

ACSI 301: Theory of Interest

2022

Mathematical Interest Theory 3rd edition, Vaaler, Harper, and Daniel, Chapters 1-9

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Course Description: An introduction to the mathematical theory of interest. Topics include money growth, investment return, annuities, arbitrage, interest rate sensitivity, and immunization.

Course Objectives: *Learn mathematics used in the actuary profession.* One of the first two tests in the actuary field is Exam FM: Financial Mathematics. This tests your knowledge of the basic ways that money is invested, and the ways that investments are evaluated. ACSI 301 prepares you for this test, while covering the basics of financial mathematics including time value of money, annuities, loans, bonds, portfolios, options, and immunizations. (Note: if you're planning to pass Exam FM, you will need to do a lot of extra studying)

Intended Learning Outcomes: At the end of the course, successful students will be able to

- Apply concepts of financial mathematics to calculating present and accumulated values
- Demonstrate proficiency in pricing, asset/liability management, and capital budgeting
- Synthesize partial financial information into a complete financial analysis
- Demonstrate the use of no-arbitrage concepts in financial mathematics
- Demonstrate proficiency of each of the learning objectives at the Society of Actuaries FM webpage

Required Reading:

Mathematical Interest Theory, Vaaler and Daniel

Equipment: A Texas Instruments BA II Plus calculator or equivalent is highly recommended. The BA II Plus is recommended by the Society of Actuaries for the FM exam.

Attendance Policy: Regular attendance is expected. You must keep up with definitions! You are responsible for everything done in class. If you miss a class, e-mail or call me before class is over and explain why. **If you have two unexplained absences, you will be dropped from the course after a warning email is sent.**

I expect you to spend at least 12 hours of work each week inside and outside of class. You should expect to spend more time on material that is difficult for you.

Academic Integrity: The college policy is fully supported. Tests and are closed notes, closed book. Homework assignments will be discussed in class, and you may always ask me for help. **Do not** collaborate on homework. No electronic devices are allowed in a test situation.

Co-Curricular: During the course of the semester, you must attend at least two approved co-curricular events. There are usually ten or so events in a semester, but do not procrastinate! For each, write a report with (1) a brief summary and (2) a discussion of something that interested you. One must be turned in before spring break. The event may be a part of the regular MCSP Conversation Series or an approved event of special interest to ACSI majors.

Study problems and homework: You should attempt as many of the problems in the book as possible. Test questions will be modeled on these problems (and Exam FM questions often look like these). These study problems are not to be turned in, but ask questions about them! There will be several homework assignments based on these study problems. Some of these problems are tricky: start early and ask questions!

Tests: We will use the mastery testing method. There will be 26 topics to master. Grading of each part of a problem will be either Mastered or not – no partial credit. You may re-try topics that you did not master previously without penalty. (Note that if you get one out of two problems on a topic, you will receive $\frac{1}{2}$ of a mastery. When you re-try that topic, you must do ALL parts of that topic. Your grade will not be lowered on that topic.) Once you have mastered a topic you do not have repeat that topic. You do not need to be perfect on a problem to receive mastery on it. For example, if you use the proper solution technique and make correct assumptions but make a minor arithmetic error, you will still receive credit for that problem. This is an important reason for showing your work, so that I can evaluate whether a mistake is minor or significant. Your overall test/exam grade will be based upon how many topics you master – see the grading scale below. There will be six full test days, with other opportunities to re-try topics. Please note that you do not have an infinite number of testing opportunities. **Do not plan on falling behind!** That strategy does not work! The exam is Thursday, April 28, 2:00-5:00.

Make-ups: In case of sickness or scheduling conflicts, get in touch with me ASAP.

Grading: Homework counts 30%. Class participation and co-curricular reports count 5%. The exam and tests count 65% of the final average. Grades may be curved up based on extenuating circumstances.

