

Salisbury University Department of Mathematical Sciences

MATH 415 : Actuarial and Financial Methods
Syllabus (Tentative)

Description: Introduction to advanced actuarial mathematical models for life insurance and life annuities emphasizing the traditional actuarial functions of determining premiums and reserves from a stochastic point of view. Topics include multiple life theory, models with expenses, stochastic process, and option pricing in life insurance and annuities. 4 Hours Credit: Meets four hours per week.

Prerequisites: C or better in MATH 215 and MATH 413.

Recommended Prerequisites: C or better in MATH 315.

Intended Audience: Math majors electing the actuarial science concentration, actuarial minors, and others interested in the application of probability theory to insurance and finance.

Objective: To provide an understanding of advanced mathematical models for actuarial sciences and finance.

Textbooks: *Actuarial Mathematics for Life Contingent Risks, 3rd Edition*, by Dickson, Hardy, and Waters, 2020.

Technology: Common statistical packages such as R, Excel, Python, may be used for analyses.

Topic	Weeks
Advanced Survival Models	3
Definition of the survival function, force of mortality, and the life table for use in studying continuous future life time and curtate future life random variables for a life that have survived to age $x > 0$. In particular, the application to multiple state mortality models and multiple life models.	
Life Insurance and Life Annuities	1
Stochastic (random present value variable) and deterministic approaches (life table) used to calculate the actuarial present value of a death benefit or survival benefit (pension); continuous and discrete models; and extension to multiple state and multiple life models. expenses not included.	
Annual Benefit premiums and Benefit Reserves	2
Calculation of annual benefit premiums from deterministic and stochastic (loss function random variable) approaches; determination of future liability for a policy in force (reserving - setting aside funds to pay eventual benefits); calculation of the probability that a fund is sufficient to cover future benefits for a group using an aggregate loss function; spreadsheet approach to illustrating results; assets and liabilities.	
Models with Expenses: Profit Analysis	2
Life insurance and annuity model including expenses and profit; asset share pricing. Profit analysis, emerging surplus, and profit testing.	
Pension Plans and Retirement Benefits	2
Understand how retirement benefits are accrued, valued, and funded.	
Options in Life Insurance and Annuities	2
Understand various types of equity-linked life insurance guarantees, options that are embedded in life insurance and annuity contracts and be able to price, reserve, and hedge the risk inherent in these options.	
Projects and Midterm Exams	2
Total	14

Evaluation

Participation	0-5%
Projects	0-25%
Homework/Quizzes	10-20%
Midterm Exams	30-45%
Final Exam/Project	25-40%

- Clear descriptions of thought processes, evidence of critical thinking, and effective communication must be demonstrated in written work.
- **Writing Across the Curriculum:** Students will be expected to communicate mathematics and mathematical ideas effectively in speech and writing. At the University Writing Center, trained consultants are ready to help you at any stage of the writing process. In addition to the important writing instruction that occurs in the classroom and during professors' office hours, the Center offers another site for learning about writing. **All students are encouraged to make use of these important services.**
- **NOTE:** Once a student has received credit, including transfer credit, for a course, credit may not be received for any course with material that is equivalent to it or is a prerequisite for it.