The University of Western Ontario
Department of Statistical and Actuarial Sciences
ACTUARIAL SCIENCE 2553A
Mathematics of Finance -- 2020-21

Although this academic year might be different, Western University is committed to a **thriving campus**. We encourage you to check out the Digital Student Experience website to manage your academics and well-being. Additionally, the following link provides available resources to support students on and off campus: https://www.uwo.ca/health/.

Technical Requirements:

Stable internet connection

Laptop or computer

Working microphone

Working webcam

Instructor	Section	Day/Time	Location	email	Office/Phone
Mr. S. Kopp	001	MWF – 9:30-10:30	Online	kopp@stats.uwo.ca	284 WSC; 661-2111 x86288
	Tutorial	M – 5:30-6:30	Online		
Office Hours: **Mondays and Tuesdays – 2:30 to 4:30 pm; Room 284, WSC**					

Prerequisites:
A minimum mark of 60% in Calculus 1501B, or a minimum mark of 85% in Calculus 1301B.

Anti-requisites:
Actuarial Science 2053

Students are advised that they are responsible to ensure that they possess the necessary prerequisites (or have written special permission) and that de-registration may occur at <u>any time</u> if they lack the prerequisite or have taken an antirequisite course.

Textbook:
"Financial Mathematics – Theory and Practice" by Robert Brown and Steve Kopp
- An online version of the textbook can be ordered (cost: $59) through the UWO bookstore by clicking on the link:

(link still needs to be provided; not yet ready from the bookstore)

Classes
Classes will be held live on ZOOM during the scheduled class time (Monday, Wednesday and Friday from 9:30 am to 10:20 pm EASTERN time zone). The class notes will be available on the course OWL site several days before the scheduled class time. The lectures will be recorded and posted on the course OWL site. This way, students who are not able to attend a lecture will be able to view the lecture in its entirety after the class.

All of the remote learning sessions for this course will be recorded.
The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other

individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Online Participation and Engagement

$\boxtimes$ Students are expected to participate and engage with content as much as possible

$\boxtimes$ Students can participate during the live class sessions by raising your hand on ZOOM or using the chat option to post a question. I plan to stop every once in a while during the live classes to check to see if any student has posted a question or has raised their hand. Students can also post any questions they might have on OWL after watching the recording after it has been posted on OWL.

$\boxtimes$ Students can also participate by interacting in the forums with their peers and instructors

Google Chrome or Mozilla Firefox are the preferred browsers to optimally use OWL; update your browsers frequently. Students interested in evaluating their internet speed, please click here.

Approximate Course Outline

Chapter 1 – The Time Value of Money (Sept 11 to Sept 30)
- Accumulation and amount functions; effective rate of interest; accumulating and discounting with simple and compound interest; time periods; rate of discount; nominal rates of interest and discount; force of interest and discount; varying interest

Chapter 2 – Equivalence Equations (Oct 2 to Oct 7)
- Equations of value; determining the length of time or rate of interest for an investment; treasury bills; real rate of interest

Chapter 3 – Simple Annuities (Oct 9, Oct 14 to Oct 21)
- Annuity immediate; annuity-due; deferred and forborne annuities; determining the length of an annuity; determining the rate of return

Chapter 4 – Other Types of Annuities (Oct 23 to Oct 30)
- Annuities payable more or less frequently than interest is compounded; perpetuities; continuous annuities; varying annuities

Chapter 5 – Repayment of Debts (Nov 9 to Nov 16)
- Amortization schedules; determining the outstanding balance of a debt; sinking fund method of repaying a loan; refinancing a loan

Chapter 6 – Bonds (Nov 18 to Nov 25)
- Bond prices on and between coupon dates; amortization of a bond, callable bonds, determining the rate of return

Chapter 7 – Rates of Return (Nov 27 to Dec 2)
- Internal rate of return; net present value; dollar-weighted and time-weighted rates of interest; dividend discount model

Chapter 8 – Yield Curves (Dec 4 to Dec 9)
- Term structure of interest rates; spot rates; forward rates; the yield curve

Chapter 9 – Asset-Liability Management (we will see if we can get to this or not)
- Duration; convexity; immunization (Reddington's and Full); cash flowing matching

What You Will Be Graded On

(a) Assignments

There will be 3 assignments requiring written answer questions where you show all your work. There will also be some questions that are designed to give you an introduction to the **spreadsheet computer program of Exce**l. They are due on the following dates:

1	Wednesday, September 30	**Due by 8:00 pm**
2	Wednesday, October 28	**(Eastern Time Zone)**
3	Wednesday, December 2	**on these dates**

The assignments will be available on the Actuarial Science 2553A OWL web page approximately 1 week before the due dates.
- Assignments are due by the start of class on the dates given above
- Each assignment will contain a few computer Excel spreadsheet questions
- There will be study notes included with assignment 1 to help get started on Excel.

