ECO481H1F, section L0101

Macroeconomic Finance (with machine learning applications)

University of Toronto

Department of Economics

Winter 2023

Instructor: Marlène KOFFI

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Office Hours: Wednesday 4:30-6:00 PM (mostly online, possibility of in-person meeting upon requests)

Teaching Assistant (TA):

- TA: Adam Neil (neil.adam@mail.utoronto.ca)

TA office hours: Wednesday from 3 PM to 4 PM at SS 2104

Overview

This course is an introductory course to different concepts and techniques related to Machine Learning, focusing mainly on Macro-finance applications. In the first part of the course, we will review supervised and unsupervised learning methods. In the second part, we will discuss various macro-finance concepts, where the use of Machine Learning is more and more common. Therefore, the course's objective is to provide students with the basics of machine learning for them to be able to solve certain economic problems using these techniques and be prepared for more advanced machine learning courses.

Course delivery

Lectures are Thursday 10:10 pm to 12:00 pm (Toronto Time).

The course is intended to be an in-person course. But, we will follow the public health recommendation and switch to an online mode as needed. The room for the course is UC 144.

All course materials will be posted on Quercus. I recommend you check it regularly.

Students are expected to attend all class sessions, actively participate in discussions and activities. Please bring your laptop during class so you can practice coding when we do.
You are also strongly encouraged and requested to wear a mask during in-person classes, tutorials, and data camp.

This course is intended to be interactive and to be able to mimic an in-person session at best when we are online. Therefore, students must have a usable microphone and are encouraged to activate their camera. For the presentations, it is required for the presenters to activate their cameras.

Tutorials

Tutorials are (usually) Thursdays 12:10 pm to 1:00 pm.

They are intended to be in-person as well. But, we will follow the public health recommendation and switch to an online mode as needed.

When in-person, the room for the course is UC 144. Please bring your laptop during those sessions so you can practice coding.

Each tutorial will be an opportunity to either revise a method, correct exercises, make applications, ask questions, etc.

NB: Note that because we have three hours for class and tutoring, we may have some time reallocations as needed, either to have more class time or more tutoring time or just remodel. You will be notified when this is the case.

Data Camp

Data camps are Thursday 1 PM - 2 PM. The room is UC 152.

This is intending to foster overall learning in the class. The camp's objective will be to provide you with an additional learning resource and space, where the TA will give extra Python classes (complement the traditional tutorials). The TA will be answering any coding questions or issues you may have (assignments, projects,...). Please bring your laptop during those sessions so you can practice coding.

Time zone

All times posted will be in local Toronto time. If you are in a different time zone, please make sure you know of Toronto time in relation to your time zone. Errors in calculations are not an acceptable reason to miss deadlines.

Evaluation

Task	Weight	(Due) Date
Class Participation	10%	Every Thursday Lecture
Assignments (2)	25%	• February 16 (before 10 AM EST) • March 23 (before 10 AM EST)
Research Project (Group Work) • Part 1: Submission of ideas • Part 2: Final submission	 • 15% • 20%	 • March 2 (before 10 AM EST) • April 9 (before 10 AM EST)
Final Exam	30%	Final Assessment Period

Class Participation:

Participation marks will be based on the individual degree of engagement throughout the course. There are based on your attendance to lectures, live questions, questions in the chat during the course (in the online format). You are also encouraged to use the discussion platform in Quercus. I will keep track of all those interactions during the course, interactions with your peers via asking and answering questions on the platform.

Assignments:

Assignment 1 will be posted on February 2 and due on February 16 before 10 AM EST. Late assignments will receive a grade of zero (see late policy). The assignment will be corrected right after (unless otherwise stated).

Assignment 2 will be posted on March 9 and due on March 23 before 10 AM EST. Late assignments will receive a grade of zero (see late policy). The assignment will be corrected right after (unless otherwise stated).

You will have to upload the assignments via Quercus.

Homework will also be an opportunity to see some concepts that we will not have had time to discuss in class, in the form of exercises, using the tools you already know.

Assignments are individual. You can help each other, but each student will have to submit their own "copy" and their own "code" in conformity to the Student Academic Integrity Code (See below).

Research Project:

You should work in **a group of 3**. Groups with less than 3 members will receive a penalty and their grades will be downgrade by 10 percentage points.[1] You should send me your group membership by February 16, 2023.

You should produce original work using the methods seen in class. You need to find a relevant question and apply machine learning tools to answer that question. You will be judged on your originality, the relevance of the project, the results obtained, and the integration of comments and criticisms.

In the first part of the project- Submission of the ideas- you will have to submit a set of 7 slides presented as follows:

- Slide 1: Title of the project, Group members' names, Utorid and email address.
- Slide 2: Motivation of the topic
- Slide 3: Research Questions
- Slide 4: Answer to the research questions and Contribution
- Slide 5: Method you plan to use
- Slide 6: Short Literature review with Three key papers. For each paper, show the similarity and the dissimilarity with your work.
- Slide 7: Data and Some descriptive statistics

This step will be beneficial for you and prepare you to present using key points. The slides should not be overloaded; they should be readable and clear. All these details will be considered for your grade.

In the second part, which presents the final submission, you must make a report (no more than 10 pages) that will take into account the potential remarks that you will have obtained during the submission of the ideas and will be articulated as follows:

- Introduction (Motivation, research questions, answer to the research question, contribution, literature, …)
- Data and Methodology
- Results
- Conclusion

Writing guidelines for the final submission:

- Font 12;

[1] If the number of students in the class is not a multiple of 3, a single group can have more or less than 3 members. In the event of a tie, we will randomly choose which group should split or merge. If the group members do not want to comply with the results of the randomization, they will get the penalty.

- 10 pages, including graphs and tables; references could be outside of the 10 pages;
- You can have the first page with the title, your names, UTorid, and mails not included in the 10 pages;
- Double spacing.

You will present your final project in front of the whole class.

Please note that those who use Kaggle will be heavily penalized because besides data, Kaggle also provides codes related to the exploration and the analysis of those data.

Final Exam

The final will be governed by the University's rules for final assessment. We will discuss it in class closer to the end of the semester.

Important Note: You are expected to work on the final exam by yourself, proctored or not. You may not use unauthorized aids or communicate with others about the test.

Late penalty:

All the evaluations are due at the "Due Date" indicated in the table, before 10:00 am.

Late assignments will receive a grade of zero unless you make a declaration of absence via ACORN and notify the instructor (adding the TA in copy) before the due date.

Late research projects will be downgrade by 10 percentage points per day late.

If you don't take the final exam in the specified windows, you will receive a grade of zero unless you make a declaration of absence via ACORN and notify the instructor (adding the TA in copy) before the due date.

Course Material

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An introduction to statistical learning (Vol. 112, p. 18). New York: springer. (JWHT).

Sarkar, D. (2016). Text Analytics with Python.

Others

Bird, S., Klein, E., & Loper, E. (2009). Natural language processing with Python: analyzing text with the natural language toolkit. " O'Reilly Media, Inc.".

Start with Python

Guido, S., & Müller, A. (2016). Introduction to machine learning with python (Vol. 282). O'Reilly Media.

Sweigart, A. (2019). Automate the boring stuff with Python: practical programming for total beginners. No Starch Press.

In addition to the mentioned books and articles seen during the course, a list of reading will be available in Quercus. The Reading List will be updated throughout the course. Please check it regularly. Papers in the reading lists are not compulsory, except those that we will see in class. There are rather suggested (some maybe even hard to read at this level).

Software

All machine learning programming activities in this course will use Python software exclusively and only. Python is a free software. All students are required to install it on their machine. Stata may be used for general economics/econometrics applications.

Topics and Required Readings

Part 1: Introduction to Machine Learning

- **Chapter 1:** Introduction

  JWHT, Chapter 2

- **Chapter 2:** Basic notions of Machine Learning and Natural Language Processing

  JWHT, Chapter 2; Sarkar, D. (2016) Chapter 3

Part 2 : Algorithmic Prediction

- **Chapter 3:** Classifier Part 1: Logistic, k-nearest neighbors, Naïve Bayes classifier

  JWHT, Chapter 4

- **Chapter 4:** Classifier Part 2: Trees-based Methods

  JWHT, Chapter 8

- **Application 1**: Financial crisis
  - Manasse, P. and Roubini, N., 2009, "Rules of thumb for sovereign debt crises", Journal of International Economics, Volume 78, Issue 2.
- **Application 2**: Delinquency risk
  - Fuster, Andreas, et al. "Predictably unequal? The effects of machine learning on credit markets." The Journal of Finance 77.1 (2022): 5-47.
- **Application 3 :** Forecasting and nowcasting

Part 3 : Natural Language processing

- **Chapter 5:** Textual Analysis Part 1: Feature engineering Model

  Sarkar, D. (2016) Chapter 4

- **Application 4:** Uncertainty and Risk
  - Alexopoulos, Michelle, and Jon Cohen, ‘‘The Power of Print: Uncertainty Shocks, Markets, and the Economy,’’ International Review of Economics and Finance, 40 (2015), 8–28.
  - Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. The quarterly journal of economics, 131(4), 1593-1636.
- **Application 5:** Intangible asset and Technology
  - Kelly, B., Papanikolaou, D., Seru, A., & Taddy, M. (2018). Measuring technological innovation over the long run (No. w25266). National Bureau of Economic Research.

- **Chapter 6:** Sentiment analysis

  Sarkar, D. (2016) Chapter 9

- **Application 6:** Prediction of Financial Return
  - Tetlock, P. C. (2007). Giving content to investor sentiment: The role of media in the stock market. The Journal of finance, 62(3), 1139-1168.
  - Loughran, Tim, and Bill McDonald. 2011. “When Is a Liability Not a Liability? Textual Analysis, Dictionaries, and 10-Ks.” Journal of Finance 66 (1): 35–65.
  - Cao, Sean, et al. How to talk when a machine is listening: Corporate disclosure in the age of AI. No. w27950. National Bureau of Economic Research, 2020.

- **Chapter 7:** Textual Analysis Part 2: Topic Modelling

  Sarkar, D. (2016) Chapter 6

- **Application 7:** Central Bank and Prediction

- Hansen, Stephen, Michael McMahon, and Andrea Prat. 2018. "Transparency and Deliberation within the FOMC: A Computational Linguistics Approach." Quarterly Journal of Economics 133 (2): 801–70.

Important notices:
(1) The schedule is tentative and may be adjusted depending on the length of some chapters compared to others.
(2) We may have to skip some applications if we are short on time.
(3) It is compulsory to read the required materials before class.
(4) In the Machine Learning literature, each chapter that we will see can constitute a course in itself. We will then not approach all these themes exhaustively but rather make a synthesis. We will keep it practical for you to use these methods easily.

(5) Please save the date of March 30 and April 6 as the date for the presentation of the final project.

Email Policy

The use of email should be restricted to private matters or to notify problems (e.g., broken links, typos, etc.).
I will answer questions related to course materials in person during lectures or office hours.

- First, ask the Teaching Assistant
- For e-mails asking for a reply, if I can answer briefly (e.g., requiring a one-sentence reply), then I will reply within three business days. If a response requires more detail, then class, tutorial, or office hours are the more appropriate forum;
- I will not respond to emails that request information that can be found on Quercus or the syllabus.
- Please also note that it is not appropriate to request marks, or the solutions to problem sets or midterm questions by email.

Finally, students are also required to send emails using their University of Toronto email address. The subject of the email should include the course number and the UTORid.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's *Code of Behaviour on Academic Matters* (http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjun011995.pdf) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

- Using someone else's ideas or words without appropriate acknowledgement.
- Submitting your own work in more than one course without the permission of the instructor in all relevant courses
- Making up sources or facts
- Obtaining or providing unauthorized assistance on any assignment

On tests and exams:

- Using or possessing unauthorized aids
- Looking at someone else's answers during an exam or test
- Misrepresenting your identity

In academic work:

- Falsifying institutional documents or grades
- Falsifying or altering any documentation required by the University, including (but not limited to) doctor's notes

All suspected cases of academic dishonesty will be investigated following procedures outlined in the *Code of Behaviour on Academic Matters*. Please have a look at these sections on Perils and Pitfalls https://www.academicintegrity.utoronto.ca/perils-and-pitfalls/ and Smart Strategies https://www.academicintegrity.utoronto.ca/smart-strategies/. Also, see the U of T writing support website at https://writing.utoronto.ca/. We may use Turnitin or Ouriginal for the final submission of the research project. More details will be given during class.

University disclaimer concerning Turnitin:

"Normally, *students will be required to submit their course essays to Turnitin.com for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site."*

Class Materials Policy:

Class materials are subject to the University's policy on intellectual property. It is strictly forbidden to copy, share, or distribute any class materials, except for the current academic use purpose, without the instructor's explicit permission.

Code of Conduct in an online environment

- The thing number one to recall is that we are in a learning environment. Mistakes, discussions, exchange of ideas, etc., are fine as long as there are made in total respect of the person and individuality.
- Please, mute yourself unless you need to talk for the class's benefit (ask a question, answer a question, etc.).
- To avoid unpleasant interruption, when you want to ask a question, please use the chat function or wait for the time allowed to do so. As you will notice, I frequently ask if there are any questions. When asked, you are welcomed to unmute yourself and ask any question you may have.
- Again, I make a point of honor to have a respectful environment during class. So please, respect your peers. Use proper and respectful language and refrain from any insults, threats or bad jokes.
- Finally, adhere to the same standards as you would in the classroom.

Academic Accommodations

The University is committed to accessibility. If a student requires accommodations for a disability, or has any accessibility concerns about the course, please contact Accessibility Services as soon as possible. Their website is http://www.studentlife.utoronto.ca/as.

Other important notice

The students are expected to comply with all University policies even if not expressly mentioned above.