UNIVERSITY OF
WATERLOO

Department of Economics
Economics 405: Quantitative finance

Course Outline
(Winter 2011)

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, 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.

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. The main textbook uses Matlab, but I will, when necessary, provide the equivalence in R. If you prefer to use Matlab, I don't have any objection, but I won't give you much support. You will be mostly on your own.

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 2002 to the last open day of December 2009. 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. 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.

    ○ Ruppert, David, *Statistics and Finance: An Introduction*, Springer (2004) (available at the UW Bookstore)

• 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.

    ○ 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. Distribution theory: (Chap. 2: sections 3 to 11 and 13 to 20 except the * sub-sections)

   You should read sections 6.1 to 6.12. It summarizes the most important results of ECON 321. I won't cover it in class.

2. A first analysis of stock returns: (Chap. 3)
   Definition of stock returns, the random walk process and the efficient market hypothesis.
   First assignments: Distributional properties of stock returns

3. Introduction to time series analysis (Chap. 4)
   ARIMA(p,d,q) processes and the forecastability of asset returns
   Second assignment: Forecasting stock returns

4. The Portfolio theory (Chap. 5 (except section 6))
   Definition and properties of the efficient portfolio frontier
   Third assignment: Analyzing the portfolio frontier of your dataset

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

6. The Value-At-Risk (chap 11)
   Measuring the potential loss of an investment

7. GARCH(p,q): modelling volatility (Ch 12)
   Estimating and forecasting the volatility of asset returns
   Fifth assignment: Measuring the Value-At-Risk of a portfolio using the GARCH process?

Evaluation

Homework (between four and five assignments): 30%
Midterm exam (January 25th) : 15%
Midterm exam (March 1st): 15%
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: 55 % on the final if one of the mid-terms is missed and 70% if both are missed. Only serious problems can justify an absence. If you miss an exam because of health problem, you have to provide 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