McGill University
Department of Economics
Econ 763: Time Series and Financial Econometrics
/ Séries chronologiques et économétrie de la finance
Winter / Hiver 2024
Course outline
(Preliminary)

Professor / Professeur: Jean-Marie Dufour

January- April 2024 / Janvier-avril 2024
Version: January 9, 2024

Economics (Arts) : This course covers advanced time series methods used in the analysis of financial data and other potentially non-stationary time series.

Topics: general time series theory, ARMA modelling, nonstationarity (unit root testing, cointegration), nonparametric methods, conditional heteroskedasticity, long memory.

Applications include: market efficiency, capital asset pricing econometrics, heavy tail modelling, stochastic volatility.

Documents and other material relevant to the course will be available from my web page:

`http://www.jeanmariedufour.com`
`http://www.jeanmariedufour.org`

- **Lecture hours**: Tuesday 18:05 - 20:55.
- Beginning: Tuesday, 9 January 2024. End: Tuesday, 9 April 2024.
  March 4-8 is the Winter reading break (no lectures)
- Final exam period: Monday 15 April 2024 to Tuesday, 30 April 2024.
- Add/Drop deadline: Tuesday, January 17, 2023.
- **Room**: Leacock 541.

- **Office hours**: by appointment
- **Teaching assistants**: TBA
- **TA sessions**: TBA
- **e-mail**: `jean-marie.dufour@mcgill.ca`

The evaluation will be based on three elements (percentage refer to the entire year's grade):

1. a mid-term exam: 30%;
2. assignments (and possibly a term paper): 30%;
3. a final exam: 40%.

Students will also learn to use the R system to do statistical analysis related to the course.

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/) for more information).
L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site www.mcgill.ca/students/srr/honest/).

Class schedule

Week	Day	Time (18:05-20:55)	
1	Tuesday	9 January 2024	
2	Tuesday	16 January 2024	
3	Tuesday	23 January 2024	
4	Tuesday	30 January 2024	
5	Tuesday	6 February 2024	
6	Tuesday	13 February 2024	
7	Tuesday	20 February 2024	
8	Tuesday	27 February 2024	Mid-term exam
9	Tuesday	5 March 2024	Study break
10	Tuesday	12 March 2024	
11	Tuesday	19 March 2024	
12	Tuesday	26 March 2024	
13	Tuesday	2 April 2024	
14	Tuesday	9 April 2024	Last lecture
15		15-30 April 2024	Final exam (time to set)

The following textbooks will be used in this course.

Brockwell, D. and Davis, R. A. (1991). Time Series: Theory and Methods, Second Edition. Springer-Verlag, New York. (BD)

Hamilton, J. (1994). Time Series Analysis. Princeton University Press, Princeton, NJ. (H)

Ait-Sahalia, Y., and Hansen, L. P. (2010). Handbook of Financial Econometrics, Volumes 1 and 2. Horth-Holland, Amsterdam.

Arratia, A. (2014). Computational Finance: An Introductory Course with R. Atlantis Press, Paris, and Springer, Berlin.

Bossaerts, Peter (2002) The Paradox of Asset Pricing. Princeton University Press.

Campbell, J.Y, Lo, A. W., and MacKinlay, A. C. (1997). The Econometrics of Financial Markets. Princeton University Press.

Cochrane, J. (2001). Asset Pricing. Princeton University Press.

Gouriéroux, C., and Jasiak, J. (2001). Financial Econometrics: Problems, Models and Methods. Princeton University Press.

McNeil, A. J., R. Frey, and P. Embrechts (2015): Quantitative Risk Management: Concepts, Techniques and Tools. Princeton University Press, Princeton, NJ, revised edn.

Ruppert, D. (2004). Statistics and Finance. Springer.

Singleton, K. J. (2006) Empirical Dynamic Asset Pricing: Model Specification and Econometric Assessment. Princeton University Press.

Tsay, Ruey S. (2013) An Introduction to Analysis of Financial Data with R. Wiley.

Tsay, Ruey S. (2010) Analysis of Financial Time Series. Wiley.

Tsay, Ruey S. (2014) Multivariate Time Series Analysis: With R and Financial Applications. Wiley.

Course outline

1. Mathematical preliminaries
   (a) Distribution and quantile functions
   (b) Moments
   (c) Covariances and correlations
   (d) Asymptotic theory
   (e) Hilbert spaces
   (f) Difference equations
   (g) Complex analysis and power series
2. Time series analysis
   (a) Introduction
   (b) Stochastic processes
      i. Basic theory
      ii. Spectral analysis
   (c) Prediction and efficient markets
   (d) Continuous time models
   (e) Testing random walk and predictability
   (f) Nonstationarity
   (g) Building univariate time series models
   (h) Multivariate time series models
      i. Causality in time series
   (i) Long memory
3. Financial econometrics
   (a) Introduction: the problems of financial econometrics
   (b) Portfolio theory and the Capital asset pricing model (CAPM)
   (c) Volatility modelling
      i. The role of volatility modelling
      ii. Conditional heteroskedasticity: GARCH and stochastic volatility
      iii. Computationally efficient methods for volatility modelling: estimation and inference

iv. Financial applications: Risk Management (VaR and Expected Shortfall), Portfolio Choice, Option pricing
v. Macroeconomic applications: VAR, DSGE, and time-varying uncertainty measures.
vi. High-dimensional and high-frequency data
   A. Realized volatility
   B. Methods for estimating models for high-dimensional and high-frequency data

(d) Heavy tails: theory and inference

(e) Factor models

(f) Dynamic optimization models and GMM

(g) Quantile methods and value at risk

(h) Option pricing