

## **ACT240 – Mathematics of Investment and Credit**

Course website: <http://q.utoronto.ca>

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### **Course Description:**

Welcome to ACT240, your first actuarial science core course. In this course we will study the Theory of Interest, including discount and present values, determination of prices of annuities, mortgages, bonds and equities, loan amortization, yield rates on investments, etc.

To effectively understand the topics above, the lectures will center around four real-life “puzzles”: payday loan, stock pricing, many scenarios of a residential mortgage, and reading WSJ bond quotes.

Note: This course is for students working to enter actuarial science major or specialist program. For other students interested in similar course material, please enroll in ACT230 Math of Finance for non-actuarial students.

**Lectures:** Mondays, 11am-1pm. Delivered in Bb Collaborate on Quercus site. All lectures are recorded.

**Tutorials:** Fridays, 10-11am. Please note:

(1) I will assign your tutorial section and TA based on your last name. The assignment will be posted by the first week of the course.

(2) The first tutorial is on September 18<sup>th</sup>, and the last tutorial is on December 4<sup>th</sup>

(3) Four tutorials this term will be used for Term tests and Term test reviews (see weekly schedule below). It goes without saying that it is mandatory that you attend those four tutorials.

(3) There are additional seven other tutorials this term, which will be conducted on Bb Collaborate by your assigned TA. The attendance for those tutorials is not mandatory. TAs may go over some practice questions, and they will leave time for you to ask your questions. So you can view those tutorials as a semi-student-directed group office hour with your TA.

**Instructor Office Hour:** Mondays, 1-2 pm (immediately after the lecture times). Please note:

1- I will stay in the Bb Collaborate Course room for 1 hour after our lecture to host my office hour. I will turn off the recording before the office hour starts.

(1) If you have a question that is general in nature, I will answer the question in public;

(2) if you have a private question, please send me a private chat in Bb Collaborate and depending on your situation, I may either send you private chats in response, or create a breakout room for us to have a private audio/video chat. Please be patient and considerate (just as during an in-person office hour), as there may be students

in queue before you.

2- If you cannot make it to the office hour immediately after our lectures but would like to contact me, please email me first.

**TA office hour:** Schedules will be posted on Quercus.

**Textbook:**

The main textbook is the digital version of Broverman course book for ACT240+ACT245. We have made that available for online purchase through the UofT bookstore website. Please click the following link to directly purchase your coursebook: [https://www.campusebookstore.com/integration/AccessCodes/default.aspx?bookseller\\_id=96&Course=STG+ACT240%2f+ACT245+COURSEBOOK&frame=YES&t=permalink](https://www.campusebookstore.com/integration/AccessCodes/default.aspx?bookseller_id=96&Course=STG+ACT240%2f+ACT245+COURSEBOOK&frame=YES&t=permalink)

Note: It is my pedagogical objective to link the course material to the real world as much as possible. Therefore, you should pay close attention to the lecture notes as some of the real-world references are not necessarily presented in the textbook.

**Calculator:**

You need a non-programmable calculator, preferably one of the following SOA-approved calculators (you will likely need it for SOA exams!): battery or solar-powered Texas Instruments BA-35 model calculator, the BA II Plus, the BA II Plus Professional, the TI-30Xa or TI-30X II (IIS solar or IIB battery), or TI-30X MultiView (XS Solar or XB Battery).

**Marking Scheme:**

You will require a reliable internet connection to complete the weekly quizzes, term tests and final test. All quizzes and tests will be held using Quizzes tool on Quercus.

1- 5% Excel Project

2- 10% Ten weekly post-lecture short quizzes (about 10 minutes each) starting from Week 2 (week of September 21) and ends in the week of December 7. There will be a practice quiz in Week 1 which counts for 0% but helps you to get familiar with the Quizzes function in Quercus.

Please note:

(1) The quiz questions will be very similar to examples in the lecture. Those are very low-stake formative assessments to make sure you are paying attention to the lecture. Numerous researches have shown frequent low-stake assessment is crucial to help students stay on track with their studies and achieve success for the course.

(2) The weekly quiz will become available on Quercus from 3pm on the lecture day, and I will leave the quiz window open for 48 hours (i.e. from 3pm on Monday to 3pm on Wednesday). This means:

- If you are attending the synchronous lectures (highly recommended!), you should attempt the quiz shortly after the lecture.

- If you have to miss a live lecture, you need to view the lecture recording and complete the quiz within 50 hours after that week's lecture time (by 3pm Wednesday). But please do not leave it to the last minute, as there is NO makeup for quizzes!

(3) Once you have started the quiz, you only have a limited time to complete it (about 10 minutes – you will see the exact time limit clearly on the quiz page).

(4) At the end of the semester, I will drop the lowest grade of your 10 quizzes and apply a factor of 10/9 to the sum of your highest 9 quiz marks.

3- 25% Term Test 1

4- 25% Term Test 2

5- 35% Final Test

**Bonus points opportunities:**

1. Up to 3% - Live seminar attendance and active participation during in-class Q&A using Poll Everywhere (I will tally participations from the whole class at course end and the top 90<sup>th</sup> percentile and above will receive 3% bonus points, 70<sup>th</sup> to 89<sup>th</sup> percentile will receive 2%, and 50<sup>th</sup> to 69<sup>th</sup> percentile will receive 1%).
2. Creative thinking/artmaking (up to 2%): Research shows that learning is most effective when students resort to both their cognitive and emotional faculties. To that end, you are welcome (but **NOT** required) to use artistic means to convey a topic you have learned in this course. Examples include drawing/painting, song/music, concept map, video, 3D model, poem, even a performance/dance. A brief artistic statement should accompany the artwork, describing how the work connects with the course content. I will also post a more detailed guideline on Quercus as well as links to creative samples from similar courses.

