Carleton University
Department of Economics

ECON 5054-A
Applied Financial Econometrics

Instructor: Ba Chu **Winter 2025**

Office: Loeb A-810
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Class hours: Wednesdays, 6:05 – 8:55 p.m. (January 08 – April 09), no class on February 26
Place: Check Carleton Central for location
Office hours: TBC

Nature of the Course:

This course explains econometric tools used for financial modelling. The focus will be on (a) constructing [linear] models from equity returns, (b) implementing some of these models in Python, and (c) understanding the process of selecting investment assets. During the course, I will mainly give an economic interpretation of the models/concepts without using too much mathematics. A more rigorous statistical inference of time series models of stock returns will be given in Time Series Econometrics (ECON 5713) offered in the winter.

To understand the material of this financial econometrics course, students are expected to have taken or be taking concurrently ECON 5027 or an equivalent course in econometrics/statistics. Students who believe they have taken a similar background course or courses from another university must provide appropriate documentation to the Department of Economics Graduate Administrator.

Note: Students are advised to check Brightspace regularly [every day] for course material and latest announcements.

While there is no learning material or textbooks that need to be purchased, I want to list some useful references below.

Texts and References:

O. Linton, *Financial Econometrics: Models and Methods*, Cambridge University Press, 2019

D.G. Luenberger, *Investment Science,* 2nd edition, Oxford University Press, 2013

T. A. Severini, *Introduction to Statistical Methods for Financial Models*, CRC Press, 2018 (a very good supplementary text).

W. Enders, *Applied Econometric Time Series*, 2nd edition, New York: Wiley, 2004 (supplementary text) HB139.E55 2004

P. Kennedy, *A Guide to Econometrics*, 5th edition, Cambridge: The MIT Press, 2003. (supplementary text) HB139 .K45 2003

J.Y. Campbell, A. Lo, and A.C. MacKinlay, *The Econometrics of Financial Markets*, Princeton University Press, 1996 (supplementary text). HG4523 .C27

D. Ruppert*, Statistics and Finance: An Introduction*, Springer, 2004 (supplementary text)

C. Gourieroux and J. Jasiak, *Financial Econometrics: Problems, Models, and Methods*, Princeton University Press, 2001 (supplementary text)

P.F. Christoffersen, *Elements of Financial Risk Management* (2nd Edition), Academic Press, 2012 (supplementary text)

J. Siegel, *Stocks for the Long Run 5/E: The Definitive Guide to Financial Market Returns & Long-Term Investment Strategies,* McGraw Hill, 2014 (supplementary text)

B.G. Malkiel, *A Random Walk Down Wall Street: The Time-Tested Strategy for Successful Investing*, WW Norton, 2020 (supplementary text)

The Campbell et al. book is the classic textbook covering most standard topics of financial econometrics. The Linton book, the Severini book, and the Ruppert book provide a good recent review of all the important topics in the area. The Luenberger book is a very comprehensive, but not too mathematical, textbook – I personally like it a lot. The Gourieroux and Jasiak book is a good reference for diffusion processes for asset pricing and high-frequency data models. If you want to read more about risk measures and standard risk management approaches, please refer to the Christoffersen book. The Kennedy book provides a good introduction to the econometric tools used for time series analysis. If you want to review standard time series models, you can refer to the Enders textbook. The last two books (in the above list of **Texts and References**) can help you to understand financial markets and investment strategies.

Notes on Course Assessment:

(1) There will be **one in-person final exam** weighted at 35% to be scheduled by the university, **two big assignments** weighted at 10% each after the 4th week, and **four short mid-term quizzes** weighted at 5% each. The rest 25% weight is awarded for **in-class group presentation**. (*Please ignore the weights automatically assigned by Brightspace*.) Note that the final exam covers all the material in this course, and this exam will be a closed-book exam.

(2) The quizzes are scheduled for *January 22, February 12, March 12, and April 02 at around 8:00pm*. Note that there will be no early/deferred in-term tests. If you miss a

quiz for a good reason, I will shift the weight of this quiz to the final exam. I will also ignore the last quiz if you do better in the final exam than in this quiz.

(3) For your assignments, you may need to use Python or any programming language of your choice. If you decide to use Python, then you can access Jupyter Notebook at https://colab.research.google.com (you need to have a Gmail account to use Colab). You may also want to run Python locally on your computer by installing both the Anaconda environment and the IDE Microsoft Visual Studio Code (note that, to install a Python package for Anaconda, you will need to run *conda install -c conda-forge <package>* to avoid any conflict. Try not to use *pip install <package>* in a conda environment as much as possible.)

There are many excellent resources to learn Python. But I find this one giving a quite good fresh start: https://www.youtube.com/c/Coreyms/videos? (please take a look at this manual before watching these youtube videos.) If you want to learn more about Python, I shall recommend: *W. McKinney (2022). Python for Data Analysis Data Wrangling with pandas, NumPy, and Jupyter.*

(4) It is very important to keep in mind that assignments will be due approximately TWO WEEKS after they are made available online. No late or deferred assignment/exam will be accepted. If you fail to submit an assignment on time or if you miss an exam/test without a verifiable reason, a zero weight of the assignment/exam missed will be assigned to your final grade.