A: 93-100 A-: 90-92 B+: 87-89 B : 83-86 B-: 80-82 C+: 77-79 C: 73-76 C-: 70-72
D+: 67-69 D: 63-67 D-: 60-62 F: 59 and below

Topics:

- | | |
|---------------------------|----------------------------|
| 1. Accumulation Functions | 14. Level Annuities |
| 2. Discount Functions | 15. Amortized Loans |
| 3. Compound Rates | 16. Sinking Funds |
| 4. Nominal Rates | 17. Replacement of Capital |
| 5. Force of Interest | 18. Bond Prices |
| 6. Equations of Value | 19. Bond Amortization |
| 7. Investment Return | 20. Callable Bonds |
| 8. Yield Rates | 21. Brokerage Accounts |
| 9. Fund Performance | 22. Arbitrage |
| 10. Annuities | 23. Rate Swaps |
| 11. Deferred Annuities | 24. Price Options |
| 12. Loan Balances | 25. Duration and Convexity |
| 13. Annuity Progressions | 26. Immunization |

Grading Scale: Master x topics, grade is $22 + 3x$ (e.g., master 13 of 26, grade is 61)

1/17		
1/19	1. Accumulation Functions	Section 1.3
1/21	1. Basic Interest	Sections 1.4,1.5
1/24	2. Discount Functions	Sections 1.6,1.7
1/26	3. Compound Discount	Sections 1.8,1.9
1/28	4. Nominal Rates	Section 1.10
1/31	5. Force of Interest	Sections 1.11,1.12
2/2	6. Equations of Value	Sections 2.2,2.3
2/4	TEST #1	Topics 1-6
2/7	7. Investment Return	Sections 2.4,2.5
2/9	8. Yield Rates	Section 2.6
2/11	9. Fund Performance	Section 2.7
2/14	10. Annuities	Section 3.2
2/16	10. Annuities	Section 3.3
2/18	TEST #2	Topics 7-10
2/21	11. Deferred Annuities	Sections 3.4,3.5
2/23	12. Loan Balances	Section 3.6
2.25	13. Annuity Progressions	Sections 3.8,3.9
2/28	14. Level Annuities	Section 4.2
3/2	14. Level Annuities	Section 4.3
3/4	TEST #3	Topics 11-14
3/14	15. Amortized Loans	Section 5.2
3/16	16. Sinking Fund	Section 5.3
3/18	17. Replacement of Capital	Section 5.5
3/21	18. Bonds	Section 6.2
3/23	18. Bond Pricing	Sections 6.3,6.4
3/25	TEST #4	Topics 15-18
3/28	19. Bond Amortization	Section 6.5
3/30	20. Callable Bonds	Sections 6.7,6.9
4/1	21. Brokerage Accounts	Sections 7.1,7.2
4/4	22. Arbitrage	Sections 8.2,8.3
4/6	23. Rate Swaps	Sections 8.5,8.6
4/8	TEST #5	Topics 19-22
4/11	24. Forward Contracts	Sections 8.9,8.10
4/13	24. Options	Sections 8.13,8.14
4/15		
4/18	25. Duration	Sections 9.2,9.3
4/20	26. Immunization	Section 9.6
4/22	TEST #6	Topics 23-26
4/25	26. Immunization	Section 9.6
4/26	Review	
4/28	Final Exam	2:00-5:00

