

The University of Western Ontario  
 Department of Statistical and Actuarial Sciences  
**ACTUARIAL SCIENCE 2553A**  
*Mathematics of Finance -- 2017-18*

| Instructor    | Section         | Day/Time                          | Location          | email             | Office/Phone             |
|---------------|-----------------|-----------------------------------|-------------------|-------------------|--------------------------|
| Mr. S. Kopp   | 001<br>Tutorial | MWF – 9:30-10:30<br>M – 4:30-5:30 | NCB 113<br>WSC 55 | kopp@stats.uwo.ca | 284 WSC; 661-2111 x86288 |
| Office Hours: |                 |                                   |                   |                   |                          |

**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 any time if they lack the prerequisite or have taken an antirequisite course.**

**Textbook:**

“Financial Mathematics – Theory and Practice” by Robert Brown and Steve Kopp – \$94.85 at the UWO bookstore

**Approximate Course Outline**

**Chapter 1 – The Time Value of Money (2 weeks)**

- 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 (1 week)**

- 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 (1.5 weeks)**

- 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 (1.5 weeks)**

- Annuities payable more or less frequently than interest is compounded; perpetuities; continuous annuities; varying annuities

**Chapter 5 – Repayment of Debts (2 weeks)**

- Amortization schedules; determining the outstanding balance of a debt; sinking fund method of repaying a loan; refinancing a loan

**Chapter 6 – Bonds (1.5 weeks)**

- Bond prices on and between coupon dates; amortization of a bond, callable bonds

**Chapter 7 – Rates of Return (1 week)**

- Internal rate of return; net present value; dollar-weighted and time-weighted rates of interest; other securities

**Chapter 8 – Yield Curves (1 week)**

- Term structure of interest rates; spot rates; forward rates
- Determinants of Interest Rates and Interest Rate Swaps

**Chapter 9 – Asset-Liability Management (1 week)**

- Duration; convexity; immunization

### Assignments

There will be 3 assignments that are designed to give you an introduction to the **spreadsheet computer program of Excel**. They are due on the beginning of class on the following dates:

|   |                       |   |                        |
|---|-----------------------|---|------------------------|
| 1 | Wednesday, October 4  | 3 | Wednesday, November 29 |
| 2 | Wednesday, November 8 |   |                        |

**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
- **You will lose 20% for every day the assignment is late**
- Each assignment will contain a few computer Excel spreadsheet questions
- You will be given an account number to use the computers in room 256 WSC OR you can use your own computer at home and any spreadsheet you wish to use
- There will be study notes included with assignment 1 to help you get started on Excel.

**For assignments, you are required to submit your own independent work. You may collaborate with other students, but you must write your assignment in your own words. The TA's marking the assignments will be instructed to look for assignments that appear to be identical and if found, ALL will receive a mark of zero.**

### Tutorials

A tutorial hour has been set aside every Monday from 5:30 to 6:30 pm in room 55, Western Science Centre. Three of them will be used for tutorial quizzes (see below) and the rest will be used as a tutorial. There will be NO tutorial on September 12 or October 10.

### Tutorial Tests:

There will be 4 tutorial tests on the following dates:

|   |                      |   |                     |
|---|----------------------|---|---------------------|
| 1 | Monday, September 25 | 3 | Monday, November 13 |
| 2 | Monday, October 23   | 4 | Monday, December 4  |

- The tests will be 20-minute tests, consisting of some written answer questions based on material taught since last test. There will be TWO shifts of tests on these dates. Half the class will write from 5:30 to 5:50, after which they will leave the room. Then the second half of the class will come into the room and write from 5:55 to 6:15 pm.
- If you miss one test with a VALID reason, the weight of that test will be added to the final exam.

**Mid Term Exam** – 2-hour exam (part multiple choice/part written answer)

**Tuesday, October 31, 2017** – 6:00 pm to 8:00 pm

(Help session scheduled for Monday, October 30 tutorial 5:30 to 6:30)

### Missed Midterm

If you have any conflict, you must check with your instructor as soon as possible (and prior to the exam). The policy of the department of Statistical and Actuarial Sciences is that there will be **no make-up exams for missed midterms**. For those that do legitimately miss a midterm and provide the required supporting documentation, the standard practice will be that the weight of the midterm will be reassigned to the final exam (**more information about what to do if you miss some course requirements is given at the end of this outline**).

**Final Exam:**

The final exam will be scheduled for the Christmas 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.

**Evaluation:**

|             | <b>Marking Scheme</b> |
|-------------|-----------------------|
| Assignments | 5%                    |
| Quizzes     | 15%                   |
| Mid Term    | 30%                   |
| Final Exam  | 50%                   |

**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

**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 multiple choice exams for you to practice (available about two weeks before the midterm and final exam dates)
4. Solutions to the tutorial tests
5. Weekly updates and information about the course that you need to know

## **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 a 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 factors that determine interest rate levels
17. Understanding interest rate swaps (if time permits)
18. 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.

### **Note**

**This course is accredited under the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP) for the 2016-17 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/uap/information-for-students>**

### **Classroom Environment**

We have adopted a “Mutual Expectations” policy governing the classroom environment and all work submitted by students. [The full text of the policy can be found on the Statistical and Actuarial Science departmental web page, [www.stats.uwo.ca](http://www.stats.uwo.ca), by clicking on the “Undergraduate” section]. In summary, all interactions between students and faculty should be governed by the principles of **courtesy, respect and honesty**.

### **Attendance**

The department of Statistical and Actuarial Sciences views classroom attendance as a very important part of the learning process. You are expected to attend all classes. You are advised that excessive absenteeism may result in being debarred from the final examination.

### **Policy on e-mail communication**

You are welcome to communicate with your instructor by e-mail, but e-mail communication should only be used to provide them with information or to ask a question that requires a brief response. For more lengthy discussions and for discussions on lectures/course material please see your instructor during their scheduled office hours or by appointment. If you do e-mail them, please use your UWO account, as these are often the only emails read (as e-mails sent from other addresses often get spammed).

### **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 provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is your responsibility to make alternative arrangements with your instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see: <http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

**For tutorial test:** There are NO make ups to any of the tests, so if you miss one, the weight of the missed test will be assigned to the final exam. You need to have a valid reason for missing a tutorial test.

**For Midterm:** If you miss the midterm exam for a valid reason, you must go to your Faculty with proof as to why you missed the exam. There is no makeup exam. The weight of the missed exam will be moved to the final exam.

**For Final Exam:** If you miss an exam for a valid reason, you must go to your Faculty with proof as to why you missed the exam. A makeup exam date will be arranged for all students who missed the exam with a valid reason.

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: [https://studentservices.uwo.ca/secure/medical\\_document.pdf](https://studentservices.uwo.ca/secure/medical_document.pdf)

Or, request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services.

### **Support Services**

Learning-skills counsellors at the Student Development Centre 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: <http://www.sdc.uwo.ca>

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

Additional student-run support services are offered by the USC: <http://westernusc.ca/services>.

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

### **Accessibility**

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 Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.