MATH 2511 Fundamentals of Actuarial Mathematics
Course outline – 2023-2024 Fall

1. Instructor (s)
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2. Teaching Assistant (s)
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3. Meeting Time and Venue – Lectures, Tutorials/ Laboratory
   Lecture: Monday and Wednesday, 10:30-11:50 Room 4619
   Tutorial: Start from week 2
       Wednesday 6:00 p.m.-6:50 p.m., Room 6602
       Thursday 12:00 p.m.-12:50 p.m. LSK1032

4. Course Description :

   Credit Points: 3

   Prerequisite: A good knowledge in single variable calculus (equivalent to MATH 1003 OR MATH 1014 OR MATH 1020 OR MATH 1024).

   Brief Information/synopsis

   This course covers the fundamental concepts of actuarial financial mathematics and how these concepts be applied in calculating present and future values for various streams of cash flows. It is of three credits. Topics covered include interest rates, present value and future value, annuities, loan repayment, bond value, bond and portfolio yield, rate of return, yield curve, term structure of interest rates, duration and convexity of general cash flows and portfolio, immunization, stock valuation, capital budgeting, dynamic cash flow processes, and asset and liability management. The course syllabus is same as part 1 (Interest theory) of Financial Mathematics Exam (dated Dec 2023) offered by Society of Actuary (SOA). For detail, please visit https://www.soa.org/education/exam-req/edu-exam-fm-detail.aspx

5. Intended Learning Outcomes

   Upon successful completion of this course, you should be able to

   1. Explain fundamentals of interest rates, time value of money and annuity.
   2. Compute the return rate of a given investment.
   3. Compare the merits of various investment options
   4. Construct loan amortization tables
   5. Analyze the value of a bond given its price, contract interest rate and maturity date.
   6. Develop problem solving skill which is essential in studying advanced courses in Actuarial Science.

6. Assessment Scheme

Assessment	Assessing Course ILOs
Assignments (25%)	2,3,4,5
Mid-term Exam (25%)	1, 2, 3, 4, 5, 6
Final Exam (50%)	1, 2, 3, 4, 5, 6

The Mid-term exam is planned in Week 7 during lecture time, and its scope is all the contents before or in Week 6. The exam will of 80 min with a A4 cheat sheet allowed.

The time and place for the final exam will be announced later, and all materials in the whole course are in the scope. It is planned to be of three hours with a A4 sized cheat sheet.

7. Student Learning Resources
   I will upload lecture notes on Canvas, and in tutorial, extra exercises will be covered for better understanding.

References:

1. Marcel B. Finan, "A basic course in the theory of interest and derivatives markets: A preparation for the Actuarial Exam FM/2"
2. Vaaler, L.J.F., Daniel, J.W., 2019, "Mathematical Interest Theory," third edition, The mathematical association of America.
3. Broverman, S.A., 2017, "Mathematics of Investment and Credit," seventh edition, ACTEX.
4. Chan, W.S., Tse, Y.K., 2022, "Financial Mathematics for Actuaries," third edition, World Scientific Publishing.

(*Last three references are recommended textbooks for financial mathematics (FM) examination of SOA)

8. Teaching and Learning Activities

Lecture notes will focus on introducing and explaining the notions of terminologies, and also provide cover some examples for better understanding.

Tutorial will provide more exercises for better comprehension.

9. Course Schedule

Chapter 1: Basic interest theory (2 weeks)

- Accumulation function and interest rate
- Simple interest and compounded interest
- Effective interest rate and its application
- Present value and discount rate
- Inflation and real rate of interest

Chapter 2: **Basic annuity theory (2 weeks)**

- Valuation of annuity with level payments: Present value and future value
- Extension of annuity theory: Annuity with non-level payment, Valuation under varying interest rate.
- Annuity with continuous payment
- Applications of annuity theory

Chapter 3: **Loan repayment (2 weeks)**

- Basic concepts and theories of loan repayment
- Amortized loans with level repayment
- Sinking fund method
- Additional topics about loan repayment: Floating rate loan, refinancing.

Chapter 4: **Bonds and its pricing theory** (**2 weeks**)

- Bonds and bond pricing using yield rates
- Accrued interest, dirty price and clean price
- Book value and amortization schedule of bonds.
- Callable bonds

Chapter 5: **Measuring rate of return of an investment (2 weeks)**

- Return rate and cost of capital
- Measuring profitability of an investment: Net present value and Internal rate of return
- Dollar-weighted rate of return and Time-weighted rate of return

Chapter 6: **Term structure of interest rates and interest rate sensitivity (2 weeks)**

- Definition of term structure of interest rate
- Bond pricing using term structure of interest rate
- Forward rate agreement and forward rate
- Duration and convexity of bonds