FINANCE 704
Numerical Methods
Winter 2023 Course Outline

Master of Finance
DeGroote School of Business
McMaster University

COURSE OBJECTIVE

This course will introduce students to common numerical methods and their applications in finance.

INSTRUCTOR AND CONTACT INFORMATION

Instructor:
Michael Milewski
milewsmr@mcmaster.ca
Office House: By Appointment
Class Location: See Mosaic

TA:
See Avenue

COURSE ELEMENTS

Credit Value:	3	Leadership:	No	IT skills:	Yes	Global view:	No
A2L:	Yes	Ethics:	Yes	Numeracy:	Yes	Written skills:	Yes
Participation:	Yes	Innovation:	Yes	Group work:	Yes	Oral skills:	Yes
Evidence-based:	Yes	Experiential:	Yes	Final Exam:	Yes	Guest speaker(s):	No

COURSE DESCRIPTION

This course covers various numerical techniques to solve quantitative problems. Its primary objective is to develop a basic understanding of the construction of numerical algorithms and the applicability and limits of their use. An important component of this course is the learning of relevant computer programs such as Python. The main topics include standard algorithms for numerical computations, such as root finding for nonlinear equations, numerical differentiation, and numerical solutions of ordinary differential equations.

LEARNING OUTCOMES

Upon successful completion of this course, students will be able to complete the following key tasks:

- Learn common numerical methods and their applications in finance
- Attain a level of comfort in programming with Python in the financial industry
- Identifying numerical approaches to solve real world financial problems
- Learn the limitations and common issues with numerical solutions and potential ethical problems that may arise
- Practice solving problems in a team environment, and practice communicating technical materials in written and oral manner

COURSE MATERIALS AND READINGS

Required:

- **Book A:** Hilpisch, Yves J., Python for Finance: mastering data-driven finance, 2nd Edition, by O'Reilly Media, 2019, 978-1492024330
- **Book B:** Kong, Q., Siauw, T., Bayen, A., Python Programming and Numerical Methods: A Guide for Engineers and Scientists, 1st Edition, Academic Press, 2020, 978-0128195499

Legacy:

- **Legacy:** Paolo Brandimarte, Numerical Methods in Finance and Economics: A MATLAB- Based Introduction, 2nd Edition, by Wiley, 2006, 978-0471745037

COURSE OVERVIEW AND ASSESSMENT

Missed tests/exams not approved by the MFIN Program Office or MSAF will receive a grade of zero. Late assignments will be penalized 10% for each day they are late. Your final grade will be calculated as follows:

Components and Weights

Assignment #1	10%
Assignment #2	10%
Mid-Term	20%
Term Project	30%
Final Exam	20%
Portfolio Optimization Assignment	10%
Total	100%

GRADING SCALE

For graduate courses, the grade conversion scales are available through the following link:

https://academiccalendars.romcmaster.ca/content.php?catoid=42&navoid=8734#2.6.1_Averaging_of_Letter_Grades

MBA and Master of Finance Grading Scale:

Grade	Points	Equivalent Percentages	Pass/Fail
A+	12	90-100	P+
A	11	85-89	P
A-	10	80-84	
B+	9	75-79	
B	8	70-74	
B-	7	60-69	
F	0	59 and under	F

COURSE STRUCTURE

ACTIVITY	DELIVERY	DESCRIPTION	TOOL(S)
Live Lectures	Synch	3hr. live session; opportunity to elaborate on content, present challenges, engage discussion	In-person
Demos	Asynch	Programming demonstration videos	Avenue
TA Office Hours	Synch	2hr. Live Session to ask TA questions	In-person/Zoom

COURSE DELIVERABLES

Assignment #1
This assignment is worth **10%** of your final grade and will be marked in groups of 2.

Assignment #2
This assignment is worth **10%** of your final grade and will be marked in groups of 2.

Term Project
This assignment is worth **30%** of your final grade and will be marked in groups of 4-5.

ML/Applied Data Science Assignment
This is worth **10%** of your final grade. This assignment is to be completed **individually**.

Midterm
This midterm is worth **20%** of your final grade.

Final Exam (Non-cumulative)
This exam is worth **20%** of your final grade.

COMMUNICATION AND FEEDBACK

Students who wish to correspond with instructors or TAs directly via email must send messages that originate from their official McMaster University email account. This protects the confidentiality and sensitivity of information as well as confirms the identity of the student.

REQUESTING RELIEF FOR MISSED ACADEMIC WORK

In the event of an absence for medical or other reasons, students should review and follow the Missed Term Work regulations that our outlined on the Master of Finance website;

https://mfin.degroote.mcmaster.ca/current-students/missed-term-work/

ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

For information on the various types of academic dishonesty please refer to the *Academic Integrity Policy,* located at https://secretariat.mcmaster.ca/university-policies-procedures- guidelines/

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY/PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software.

All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses With an On-Line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course.

The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all our living, learning and working communities. These expectations are described in the *Code of Student Rights & Responsibilities* (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's *Academic Accommodation of Students with Disabilities* policy.

Academic Accommodation For Religious, Indigenous or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office ***normally within 10 working days*** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Acknowledgement of Course Policies

Your enrolment in Finance 704 will be considered an implicit acknowledgement of the course policies outlined above, or of any other that may be announced during lecture and/or on A2L. **It is your responsibility to read this course outline, to familiarize yourself with the course policies and to act accordingly.**

Lack of awareness of the course policies **cannot be invoked** at any point during this course for failure to meet them. It is your responsibility to ask for clarification on any policies that you do not understand.

DeGroote SCHOOL OF BUSINESS
EDUCATION WITH PURPOSE

McMaster University

COURSE SCHEDULE

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Week	Week of	Topic*	Readings*	Legacy Reference Readings*	Due Dates*
1	09-Jan	Introduction, Coding and Python	Book A: Chapter 3, 4, 5	Chapter 1 Chapter 2	
2	16-Jan	Computer Numbers, Numerical Instability, and ill-conditioning	Book A: Chapter 12 - Random Numbers Book B: Chapter 9, 18	Chapter 4 – Section 4.3 Chapter 3 – Section 3.1	
3	23-Jan	Solving non-linear equations	Book B: Chapter 19	Chapter 3 – Section 3.4	Assignment 1 Jan 28th 12:00
4	30-Jan	Solving systems of linear equations	Book B: Chapter 14	Chapter 3 – Section 3.2	
5	06-Feb	Finite Difference Methods	Book B: Chapter 20, 22, 23	Chapter 5	Assignment 2 Feb 11th 12:00
6	13-Feb	Finite Difference Methods		Chapter 5	
7	20-Feb	Reading Week			
8	27-Feb	Midterm		Chapter 9	TBD
9	06-Mar	Simulation	Book A: Chapter 10, 12	Chapter 7 Chapter 8 – Section 8.1	
10	13-Mar	Simulation	Book A: Chapter 18, 19	Chapter 4 – Section 4.4 Section 4.5 Chapter 8 – Section 8.3	
11	20-Mar	Optimization	Book A: Chapter 11 - Convex Optimization	Chapter 6 – Section 6.1 Section 6.4	
12	27-Mar	Optimization	Book A: Chapter 13 - Portfolio Optimization	Chapter 6 – Section 6.2 Section 6.3 Section 6.5 Section 6.6	Progress Report Apr 1st 12:00
13	03-Apr	Modelling			Data Analysis Apr 8th 12:00
14	10-Apr	Spare/Presentations			Term Project Apr 12th 12:00

* Note: Any changes to the reading list or topics will be posted on Avenue in advance