Study Problems

Section 1.3	page 71	#2,3,7
Section 1.4	page 72	#1,2,3,4,5
Section 1.5	page 72	#1,2,3,6,7,8
Section 1.6	page 74	#1,2,3
Section 1.7	page 74	#1,2,3,4,5,7
Section 1.8	page 75	#1,2,3
Section 1.9	page 76	#1,2,4,5
Section 1.10	page 77	#2,3,4
Section 1.11	page 77	#1,2,3
Section 1.12	page 78	#1,3,4,5,10
Section 2.2	page 111	#1,2,3,4
Section 2.3	page 112	#1,2,3,4,6
Section 2.4	page 114	#1,2,3,4,5,6
Section 2.5	page 116	#1,2,3
Section 2.6	page 117	#1,2,4
Section 2.7	page 117	#1,2,3
Section 3.2	page 181	#1,3,4,5
Section 3.3	page 182	#1,2,4,5
Section 3.4	page 184	#1,3,4
Section 3.5	page 185	#1,2,3,5
Section 3.6	page 186	#1,2,3,4,6
Section 3.8	page 189	#1,3,4
Section 3.9	page 189	#3,5,6
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Section 4.3	page 223	#3,5
Section 5.2	page 256	#1,2,3,4,5
Section 5.3	page 258	#1,2,3
Section 5.5	page 260	#1,2,4,5
Section 6.2	page 317	#1,2,3,5,6
Section 6.3	page 318	#1,2,3
Section 6.4	page 319	#1
Section 6.5	page 319	#1,2,3,4
Section 6.7	page 320	#1
Section 6.9	page 322	#1,2,3
Section 7.2	page 345	#1,2,3
Section 8.2	page 434	#1,2
Section 8.3	page 435	#1,2,3,4
Section 8.5	page 437	#2
Section 8.6	page 439	#1
Section 8.9	page 441	#1
Section 8.10	page 442	#2,3,4
Section 8.13	page 444	#2,3,4
Section 9.2	page 496	#1,2,3,4
Section 9.3	page 497	#1,2
Section 9.6	page 499	#1,2

Special Classroom Policies for 2022SP

1. Face coverings/masks must be worn over the mouth and nose by all students and instructors in classrooms and hallways of academic buildings. By wearing face coverings, we protect our college community and its most vulnerable members. Students who come to class without a face mask that is being worn properly will be asked to leave and will be readmitted only after they are wearing one.
2. If you have a temperature of 100.4 or higher or other coronavirus symptoms, don't come to class. Call Health Services IMMEDIATELY. Do not come to class or go to any public area on campus. Do keep up with all readings, assignments, and deadlines.
3. If the college is forced to suspend in-person attendance, this class will continue to meet via Zoom at our regular time. I will distribute an amended syllabus. I will email the class that plan. You will need internet connectivity. If you have technology challenges, I need you to email me as soon as the decision is made to go remote so that we can discuss how you can keep up. I will continue to have office hours at my regular times via Zoom.
4. The fall semester saw about another increase in the number of academic integrity charges, mostly cheating and many of them related to online testing. The use of Chegg, Course Hero, and similar "homework help" sites for Reports and Tests is prohibited. Although tests are open notes and open book, you should approach the tests as you would an in-class test back in the day. The book and notes should only be used as to remind you of a formula or jog your memory about one aspect of a solution technique. "Open notes" refers to activities done in class, and not work done out of class with others. In particular, shared study guides should not be used on tests.
5. Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4 pm – 9 pm, Sunday – Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are friendly, highly-trained Roanoke College students who offer free, one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences, see subjects at www.roanoke.edu/tutoring. Tutoring sessions are available in-person or online in 30 or 60-minute appointments (please specify if you prefer to meet with a tutor online or in-person when you make your appointment). All in-person appointments will maintain at least 6 feet of physical distance, desks will be cleaned between appointments, and masks must be worn in all indoor, public spaces. Schedule an appointment at www.roanoke.edu/tutoring, or contact us at 540-375-2590 or subject_tutoring@roanoke.edu.

The Writing Center @ Roanoke College offers tutorials focused on writing projects and oral presentations for students working in any field. You may schedule appointments at www.roanoke.edu/writingcenter. Questions? Email writingcenter@roanoke.edu.

Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Laura Leonard, Assistant Director of Academic Services for Accessible Education, at 540-375-2247 or by e-mail at aes@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Laura Leonard at your earliest convenience to schedule an appointment and/or obtain your accommodation letter for the current semester.