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MATH 2FM3 – Introduction to Mathematical Finance

2023 Spring Term

Instructor: Xuwei Yang | **E-mail:** yangx212@mcmaster.ca | **Office:** HH 103E

Office Hours: Wed, 3:00 pm – 4:00 pm and/or by appointment (either in-person or virtually)

Lecture

Days and Times: Tuesday and Thursday, 7:00 pm – 10:00 pm

Dates: May 1, 2023 – June 16, 2023

Classroom: ETB 235

Tutorial

Days and Times: Not Available

Tutors and Office Hours: Not Available

Materials & Fees

Textbook: Mathematics of Investment and Credit, 7th edition, by Samuel A. Broverman, published by Actex Publications. There is an accompanying solutions manual whose purchase is optional

Calculator: Only the standard Casio fx 991 MS or MS Plus calculator is permitted.

Course Website

Course materials and announcements will be posted on Avenue to Learn. Please check it regularly.

Course Description

Nominal and effective rates of interest and discount, forces of interest and discount, compound interest, annuities certain; amortization, sinking funds, bonds, security evaluation, determination of yields; rates of return, duration, immunization, swaps.

Prerequisite(s): One of MATH-1A03, 1LS3, 1M03, 1N03, 1X03, 1Z04, 1ZA3, ARTSSCI 1D06 A/B, ISCI 1A24 A/B

Anti-requisite(s): MATH 2K03



Course and Learning Objectives

Upon completion of this course, the student will be able to:

- Define, calculate, and recognize the definitions of the following terms: interest rate, simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate, convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.
- Define, calculate, and recognize the definitions of the following terms: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity.
- Define, calculate, and recognize the definitions of the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization.
- Define, calculate, and recognize the definitions of the following terms: price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable.
- Define, calculate, and recognize the definitions of the following terms: yield rate/rate of return, dollar-weighted rate of return, time-weighted rate of return, current value, duration (Macaulay and modified), convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, stock price, stock dividend.
- Define, calculate, and recognize the definitions of the following terms: cash flow matching, immunization (including full immunization), Redington immunization.
- Define, calculate, and recognize the definitions of the following terms: swap rate, swap term.
- Define, calculate, and recognize the key concepts concerning the determinants of interest rates and the components of interest.



Course Overview and Assessment

Topics

Topics	Chapter (7th Edition)	Schedule
Introduction and Interest Rate Measurement	1	Week 1
Valuation of Annuities	2	Week 1-2
Loan Repayment	3	Week 2-3
Bond Valuation	4	Week 4
Measuring the Rate of Return of an Investment	5	Week 4-5
The Term Structure of Interest Rates	6	Week 5-6
Cashflow Duration and Immunization	7	Week 6-7
Interest Rate SWAPS	8	Week 7

Evaluation

Evaluation of the course consists of assignments, labs, midterm tests and a final exam:

- There will be **5 assignments** to be completed during the term. Assignments will be completed online using the internal assignment system. Information about the assignments, including the link, will be provided on the course website on Avenue. Closing dates are posted on the assignment system. No late assignments will be accepted.
- There will be **5 labs** to be completed during the term. Labs will focus on the use of Excel and VBA to answer problems related to the course material. Labs will be completed online using the internal assignment system. Information about the assignments, including the link, will be provided on the course website. Closing dates are posted on the assignment system. No late assignments will be accepted.



- There will be **2 midterms**, each lasting 60 minutes. More information, including the topics covered, will be announced in class. The tentative dates of the midterms are TBA.
- There will be a **2.5-hour final exam** at the end of the term. It will cover all course material.

Grade Component	Weight
Final Examination	40%
Midterm Tests 1, 2	40% = 20% + 20%
Labs	10%
Assignments	10%

Virtual Course Delivery

It is required that all students attend the in-person lectures. The lectures will be video recorded for students to review after class.

To follow and participate in virtual classes it is expected that you have reliable access to the following:

- A computer that meets performance requirements [found here](#).
- An internet connection that is fast enough to stream video.
- Computer accessories that enable class participation, such as a microphone, speakers and webcam when needed.

If you think that you will not be able to meet these requirements, please contact uts@mcmaster.ca as soon as you can. Please visit the [Technology Resources for Students page](#) for detailed requirements. If you use assistive technology or believe that our platforms might be a barrier to participating, please contact [Student Accessibility Services](#), sas@mcmaster.ca, for support.

