

**ACT230 – Math of Finance**  
**Fall Term, 2013**

**Important Note:**

This course is NOT for students who wish to pursue an actuarial science major or specialist program. If that is what you aspire to do, please enrol in *ACT240 – Fundamentals of Investment and Credit* instead. The prerequisite for ACT240 is MAT137Y (minimum grade 65%) or MAT157Y.

**Vital Statistics:**

Instructor: Vicki J. Zhang, FSA, MAAA, ACIA, MStat  
Lectures: Tuesdays, 7-9pm  
Lecture location: Koffler House 108 (569 Spadina Crescent)  
Tutorials: Tuesdays, 6-7pm  
Tutorial Location: TBA  
Office: 6<sup>th</sup> floor, SS Room TBA  
Office Hour: Mondays, 2-4pm  
Blackboard: <http://portal.utoronto.ca>  
Email: vickijing.zhang@utoronto.ca

**Evaluation:**

5% class participation (including class discussions, survey participations, but excluding course/instructor evaluation)  
15% assignments (choose two out of five assignments) or independent research  
25% 1-hour mid-term exam  
55% final exam

**Notes on assignments:**

**Option 1:**

There will be five case study assignments throughout the semester. You can choose two to be submitted and included in your course evaluation (each worth 7.5%):

- ← 1- Fractional Insurance Premium
- ← 2- Index Annuity tracking S&P500
- ← 3- Variable Annuity(VA) with Guaranteed Life Withdraw Benefits (GLWB)
- ← 4- What is VA Guaranteed Life Income Benefits (GLIB) Guarantee worth?
- ← 5- Shall I prepay my mortgage?
- ←
- I will provide ample background in the assignment documents and will ensure the assignments only use the level of materials we have covered up to the time of the assignment in this course.
- Each of the five questions has a “hard” (technical) part and a “soft” part involving understanding and communicating the implications of the assignment.
- You will first complete the technical part on an Excel spreadsheet I will provide. You are then required to write notes at the end of your spreadsheet to communicate your reflections on the assignment (not on the technical details, but bigger-picture

implications). These notes should be concise but you should strive to use the best sentences you can come up with to express your thoughts.

- I will either recap the technical part of the assignment at the beginning of each class or have TAs do the recap in your tutorials. Time permitting, we will have 5-10 minutes of class discussion on the larger implication of the cases at the beginning of the lectures.
- Materials covered in the assignments are not directly tested in mid-term or final exams.

### **Option 2:**

- Instead of choosing from the five assignments that I will provide, you can also research your own case.
- The case study will have to be related to an insurance product that is in the following categories: life insurance products, annuity products, Long-term care products, disability insurance. The products will have to be available in the market between now and five years ago – it doesn't mean the policy has to be purchased recently; it can be purchased a long time ago as long as it is still available in the market now or until recently
- Ideally, you should have access to either the actual policy or detailed policy illustrations (e.g. ask your parents or their friends whether they own any of these products, or any insurance agents/brokers who can provide detailed policy “illustrations”). Just like the five case studies I will present in this course, I want you to read the fine prints or illustrations and think about whether the policies have been presenting anything that would be confusing and challenging to analyze for the regular consumers.
- I will also accept your research if it is based on secondary source materials as long as there are concrete numerical examples based on real products (that you can demonstrate on a spreadsheet). Please include your sources in your submission.
- You will need to present a numerical calculation in an excel spreadsheet and write notes to explain what the problems are with the product. Follow the examples of the five assignments I give you when you approach your personal case. You are allowed to present cases that are conceptually similar to my examples as long as they are actual policies.
- **Your personal research is worth up to 15% of course valuation - so you do not need to work on the assignments I provide. You are allowed to hand in this independent research by December 1st.**
- One word of caution: it has been proved to be very challenging to acquire detailed insurance policy information from the public domain. So you should make a decision early on in the semester if you have enough information to pursue Option 2. By the time of the 4<sup>th</sup> assignment, you have the last chance to switch to Option 1 if you cannot obtain information for Option 2.

No matter which assignment option you choose, you need to hand in your work by the due dates specified in this syllabus (see the schedule below). As the assignments are recapped in class, late submission will not be accepted or graded.

### **Texts and Reference:**

The main textbook we will use for this course is Broverman's Study Guide for SOA EXAM FM/ CAS EXAM2. The Actuarial Club has made cheaper version of this study guide available (after acquiring permission from Prof. Broverman). I will arrange for them to make an appearance in the first two lectures so you can purchase the study guide from them.

I have also asked the library to put the following SOA official textbook for FM on the course reserve: Mathematics of Investment and Credit (S. Broverman). This book can be used as a reference for the course. You are, however, not required to purchase this book.

### **Schedule of Topics:**

#### **Lecture 1 - September 10: Course Introduction and Math Review**

- Overview of the course, including the pedagogical and intellectual goals
- The use of Excel in this course
- Review of math concepts to be used in the course
- Simple and compound interest, Present value of cashflow

#### **Lecture 2- September 17:**

- Present Value of cashflow (continued)
- Nominal rates of interest

#### **Lecture 3- September 24:**

- Force of interest
- A tale of inflation in Western countries
- Introduction to annuity immediate

#### **Lecture 4- October 1:**

- Annuity Immediate and Annuity Due
- Assignment #1: Cost of Fractional Premium (**Due date: October 7**)

#### **Lecture 5- October 8:**

- Recap Assignment #1
- Annuity valuation
- Reconcile interest accumulation and payment period
- Assignment #2: Indexed annuity tracking S&P500 (**Due date: October 15 5pm**)

#### **Lecture 6- October 15**

- Recap Assignment #2
- Continuous annuity
- Annuity products in the market
- Valuation of annuities following a geometric progression
- Increasing and decreasing annuities

#### **Mid-term - October 22 (in tutorial hour)**

- Covers everything up to and including annuities following a geometric progression
- Excludes increasing the decreasing annuities

**Lecture 7- October 22:**

- Increasing and decreasing annuities (continued)
- Assignment #3: Guarantee in VA products with GLIB rider **(Due date: October 28)**

**Lecture 8- October 29:**

- Recap Assignment #3
- Amortization of a loan

**Nov 4: (last day to drop class)**

**Lecture 9- November 5:**

- Sinking fund method of loan repayment
- Assignment #4: Variable Annuity(VA) with Guaranteed Life Withdraw Benefits (GLWB) **(Due date: November 15)**

**November 12: Fall break, no class**

**Lecture 10- November 19:**

- Recap Assignment #4
- Bond valuation
- Assignment #5 Shall I prepay mortgage? **(Due date: November 25)**

**Lecture 11- November 26:**

- Recap Assignment #5
- Bond Amortization and callable bonds
- Green Bond (tentative)

**Lecture 12- December 3:**

- Recap key concepts and formula for the final exam

**Final Exam – Date TBA**

- Covers all the materials we covered in the course (including materials before mid-term)
- Context-specific materials in course assignments are not tested

**Missed Assignments or Exams**

- If you miss exams due to medical, family or other reasons, you have to provide documentation to me. The acceptable types of medical documentations are: UofT Verification of Illness or Injury Form, Student Health or Disability Related Certificate, A College Registrar's Letter, or Accessibility Services Letter. The Faculty of Arts and Science require the student who misses an exam to come forward to the course instructor no later than one week of the exam.
- There is no make-up assignment
- There will be **one** make-up mid-term test (Date is TBA).
- There will be **one** make-up final test arranged by Faculty of Arts and Science directly.