ASC301: Financial Mathematics
Section A
Spring 2017
2:00 - 3:50 pm TR
Main 113

Instructor: John Symms
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Email: jsymms@carrollu.edu
Office Hours: 9:00-9:50 am and 4:00-4:50 pm TR, or by appointment
Calculator: Any SOA approved calculator (at minimum get a Texas Instruments BA II Plus).
Prerequisite: MAT161, or Concurrently in MAT161

Course Overview
The goal of course is to provide a development of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows.

We’ll be using an older study manual, but we’ll adhere to the new SOA Summer 2017 syllabus. In terms of the study manual, we will use only Volume I during the semester.

Course Objective
This course will introduce students to the required topics in financial mathematics needed to pass Exam FM.

Learning Outcomes
1. By the end of this course, students should be able to:

1. Time Value of Money (10-15%)

   (a) 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.

      i. Given any three of interest rate, period of time, present value, current value, and future value, calculate the remaining item using simple or compound interest. Solve time value of money equations involving variable force of interest.

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1 These are direct from a draft of the new June 2017 FM syllabus.
2 The ranges of weights “apply to the large majority of exams administered. On occasion, the weights of topics on an individual exam may fall outside the published range. Candidates should also recognize that some questions may cover multiple learning objectives.”
ii. Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate any of the other items.

iii. Write the equation of value given a set of cash flows and an interest rate.

2. Annuities/cash flows with payments that are not contingent (15-20%)

(a) 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.

(b) For each of the following types of annuity/cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate, payment amount, and term of annuity, the candidate will be able to calculate any remaining item.

i. Level annuity, finite term

ii. Level perpetuity

iii. Non-level annuities/cash flows

A. Arithmetic progression, finite term
B. Arithmetic progression, perpetuity
C. Geometric progression, finite term
D. Geometric progression, perpetuity
E. Other non-level annuities/cash flows

3. Loans (15-20%)

(a) 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.

i. Given any four of term of loan, interest rate, payment amount, payment period, principal, calculate the remaining item.

ii. Calculate the outstanding balance at any point in time.

iii. Calculate the amount of interest and principal repayment in a given payment.

iv. Given the quantities, except one, in a sinking fund arrangement calculate the missing quantity.

v. Perform similar calculations to the prior when refinancing is involved.

4. Bonds (15-20%)

(a) 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, callable/non-callable.

(b) Given sufficient partial information about the items listed below, calculate any of the remaining items.

i. Price, book value, amortization of premium, accumulation of discount

ii. Redemption value, face value

iii. Yield rate
iv. Coupon, Coupon rate
v. Term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount

5. General Cash Flows and Portfolios (10-15%)

(a) Define and recognize the definitions of the following terms: 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), portfolio, spot rate, forward rate, yield curve, stock price, stock dividend.

i. Calculate the dollar-weighted and time-weighted rate of return.
ii. Calculate the duration and convexity of a set of cash flows.
iii. Calculate either Macaulay or modified duration given the other.
iv. Use duration to approximate the change in present value due to a change in interest rate.
   A. Use a 1st-order linear approximation based on modified duration.
   B. Use a 1st-order approximation based on Macaulay duration.
v. Calculate the price of a stock using the dividend discount model.

6. Immunization (10-15%)

(a) Define and recognize the definitions of the following terms: cash flow matching, immunization (including full immunization), Redington immunization.

i. Construct an investment portfolio to fully immunize a set of liability cash flows.
ii. Construct an investment portfolio to match present value and duration of a set of liability cash flows.
iii. Construct an investment portfolio to exactly match a set of liability cash flows.

7. Interest Rate Swaps (0-10%)

(a) Define and recognize the definitions of the following terms: swap rate, swap term or swap tenor, notional amount, market value of a swap, settlement dates, settlement period, counterparties, deferred swap, amortizing swap, accreting swap, interest rate swap net payments.

i. Calculate the swap rate in an interest rate swap, deferred or otherwise, and with either constant or varying notional amount.
ii. Calculate the market value of an interest rate swap, deferred or otherwise, and with either constant or varying notional amount.

8. Determinants of Interest Rates (0-10%)

(a) Define and recognize the components of interest rates including: real risk-free rate, inflation rate, default risk premium, liquidity premium, and maturity risk premium.
(b) Explain how the components of interest rates apply in various contexts, such as commercial loans, mortgages, credit cards, bonds, government securities.
(c) Explain the roles of the Federal Reserve and the FOMC in carrying out fiscal policy and monetary policy and the tools used by the Federal Reserve and the FOMC including targeting the Federal Funds rate, setting reserve requirements, and setting the discount rate.
(d) Explain the theories of why interest rates differ by term, including liquidity preference (opportunity cost), expectations, preferred habitat, and market segmentation.

(e) Explain how interest rates differ from one country to another (e.g., U.S. vs. Canada).

