

Actuarial Science 325

Theory of Interest/Mathematics of Finance

(see Course Descriptions for the applicable academic year: <http://www.ucalgary.ca/pubs/calendar/>)

Syllabus:

This course covers topics in financial mathematics for Society of Actuaries (SOA) Exam FM. These topics include (but are not restricted to):

- Simple and compound interest
- Force of interest
- Annuities
- Spot rates, forward rates and term structure
- Rate of return
- Loans and cost of borrowing
- Bonds and bond pricing and bond yields
- Durations and convexities
- Immunization and dedication

Instructors may choose to adopt any one (or more) of the following texts (or any other text recommended by the Society of Actuaries, or that gives ample coverage of the Exam FM learning objectives):

Option 1: Kellison, S.G., *The Theory of Interest* (Third Edition), 2009, Irwin/McGraw-Hill:

Chapter 1
Chapter 2
Chapter 3 (excluding 3.9)
Chapter 4
Chapter 5 (excluding 5.4, 5.7, and 5.8)
Chapter 6 (excluding 6.8, 6.9, and 6.11)
Chapter 7 (excluding the investment year portion of 7.7 through 7.10)
Chapter 9 (9.4)
Chapter 10 (excluding 10.6 and 10.7)
Chapter 11 (excluding 11.4 and 11.9)

Option 2: Broverman, S.A., *Mathematics of Investment and Credit* (Seventh Edition), 2017, ACTEX Publications:

Chapter 1 (excluding 1.2.1 and 1.8)
Chapter 2 (excluding 2.4.2, 2.4.3 and 2.4.5)
Chapter 3 (excluding 3.2.1, 3.2.2, 3.3, and 3.4)
Chapter 4
Chapter 5 (excluding the investment year method portion of 5.3.1, and excluding all of 5.3.2, 5.3.3 and 5.3.4)
Chapter 6 (excluding 6.2 and 6.4)
Chapter 7 (excluding 7.1.3, 7.1.6 and 7.3)
Chapter 9 (9.1 only)

Option 3: Daniel, J.W., and Vaaler, L.J.F., *Mathematical Interest Theory (Second Edition)*, 2009,

Chapter 1 (excluding 1.13)

Chapter 2

Chapter 3 (excluding 3.10, 3.12, and the investment year method portion of 3.13)

Chapter 4

Chapter 5 (excluding 5.3)

Chapter 6 (excluding example 6.8.1 and section 6.10)

Chapter 7 (excluding 7.2, 7.3, and 7.4)

Chapter 8 (8.3)

Chapter 9 (excluding 9.5)

The following additional readings will also be discussed in class, and are required readings:

- SOA Study Note FM-24-17 Using Duration and Convexity to Approximate Change in Present Value (Sections 1-4).
- SOA Study Note FM-25-17 Interest Rate Swaps.
- SOA Study Note FM-26-17 Determinants of Interest Rates.

Note, the topic of Interest Rate Swaps is studied in more detail in ACSC 515.

Course Outcomes for Actuarial Science 325 (Theory of Interest) include:

1. By the end of the course, students will be expected to be able to define and recognize the definitions of the following terms: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value.
2. By the end of the course, students will be expected to be able to write and solve time value of money equations.
3. By the end of the course, students will be expected to be able to define and recognize the definitions of the following terms: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity.
4. By the end of the course, and given sufficient information of immediate or due, present value, future value, current value, interest rate/yield rate, payment amount, and term of annuity, students will be expected to be able to calculate any remaining item.
5. By the end of the course, students will be expected to be able to define and recognize the definitions of the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization, sinking fund.
6. By the end of the course, given sufficient information of loan amount, payment stream, interest rates, etc., students will be expected to be able to calculate the outstanding balance at any point in time, the amount of principal and interest in a given payment, and complete an amortization and / or sinking fund schedule.
7. By the end of the course, students will be expected to be able to define and recognize the definitions of the following terms: price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond.
8. By the end of the course, and given sufficient information of price, book value, redemption value, face value, yield rate, coupon amount, coupon rate, and term of bond, students will be expected to be able to calculate any remaining item.
9. By the end of the course, students will be expected to be able to define, recognize, and (where appropriate) calculate the following: yield rate/rate of return, dollar-weighted rate of return, time-weighted rate of return, current value, duration (Macaulay and modified), convexity (Macaulay and modified), immunization, portfolio, spot rate, forward rate, yield curve.

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