However, you will not submit your solutions to OWL. Instead we will be using GRADESCOPE for you to submit your assignments. (I will send out information about how to upload your solutions to Gradescope through an announcement on OWL as we get closer to the date an assignment is due).

Assignments can be written out by hand or typed up. If your solutions are hand written, you must make a <u>pdf version</u> of your solutions (including any graphs created by Excel or some software). It will be that pdf version that you will upload to Gradescope. (again, I will have information about how to make a pdf copy of your solutions on OWL).

<u>LATE penalties</u>: I have tried to space out the dates that things are due in this course so that you have time to get things done and not feel overwhelmed. You are expected to get things done ON TIME. If you are late with your assignments, there will be a 20% penalty PER DAY late (thus, if you get it in at 8:01 pm on the due date, that is consider one day late and will be subject to the 20% penalty)

(b) In-class Tests:

There will be 6 in-class tests. They will be held during the class times from 9:30 to 10:20 am. The tests will be synchronous: ALL STUDENTS WILL WRITE AT THE SAME TIME.

I had initially planned to use the tutorial hour to have the tests. But given that people will be writing these times at various time zones across the world, I did not think having the tests during the tutorial hour from 5:30 to 6:20 pm (Eastern) was a convenient time slot, especially for students in China. Thus, I have decided to have the tests during the class time, because a start time of 9:30 am (Eastern) is more convenient for most students (although students who remain at home in British Columbia will have to start at 6:30 am).

1	Monday, September 21	4	Monday, November 9
2	Monday, October 5	5	Monday, November 23
3	Monday, October 19	6	Monday, December 7

- The tests will be 50-minutes in duration, consisting of some written answer questions based on material taught since last test. You will be required to show all your work.

(c) Final Exam:
The final exam will be scheduled for the December exam period. It will be a 3-hour exam covering the whole term, with emphasis on material covered since the midterm. It will be a combination of multiple choice and written answer questions.

For all in-class tests and the final exam, it is expected that:
- An online proctoring system will be used (such as ProctorTrack)
- We plan to make the exams available using OWL
- We plan to give the exam synchronously to all students at the exact same time

For the tests and final exam, it will be open-book. You are encouraged to make use of lecture slides and the text when writing the exam. However, you must work independently. Before you begin each test, you will agree to an Honour Statement. I will be conducting response and cheating analysis after each quiz. Please honour the Honour Statement.

Policy on tests and examinations
Tests and examinations in this course may be conducted using the remote proctoring service, **Proctortrack**. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. More information about this remote proctoring service is available in the Online Proctoring Guidelines at the following link:
https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. Information about the technical requirements are available at the following link:
https://www.proctortrack.com/tech-requirements/

Tutorials
A tutorial hour has been set aside every Monday from 5:30 to 6:30 pm. Six of them will be used to replace the class time that was missed due to the in-class test that day. The rest will be used as a tutorial. Right now, the plan is to run the tutorials live using ZOOM. They will be recorded and uploaded to the course OWL site. There will be NO tutorial on October 12 or November 2.

Evaluation:

	Marking Scheme
Assignments (3 of them)	10%
In-class Tests (6 of them)	60%
Final Exam	30%

Calculator
You will also need a pocket calculator for assignments, midterm and the final exam. **Only non-programmable calculators may be used for the midterm and final exam.** The following (SOA exam) models are strongly recommended:
    Texas Instruments BA-35
    BA II Plus or TI-30X II (memory must be cleared prior to start of exam)
    TI-30X or TI-30Xa
Rounding of Marks

Across the Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement. *Final grades* on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g., 74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark "bumping" will be denied.

Course OWL Web Page:
The web page will contain:

1. **Class notes**. I am hoping to make my class notes available before each class (they may not be ready until the day before the class however). This will save you time from having to write everything down during class time. Instead, what you will need to do is come to every class and add things that I write down in class (like solutions to examples) to your class notes.

2. Solutions to the textbook exercises

3. Old exams for you to practice (available about 2 weeks before the midterm/final exam dates)

4. Solutions to the tutorial tests

5. Weekly updates and information about the course that you need to know

Note
This course is accredited under the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP) for the 2019-20 academic year. Achievement of the established exemption grade in this course may qualify a student from exemptions from writing certain preliminary exams.