Assessment will be conducted via worked Daily Problems, journals, and exams.

**Attendance**
Students are expected to attend all classes. Classes will frequently involve activities that will impact your overall grade.

**Weekly Effort - Professional Exam Preparation**
As you probably know, the rule-of-thumb in this industry is that for each hour of an exam, one should study 100 hours. Exam FM is a three hour exam. Studying means trying to understand content in the study manual, working practice problems or trying to figure them out, deconstructing provided solutions to ferret out errors and improve understanding, and exam simulations.

Thus, I expect you to study for this course alone on average at least 8 hours per week outside of class. Most of you should plan on taking the exam in June 2016. A good goal is to pass FM before taking ASC302 (or studying for Exam P), i.e., do not plan to study for two exams at the same time.

For purposes of giving a grade for “weekly effort,” a “week” will be defined as the time spanning from the end of a class meeting on a Tuesday to the beginning of the following Tuesday meeting. Each week keep track of your daily study hours using the “StudyHours” Excel file (available on the portal). Upload your updated Excel file before each Tuesday class meeting.

In your preparation for the exam, you should use only an approved calculator, as knowing how to use such a calculator efficiently and accurately is a key to passing. For Exam FM, the best of the approved calculators is the Texas Instruments BA-II Plus. Resistance is futile, get one.

**Homework Journal**
You will do lots of practice problems. Get a notebook (which we will call your “journal”) to record your work. Bring it to class each week. I will use the notebook weekly to gauge work completed. You can work in groups, if you find working in groups useful, but avoid parasite-host relationships.

**Daily Problems**
On most days you will be given one or two “Daily Problem(s)” to hand in at the start of the next class. These problems will be graded on the following scale: 4 = essentially flawless; 3 = minor errors, but no major errors; 2 = one major error; 1 = at least two major errors; 0 = no attempt or your solution is unintelligible. Late Daily Problems will not be accepted.

**Exams**
Exams will measure both your conceptual understanding of the material and your problem solving skills. There will be three 2-hour comprehensive exams each consisting of 24 multiple choice questions. You may use an SOA approved calculator and approved formula sheets for these exams. No other notes, books, or calculators will be allowed during exams. I expect to give the first two 2-hour exams on February 23 and April 6. The last will be given at 2:00 pm on Tuesday, May 3.

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3Generally, a serious effort at passing in June will require 12 to 16 hours per week.
9. If you miss an exam, acceptable written documentation for the absence must be supplied to be eligible for a make-up.

Exams will simulate an actual professional exam, i.e., problems will be multiple choice with five possible answers for each. There will be no penalty for wrong answers. A good rule-of-thumb for passing a professional exam is to get 70% or higher on the problems, so exams will be graded as follows: 70% or higher = 100 points; less than 70% but at least 60% = 80 points; less than 60% but at least 50% = 70 points; less than 50% but at least 40% = 60 points; less than 40% = Actual Score.

**Academic Honesty**

All work on assignments, quizzes and tests is expected to be your own and represent your ability in course content. The Carroll University Academic Integrity Policy is located in your student handbook. Please familiarize yourself with this policy. If a student violates this policy in any way, the instructor or College reserves the right to impose a sanction of failure on the assignments/assessment or failure in the course.

**Grades**

The grading scheme is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
<th>Percent Interval</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>Weekly Effort</td>
<td>15%</td>
<td>[92, 100)</td>
<td>A</td>
</tr>
<tr>
<td>Homework Journal</td>
<td>15%</td>
<td>[88, 92)</td>
<td>AB</td>
</tr>
<tr>
<td>Daily Problems</td>
<td>20%</td>
<td>[82, 88)</td>
<td>B</td>
</tr>
<tr>
<td>Exam I</td>
<td>15%</td>
<td>[78, 82)</td>
<td>BC</td>
</tr>
<tr>
<td>Exam II</td>
<td>15%</td>
<td>[68, 78)</td>
<td>C</td>
</tr>
<tr>
<td>Exam III</td>
<td>20%</td>
<td>[58, 68)</td>
<td>D</td>
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<tr>
<td>Total</td>
<td>100%</td>
<td>(0, 58)</td>
<td>F</td>
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**Final day to drop:** Wednesday, April 5.

**Carroll Portal (LMS)**

This course will use the Carroll Portal for various purposes, including for your grades. Keep track of your grades, and notify the instructor should you spot an error.

**Final Notes**

1. Special accommodations for this course may be granted via direct orders from the Walter Young Center (WYC). It is your responsibility to notify the WYC of your special needs. (They will require certain forms of verifiable documentation or diagnoses.) Such accommodations will be made only after the instructor has received notification from the WYC, and will not be given retroactively for previous assignments or exams.

2. The instructor and the College reserve the right to modify, amend, or change the syllabus (course requirements, grading policy, etc.) as the curriculum and/or program require(s).