))
   Overview of some important concepts in statistics
   You should read sections 12.1 to 12.5. It summarizes the most important results of ECON 321. I won't cover it in class.

2. A first analysis of stock returns: (Chap. 1 and 4)
   Definition of stock returns, the random walk process, the efficient market hypothesis and the introduction to some data analysis tools.
   First assignments: A first look at the behavior of you stock returns

3. Fixed income securities (Chap. 3)
   Definition and computation of the yield curve

4. Distribution theory and Bootstrapping methods: (Chap. 5: sections 5.1 to 5.16 and Chap. 6)
   Methods for modeling univariate distributions
   Second assignment: Fixed income securities and distribution theory

5. Introduction to time series analysis (Chap. 9 and some topics in Chap.10)
   ARIMA(p,d,q) processes and the forecastability of asset returns
   Third assignment: Forecasting stock returns

6. The Portfolio theory (Chap. 11 (except section 6))
   Definition and properties of the efficient portfolio frontier

7. The Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT) (Chap. 16 and 17)
   Definition of the capital and security market lines, the β of an asset, and tests of the theories.
   Fourth assignment: Does your dataset satisfy the CAPM and the APT?

8. GARCH(p,q): modelling volatility (Ch 18)
   Estimating and forecasting the volatility of asset returns

9. The Value-At-Risk (chap 19)
   Measuring the potential loss of an investment
   Fifth assignment: Measuring the conditional and unconditional Value-At-Risk of a portfolio

Evaluation

Homework (between four and five assignments): 40%
Midterm exam (February 14): 20%
Final exam (cumulative): 40%

Policy regarding assignments: The assignments are due at the beginning of class on the due date. If I leave the class without your copy, you get 0. I won't accept excuses like: ma printer did not work, my teammate let me down etc. Don't wait until the last minute to do it and you won't get those problems.

Policy regarding missed exams: There is no make-up exam for the mid-terms. Students will be graded on the alternative scheme: 60 % on the final if the mid-term is missed. Only serious problems can justify an absence. If you miss an exam because of health problem, you have to provide me with the appropriate original documentation from your doctor. If you miss the scheduled final exam, you MUST petition the department within five calendar days to write the departmental deferred examination. If the student has failed to write the departmental deferred examination, the student will automatically receive a grade of 0 for the missed deferred final examination.

Avoidance of Academic Offenses

All students registered in the courses of the Faculty of Arts are expected to know what constitutes an academic offense, to avoid committing academic offenses, and to take responsibility for their academic actions. When the commission of an offense is established, disciplinary penalties will be imposed in accord with Policy #71, Student Academic Discipline. For information on categories of offenses and types of penalties, students are directed to consult the summary of Policy #71, Student Academic Discipline http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm

If you need help in learning how to avoid offenses such as plagiarism, cheating, and double submission, or if you need clarification of aspects of the discipline policy, ask your course instructor for guidance. Other resources regarding the discipline policy are the graduate advisor and the Associate Dean of Graduate Affairs. Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm