Rotman Commerce
UNIVERSITY OF TORONTO

Course Outline

Course Code	RSM 338 H1 LEC0501
Course Name	Applications of Machine Learning in Finance
Term, Year	Fall, 2025
Course Meets	Tuesday 5pm-7pm
Web page URL	https://q.utoronto.ca

Instructor Details

Name	Email	Phone	Office Hours
Goutham Gopalakrishna	goutham.gopalakrishna@rotman.utoronto.ca	416-978-4291	By appointment

Course Description

This course provides an overview of the basic tools in data analysis and machine learning, with emphasis on applications in finance. Data analysis and machine learning play an important role in FinTech. Individual investors and financial institutions who can leverage these new tools and technology will have a significant advantage. This course discusses these new opportunities and challenges. It seeks to equip students with these highly coveted skills in the market.

Real world finance problems often deal with large datasets, traditionally with historical price and return as well as data on financial statements. More recently, other databases like consumer credit and online data (like Google search) are also becoming more important for financial analysts. Dealing with such large datasets requires tools to manipulate them, and we will introduce the use of Python and detailed instructions on how to perform analysis on large datasets. Once students become comfortable with the use of Python and manipulation of large sets, we will introduce students to various tools in machine learning.

Machine learning plays an important role in our financial market, from approving loans, managing portfolios, to assessing risks. Advances in machine learning technology have enabled financial institutions to explore the applications of machine learning techniques in areas like customer service, personal finance, wealth management, and risk management.

Learning Outcomes

By the end of this course, students will be able to:

- Perform data analysis with Python
- Apply popular machine learning tools in various financial applications

Course Prerequisites

ECO220Y1/ ECO227Y1/(STA220H1, STA255H1)/(STA237H1, STA238H1)/(STA257H1, STA261H1); CSC108H1/ CSC148H1

Course Exclusions

RSM358H1; RSM316H1 (if taken in Winter 2020, Fall 2020, or Winter 2021

Required Readings

There are two required texts for this course:

Machine Learning in Business – An Introduction to the World of Data Science, John Hull, 3rd edition, ISBN 979-8508489441

An Introduction to Statistical Learning with Applications in Python, Gareth James, Daniela Witten,Trevor Hastie, Robert Tibshirani, and Jonathan Taylor, 1st edition, Download here (ISL hereafter)

Two optional texts are recommended for this course:

The Elements of Statistical Learning, Data Mining, Inference, and Prediction, 2nd edition, Trevor Hastie, Robert Tibshirani, and Jerome Friedman, Download here

Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow, 3rd edition, Aurélien Géron, ISBN 978-1098125974

Evaluation and Grades

Grades are a measure of the knowledge and skills developed by a student within individual courses. Each student will receive a grade on the basis of how well they have command of the course materials, skills and learning objectives of the course.

Work	Percentage of grade	Due Date
Assignment 1	10%	Sep. 16
Assignment 2	10%	Sep. 30
Assignment 3	10%	Oct. 14
Assignment 4	10%	Nov. 4
Assignment 5	10%	Nov. 18
Assignment 6	10%	Dec. 2
Final Term Test	40%	TBA

Course Format and Expectations

There will be six homework assignments covering various aspects of data analysis and the implementation of machine learning methodologies. The first two assignments are individual. For the rest, you are encouraged to work in groups. Homework assignments are due at 10 am on specified dates and late ones are not accepted. Except for unusual circumstances, grades on problem sets are final and re-grading requests will not be accepted.

The course requires the use of Python. We will run a Python workshop on Thursday 5:00-8:00pm at Desautels Centre for Integrative Thinking (DCIT, 105 St. George Street, Room 4001). In addition, the Coding Café at DCIT will be running all semester the same day and time. You are welcome to show you with your coding questions. Prior knowledge of Python is not a requirement for this course but students who are uncomfortable with coding should not take this course. The course also makes heavy use of statistics, and students who have difficulties with

quantitative materials are not suggested to take this course. In addition to the lecture, I will run some online tutorials typically before the homework assignments are due. The TA of the course is Yulong Peng and his E-mail address is yulong.peng@rotman.utoronto.ca.

Missed Tests and Assignments

Students who miss a term test or assignment for reasons entirely beyond their control (e.g. illness) may request special consideration **within 2 business days** of the missed midterm/test/assignment due date.

In such cases, students must:

1. Complete the Request for Special Consideration form: https://uoft.me/RSMConsideration
2. Provide documentation to support the request, eg. Absence Declaration from ACORN, medical note etc.

Please note: As of September 2023, students may use the Absence Declaration on ACORN ***one time per term*** to report an absence and request consideration. **Any subsequent absence will require a Verification of Illness form or other similar relevant documentation.**

Students who do not submit their requests and documentation within 2 days may receive a grade of 0 (zero) on the missed course deliverable.

Final Exams: If you miss the final exam in this course for a legitimate reason (illness, etc) you will need to contact your College Registrar to file a petition for a deferred exam. This deferred exam will be written at a later date as established by the Faculty of Arts & Science. Instructions can be found here: https://www.artsci.utoronto.ca/current/faculty-registrar/petitions-appeals/preparing-petition

Statement on Equity, Diversity and Inclusion

The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

Commitment to Accessibility

The University is committed to inclusivity and accessibility, and strives to provide support for, and facilitate the accommodation of, individuals with disabilities so that all may share the same level of access to opportunities and activities offered at the University.

If you require accommodations for a temporary or ongoing disability or health concern, or have any accessibility concerns about the course, the classroom or course materials, please email Accessibility Services or visit the Accessibility Services website for more information as soon as possible. Obtaining your accommodation letter may take up to several weeks, so get in touch with them as soon as possible. If you have general questions or concerns about the accessibility of this course, you are encouraged to reach out to your instructor, course coordinator, or Accessibility Services.

Generative AI / ChatGPT

Students may use artificial intelligence tools, including generative AI, in this course as learning aids or to help produce assignments. However, students are ultimately accountable for the work they submit.

Academic Integrity

Academic Integrity is a fundamental value essential to the pursuit of learning and scholarship at the University of Toronto. Participating honestly, respectfully, responsibly, and fairly in this academic community ensures that the U of T degree that you earn will continue to be valued and respected as a true signifier of a student's individual work and academic achievement. As a result, the University treats cases of academic misconduct very seriously.

The University of Toronto's Code of Behaviour on Academic Matters outlines the behaviours that constitute academic misconduct, the process for addressing academic offences and the penalties that may be imposed. You are expected to be familiar with the contents of this document. 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.
- Making up sources or facts.
- Obtaining or providing unauthorized assistance on any assignment (this includes collaborating with others on assignments that are supposed to be completed individually).

On test and exams

- Using or possessing any unauthorized aid, including a cell phone.
- Looking at someone else's answers.
- Misrepresenting your identity.
- Submitting an altered test for re-grading.

Misrepresentation

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

All suspected cases of academic dishonesty will be investigated by the procedures outlined in the *Code of Behaviour on Academic Matters*. If you have any questions about what is or is not permitted in the course, please do not hesitate to contact the course instructor. If you have any questions about appropriate research and citation methods, you are expected to seek out additional information from the instructor or other U of T or RC resources such as the RC Centre for Professional Skills, the College Writing Centres or the Academic Success Centre.

Email

At times, the course instructor may decide to communicate important course information by email. As such, all U of T students are required to have a valid UTmail+ email address. You are

responsible for ensuring that your UTmail+ email address is set up and properly entered on ACORN. For more information visit the Information Commons Help Desk.

Forwarding your utoronto.ca email to a Gmail or other type of email account is not advisable. In some cases, messages from utoronto.ca addresses sent to Gmail accounts are filtered as junk mail, which means that important messages from your course instructor may end up in your spam or junk mail folder.

Recording Lectures

Lectures and course materials prepared by the instructor are considered by the University to be an instructor's intellectual property covered by the Canadian Copyright Act. Students wishing to record a lecture or other course material in any way are required to ask the instructor's explicit permission and may not do so unless permission is granted. Students who have been previously granted permission to record lectures as an accommodation for a disability are excepted. This includes tape recording, filming, photographing PowerPoint slides, Quercus materials, etc.

If permission for recording is granted by the instructor (or via Accessibility Services), it is intended for the individual student's own study purposes and does not include permission to "publish" them in any way. It is forbidden for a student to publish an instructor's notes to a website or sell them in any other form without formal permission.

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Weekly Schedule

Session	Date	Topic	Readings
1	9/2	**Introduction** Introduction to the course, characteristics of stock returns **Investing for the Long-Horizon** Distribution of Long-horizon returns, estimation risk	
2	9/9	**Predictive Regression** Predicting returns using different Information variables, in-sample vs. out-of-sample R^2	A Comprehensive Look at the Empirical Performance of Equity Premium Prediction, Welch and Goyal, 2008, *Review of Financial Studies* 21(4), 1455-1508
3	9/16	NO CLASS	
4	9/23	**Machine Learning** Introduction to machine learning	Hull (Ch. 1) ISL (Ch. 1-2)
5	9/30	**Clustering Analysis** Hierarchical clustering and K-means clustering	Hull (Ch. 2) ISL (Ch.12)
6	10/7	**Linear Regression** Least squares regression and its problems. Lasso, ridge regression, and elastic net	Hull (Ch 3.1-3.8) ISL (Ch.3, 6)
7	10/14	**Estimation Risk** Optimal portfolio theory, impact on out-of-sample performance due to estimation risk	Approaching Mean-Variance Efficiency for Large Portfolios, Ao, Li, and Zheng, 2019, *Review of Financial Studies* 32(7), 2890-2919
8	10/21	**Linear Classification** Linear methods for classification, linear discriminant analysis and logistic regression	Hull (Ch. 3.9-3.12) ISL (Ch. 4)
9	10/28	**Decision Trees/Support Vector Machines** Tree based methods for classification and support vector classifiers	Hull (Ch. 4, 5) ISL (Ch. 8)
10	11/4	**Neural Networks** Artificial neural networks, hidden units and layers	Hull (Ch. 6-7) ISL (Ch. 10)
11	11/11	**Reinforcement Learning** Multi-armed bandit problem, temporal Difference learning	Hull (Ch. 8)
12	11/18	**Textual Analysis** Bag of words, sentiment analysis, large language model	Hull (Ch. 9)

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Other Useful Links

- Become a volunteer note taker
- Accessibility Services Note Taking Support
- Credit / No-Credit in RSM courses
- Rotman Commerce Academic Support
- Where to find teaching assistant opportunities

URL links for print

- ACORN: http://www.acorn.utoronto.ca/
- Email Accessibility Services: accessibility.services@utoronto.ca
- Accessibility Services website: http://studentlife.utoronto.ca/as
- University's Plagiarism Detection Tool FAQ: https://uoft.me/pdt-faq
- The University of Toronto's Code of Behaviour on Academic Matters: http://www.governingcouncil.utoronto.ca/policies/behaveac.htm
- Information Commons Help Desk: http://help.ic.utoronto.ca/category/3/utmail.html
- Become a volunteer note taker: https://studentlife.utoronto.ca/program/volunteer-note-taking/
- Accessibility Services Note Taking Support: https://studentlife.utoronto.ca/service/note-taking-support/
- Credit / No-Credit in RSM courses: https://rotmancommerce.utoronto.ca/current-students/degree-requirements/credit-no-credit-option/
- Rotman Commerce Academic Support: https://rotmancommerce.utoronto.ca/current-students/academic-support/
- Book an appointment with a writing or presentation coach: http://uoft.me/writingcentres
- Writing and Presentation Coaching academic support page: https://rotmancommerce.utoronto.ca/current-students/academic-support/writing-and-presentation-coaching/
- Centre for Professional Skills Teamwork Resources page: https://rotmancommerce.utoronto.ca/teamwork-resources
- Book an appointment with a Teamwork Mentor: http://uoft.me/writingcentres