Please note, a combination of this course, and Financial Modeling 2557B, is required to achieve an exemption for preliminary exam FM (minimum of 75% in each course is required). Please see the following link for full details:

http://www.cia-ica.ca/membership/university-accreditation-program---home

Intellectual Property Statement
Course material (i.e. course content (including lecture notes), videos, solutions, practice questions and other supplementary material posted on OWL) is the intellectual property of your instructors and course developers and is made available to you for your personal use in this course. *Sharing, posting, selling or using this material outside your personal use in this course is considered to be an infringement of intellectual property rights.*

COURSE OBJECTIVES

This course is intended to give you an introduction to the underlying formulas and theory regarding interest and interest rates and how they are used in financial calculations. Specifically, by the end of this course you will be able to perform the following calculations and understand the principles behind them:

1. Accumulate and discount a single sum of money at either a simple or compound rate of interest or at a rate of discount
2. Determine an effective rate of interest, given a rate of interest that is compounded more than once a year allowing you to compare various investments
3. Solve equations of value and recognize the time value of money
4. Accumulate and discount a series of payments made at regular intervals of time
5. Determine the rate of return on an investment
6. Determine the length of time that is required to yield a given rate of return
7. Accumulate and discount a series of payments where payments are made at regular intervals of time that differ from how frequently interest is compounded
8. Accumulate and discount a series of payments where the payments vary
9. Determine loan payments
10. Determine the outstanding balance of a loan using the amortization and sinking fund methods
11. Deal with interest that is compounded continuously and payments that are made continuously
12. Using discounted cash flow analysis and calculating internal rates of return to assist in making business decisions
13. Determining the rate of return of a fund when deposits and withdrawals are made
14. Calculating the duration, modified duration and convexity of a series of cash flows and be able to use it to approximate the change in the value of an financial asset
15. Understanding the spot rate, forward rate and how to calculate the price of a stock using the dividend discount model
16. Understanding the terminology of cash flow matching and immunization

Your success in this course will depend on attending classes on a regular basis, writing all four tutorial tests and, like any math course, working on the exercises in the textbook.

Success in any math based course (like this one) depends on keeping up with the work and not falling behind. It will be very difficult to "cram" at the last minute to write the tutorial tests and to study for the mid-term and final exams.

Accommodation and Accessibility
Accommodation Policies
Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found at:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

Academic Consideration for Student Absence
Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student's final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student's final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are *not* met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

For policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf
and for the Student Medical Certificate (SMC), see:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Religious Accommodation
Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar:
https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Computer-marked multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

Professionalism & Privacy

Western students are expected to follow the Student Code of Conduct. Additionally, the following expectations and professional conduct apply to this course:

☒ Students are expected to follow online etiquette expectations provided on OWL

☒ All course materials created by the instructor(s) are copyrighted and cannot be sold/shared

☒ Recordings are not permitted (audio or video) without explicit permission

☒ Permitted recordings are not to be distributed

☒ Students will be expected to take an academic integrity pledge before some assessments

☒ All recorded sessions will remain within the course site or unlisted if streamed

Copyright Statement

Please be aware that all course materials created by the instructor(s) are copyrighted and cannot be **sold/shared**. Those include materials used in tests/quizzes, midterms, and finals. Any posting/sharing of such materials in part or whole without owner's consent is considered as violation of the Copyright Act and will be considered as a scholastic offence.

In addition, online services such as Chegg are actively monitored. Any questions that are coming out during midterms and finals and are posted to an online service will be searched. Such an activity will be considered as a scholastic offence and will result in academic penalty.

Support Services

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Student Accessibility Services (SAS) at 519-661-2147 if you have any questions regarding accommodations.

The policy on Accommodation for Students with Disabilities can be found here:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Learning-skills counsellors at the Student Development Centre (http://www.sdc.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https://www.uwo.ca/se/digital/.

What Do You Do if You Miss a Course Requirement Due to Illness or Special Circumstances?

If you are unable to meet a course requirement due to illness or other serious circumstances, you must seek approval for the absence as soon as possible. Approval can be granted either through a self-reporting of absence or via the Dean's Office/Academic Counselling unit of your Home Faculty. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in NCB 280, and can be contacted at scibmsac@uwo.ca.

For further information about absences, including the **self-reporting procedure** and requirements, please click on the following link (look at Section 3 on page 3):
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

You may also be eligible to write a Special Exam if you are in a "Multiple Exam Situation" (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

If you require academic accommodation due to illness, you should use the Student Medical Certificate when visiting an off-campus medical facility. The form can be found here:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

The website for Registrarial Services is http://www.registrar.uwo.ca.