**To celebrate great work**, there will also be a possibility of creating an e-zine (published online) for the best creative work and reflections from this course.

**Estimated Weekly Schedule of Topics:**

**Lecture 1 - September 14:**

- Welcome and introduction
- The five “puzzles” we will solve in this course
- Poll Everywhere test-run
- **Puzzle #1 What was Jon Oliver ranting about when it came to payday loan?**
  - o Introducing simple and compound interest, present value, effective rate of interest (Section 1)

**First Tutorial - September 18**

**Lecture 2 - September 21:**

- Rate of discount (Section 1)
- Nominal rate of interest and normal rate of discount (Section 2)

**Lecture 3 - September 28:**

- Taking it to the limit: Force of interest (Section 3)

**Lecture 4 – October 5:**

- Inflation, tax and risk of default

- **Puzzle #2: How are stocks priced?**
  - o Introducing present value of cash flow patterns known as “perpetuity” and “annuity”. (Section 4)
- Annuity Immediate and Annuity Due

**October 12: Thanksgiving, no class**

**Tutorial October 16 – Term test 1 (1 hour, 10-11am)**

**Lecture 5 - October 19:**

- “Equating” two cashflows (Section 4)
- More “annuity” valuation (interest rate change, etc.) (Section 5)

**Tutorial October 23 – Term test 1 review**

**Lecture 6 - October 26:**

- More “annuity” valuation - Annuity with different interest and payment period (Section 6)
- More “annuity” valuation - Annuities following a geometric progression (Section 7)

**Lecture 7 – November 2:**

- More “annuity” valuation - Annuities following an arithmetic progression (Section 8)

**November 9: Fall break, no class. Last day to drop class.**

**No Tutorial on November 13 (Fall break).**

**Lecture 8 - November 16:**

- **Puzzle #3: What do all the numbers on a mortgage statement mean?**
  - o Introducing amortization of a loan (Section 9)

**Tutorial November 20 – Term Test 2 (1 hour, 10-11am).**

**Excel homework will become available from Friday November 20, 11am and it is due by next Friday (November 27).** Please see Quercus for details.

**Lecture 9 - November 23:**

- **Puzzle #4: How to read Wall Street Journal bond quotes page?**
  - o Introducing bond valuation (Section 10)

**Tutorial November 27 – Term Test 2 Review with TA**

**Lecture 10 - November 30:**

- Bond amortization (Section 11)
- Callable bonds (Section 11)
- How do you read actual quotes on WSJ? – clean and dirty price (Section 10)

### **Lecture 11 - December 7:**

- Measurements of the Rate of Return on a Fund (Section 12)
- Final course review in preparation for final test

### **December 11 - NO tutorial in the last week**

**Final Test – Date TBA.** Faculty of Arts and Science Registrar’s office will schedule this test during the Final Assessment Period. The date/time will be announced on Quercus once it is available.

### **Missed Assignments or Tests**

- Late submission for Excel homework is not accepted.
- There are no makeup post-lecture quizzes, or makeup in-class bonus questions.
- If you miss a term test for a valid reason (e.g. sickness), you need to email me **by the day immediately after the term test at the latest**. Your missed term test weight will be shifted to the final exam (i.e. if you missed a 25% term test, your final exam will be worth 60%). This “shifting” may be done after comparing and adjusting the class average of the missed test and final exam to ensure fairness to all students. You will be informed of that adjustment should it happen. You can only do this shifting once (i.e. not for both term tests). Please note false claim of sickness or personal emergency is an offence under the Code of Behaviour on Academic Matters.
- You must write at least one term test to pass the course.

### **Academic Integrity**

Academic integrity is fundamental to learning and scholarship at the University of Toronto. All assessments in this course are “open-book” in nature (i.e. you can consult your coursebook and your lecture notes). However, all work must be done by yourself, without help from others. Receiving help from anyone on an assessment, whether they are another student in the course or someone external to the course, is a serious academic offence. Providing help to another student in the course on an assessment is an equally serious academic offence. Posting or distributing questions from assessments is not permitted at any time.

Please further familiarize yourself with the University of Toronto’s Code of Behaviour on Academic Matters available at <http://academicintegrity.utoronto.ca>.

### **Canadian Institute of Actuaries (CIA)’s University Accreditation Program (UAP)**

ACT240 is an accredited course under the UAP program. The minimum grade needed to apply for an exemption is 70. For detailed information on UAP, please visit the following webpages:

- University Accreditation Program description (<https://www.cia-ica.ca/membership/university-accreditation-program---home>)
- List of accredited courses offered by University of Toronto: <https://www.cia-ica.ca/membership/university-accreditation-program---home/accredited/toronto>

- How to apply for CIA exemption credits: <https://www.cia-ica.ca/membership/university-accreditation-program---home/information-for-candidates>

Note: The CIA will grant credits to students for SOA/CAS examinations based on the achievement of the minimum Grade towards Associateship (ACIA) and Fellowship (FCIA) in the CIA. At the time of this agreement, CIA credits are recognized by the following actuarial organizations towards their respective designations:

Casualty Actuarial Society (CAS): ACAS, FCAS  
UK Institute and Faculty of Actuaries (IFoA): FIA, AIA  
Institute of Actuaries of Australia (IAA): AIAA, FIAA  
Actuarial Society of South Africa (ASSA): AMASSA, FASSA  
American Academy of Actuaries (AAA): MAAA

The CIA does not guarantee that credits granted to students under the CIA UAP will be recognized by any other actuarial organizations towards their actuarial designations.