(5) The in-class group presentations are scheduled for *March 26*. Each group consists of *four* students. Each presentation will take roughly *25 minutes*. (We will use Zoom to present in an online course.) I will provide a list of papers on various topics so that students are welcome to choose any topic that they are interested in. Students are expected to let me know the papers to be chosen for their presentations by *the end of January* - please note this deadline.

Reading Assignments:

Further readings in theory/applied work may be assigned as the course progresses.

1. Background Material

   a. financial markets
   b. types of financial assets traded in a financial market
   c. financial returns and their descriptive statistics
   d. utility functions and risk aversion
   e. portfolio choice

   Linton, Ch. 1
   Severini, Ch. 2

2. Time Series Models of Stock Returns

a. autoregression
b. random walk
c. return predictability
d. predicting stock returns

Linton, Ch. 2
Ruppert, Ch. 4
Severini, Ch. 3

M. Hashem Pesaran & A. Timmermann, "Predictability of Stock Returns: Robustness and Economic Significance," *Journal of Finance*, 1995, 50(4), 1201-2228.

3. Capital Asset Pricing Model (CAPM)

a. Wald-type test of CAPM
b. Fama and MacBeth's (1973) regression

Linton, Ch. 7
Severini, Ch. 7

R. Grauer, "Investment Policy Implications of the Capital Asset Pricing Model," *Journal of Finance*, 1981, 36(1), 127-141.

4. Factor Models

a. diversification
b. arbitrage pricing theory
c. testing factor models

Linton, Ch. 8
Severini, Chs. 9 and 10
Luenberger, Ch. 8

E.F Fama & K.R. French, "A five-factor asset pricing model," *Journal of Financial Economics*, 2015, 116(1), 1-22.

E.F. Fama & K.R. French, "Common risk factors in the returns on stocks and bonds," *Journal of Financial Economics*, 1993, 33(1), 3-56.

5. Volatility Modelling

a. ARCH and GARCH models
b. realized volatility
c. stochastic volatility

Linton, Ch. 11

Ruppert, Ch. 12

T. Bollerslev, R.F. Engle, & J.M. Wooldridge, "A Capital Asset Pricing Model with Time-varying Covariances, *Journal of Political Economy*, 1988, 96(1), 116-131.

6. Risk Management with Value-at-Risk (VaR)
   a. VaR for individual asset
   b. VaR for a portfolio of assets

   Linton, Ch. 14
   Ruppert, Ch. 11
   Christoffersen, Chs. 1 and 2

   A. Patton, "On the Out-of-Sample Importance of Skewness and Asymmetric Dependence for Asset Allocation," *Journal of Financial Econometrics*, 2004, 2(1), 130-168.
   B. Chu, "Recovering copulas from limited information and an application to asset allocation," *Journal of Banking & Finance*, 2011, 35(7), 1824-1842.

Notes:

Student or professor materials created for this course (including presentations and posted notes, labs, case studies, computer codes, assignments, and exams) remain the intellectual property of the author(s). They are intended for personal use and may not be reproduced or redistributed without prior written consent of the author(s).

Re-grading policy: If you feel that there is a marking error in your work, you can always make an appeal. The procedure is as follows: 1) write one page detailing where you should deserve extra points - please remember to provide a good justification as well; 2) submit this page to the T.A. within *two weeks* after grades are announced on Brightspace. If you are still not happy with the T.A.'s decision, you can bring this page to me. *It is important to keep in mind that your grade may be more or less because of re-marking.*

24-Hour Window Policy: If you have any question regarding the material, please ask early so that you are well prepared for success! The Instructor & TA will not be available for 24 hours before exam times and assignment due deadlines, or 24 hours after assignments/midterms are returned. Do not raise questions in these windows.

Plagiarism:

Please be aware that plagiarism is a serious offence at Carleton and should be recognized and avoided. You are responsible for reading and knowing the information about plagiarism, Carleton University resources, and academic accommodations found in https://carleton.ca/economics/plagiarism-resources-and-accommodations/.

The University Academic Integrity Policy defines plagiarism as "*presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own."* This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source. Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, artworks, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared in whole or in part, by someone else, including the unauthorized use of generative AI tools (e.g., ChatGPT)
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment
- using another's data or research findings without appropriate acknowledgement
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own
- failing to acknowledge sources with proper citations when using another's work and/or failing to use quotations marks.

Requests for Academic Accommodations:

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).

For Religious Obligations	To be worked out on individual basis with instructor. Consult Equity Services Website or an Equity Advisor (ext. 5622) for Policy and list of Holy Days (www.carleton.ca/equity)
For Pregnancy	Contact Equity Services (ext. 5622) to obtain *letters of accommodations*

Student Mental Health:

As a student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help, please speak to

someone. There are numerous resources available both on- and off-campus to support you. For more information, please consult https://wellness.carleton.ca/

For Students with Disabilities:

Students with disabilities needing academic accommodations are required to contact a coordinator at the Paul Menton Centre to complete the necessary *letters of accommodation*. The student must then make an appointment to discuss their needs with the instructor at least two weeks prior to the mid-term examination. He/she must also check with the PMC for accommodation for formally scheduled final examinations.

Thank you! If you have any further questions/concern, please feel free to ask me for help.