Requests for Relief for Missed Academic Term Work

[McMaster Student Absence Form \(MSAF\)](#): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”.



MSAF Course Specific Information

Absences for a longer duration or for other reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. The percentages of the missed work will be transferred to the final examination. Please note that the MSAF may not be used for term work worth 25% or more. In particular, note that the MSAF cannot be used for the final examination. Finally, please note that for assessments where an MSAF is used, the missed weight of the assessment will be moved to the final exam.

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.

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, user names 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.

Academic Integrity

You are expected to exhibit honesty and use ethical behavior 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 behavior 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](https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/), 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 the [McMaster Office of Academic Integrity's](#) webpage.

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 behaviors 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.

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.

Research Ethics - NA

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, labor disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

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MATH 3FM3 – MATHEMATICS OF FINANCE

2023 Fall Term

Instructor: Dr. Anas Abdallah | **E-mail:** anasabdallah@mcmaster.ca | **Office Hours:** Monday 2:30pm-4:00pm (HH-408)

COURSE DESCRIPTION

This course introduces financial markets and derivatives and to the mathematics of finance. Major topics include: Forwards and Options, Trading strategies, Parity and other option relationships, Binomial Option Pricing, Exotic options, Stochastic processes and the lognormal property of stock prices, Black-Scholes formula. The material, together with MATH-4FM3, will form the basis of the material needed for the Investment and Financial Markets (IFM) exam of the Society of Actuaries and the Financial Economics exam (3F) of the Casualty Actuarial Society (CAS).

Prerequisite(s): One of ISCI 2A18 A/B, MATH 2X03; and STATS 2D03

COURSE AND LEARNING OBJECTIVES

This course introduces financial markets and derivatives and the mathematics of finance. Students will learn the following topics: Forwards and Options, Trading strategies, Parity and other option relationships, Binomial Option Pricing, Exotic options, Stochastic processes and the lognormal property of stock prices, Black-Scholes formula.

Lecture:

- Days and time: Monday-Wednesday-Thursday: 5:30pm - 6:20pm
- Format: **in-person** -- Go over the slides, fill in the blanks, solve the examples and exercises.
- Room: BSB-B136 (Mon & Wed) and BSB-B135 (Thurs).

Tutorial:

- Tutor: Gujie Fu fug3@mcmasteru365.onmicrosoft.com
- Day and time: T01 – Wednesday 1:30pm to 2:20pm & T02 – Wednesday 9:30am to 10:20am
- Room: HH-109 (T01) and HSC-1A4 (T02).
- TA Office hours: right after each tutorial (with Gujie Fu)

MATERIALS & FEES

REQUIRED MATERIALS/ RESOURCES

Textbook:

- *Derivatives Markets (Third Edition)*, 2013, by McDonald, R.L., Pearson Education, ISBN: 978-0-32154-308-0.
https://campusstore.mcmaster.ca/cgi-mcm/ws/txsub.pl?wsTERMG1=234&wsDEPTG1=MATH&wsCOURSEG1=3FM3&wsSECTIONG1=DAY%20C01&crit_cnt=1

Calculator: Only the standard Casio fx 991 MS or MS Plus calculator is permitted.



VIRTUAL COURSE DELIVERY

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COURSE OVERVIEW AND ASSESSMENT

Final Exam:

A 2.5-hour duration in-person final exam, worth 45% of the final grade, will be administered by the registrar.

Mid-Term Tests:

- Platform: Childsmath (in-person)
- Tentative Dates: (during class time 5:30pm to 6:20pm)
 - Test #1 on Thursday, October 5, 2023
 - Test #2 on Wednesday, November 8, 2023
 - Test #3 on Wednesday, November 29, 2023
- Room: TBD
- Topic: More information will be announced in due course

Assignments:

- There will be up to 5 assignments, to be uploaded and submitted on Avenue to Learn.

EVALUATION

Tentative Marking Scheme*:

Assessment	Weight
1. Final Exam	45%
2. Three Midterms	40%
3. Assignments	15%

** Alternate Grading Scheme may be considered at the end of the term. Please note that this alternate grading scheme may NOT be applied if you used an MSAF for a midterm (assignment), and we will only use the grades of the midterms (assignments) that were completed.*

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RESEARCH ETHICS – NA

EXTREME CIRCUMSTANCES

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