

**SYRACUSE UNIVERSITY**  
**MAT 500, Probability Models for Actuarial Science**  
**SPRING 2018 SYLLABUS**

**Class:** Tue & Thu 11:00AM - 12:20AM in Carnegie 120

**Instructor:** Thomas John, Ph.D.

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**Office Hours:** TBA

**Catalogue/MySlice Description:** Applied probability with focus on actuarial models. Common distributions used in actuarial applications. Conditional expectation. Moment generating functions. Probability inequalities. Limit theorems. Loss and Survival models. Parametric and Non-Parametric estimation. Model assessment. Computing benefit reserves and risk measures.

**Course Overview:** The goal of the course is to provide partial preparation towards actuarial exams P (Probability), STAM (Short Term Actuarial Math), and LTAM (Long Term Actuarial Math). The course will focus on applications of probability models in risk/insurance areas. This entails covering some topics that may not have been covered in MAT 521 and extending the topics covered in MAT 521 to specific applications.

**Text:** Following textbooks will be used as references.

- *Loss Models: From Data to Decisions*, 4th Ed, Klugman, Panjer, and Willmot; ISBN: 978-1-118-31532-3.
- *Introduction to Probability*, Blitzstein and Hwang; ISBN: 9781-4665-75578.
- The study guides available online from Marcel Finan (Arkansas Tech University) available at <http://faculty.atu.edu/mfinan/actuaries.html>, specifically the guides for Exams C and MLC, will be used as additional resources.

**Prerequisite:** MAT 521 or permission of instructor.

**Grading:** Your final grade will be based on two semester exams (25% each), a cumulative final exam (30%), quiz/HW/class attention (20%). Final letter grades will be given according to the following scale:

Grade/Range	Grade/Range	Grade/Range	Grade/Range	Grade/Range
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 (60-70)	F (0-59)

There will be absolutely no make-ups for any reason. If you miss a quiz/test for a valid reason (which must be verified by a note from a physician or your dean's office), performance from the corresponding part of a test/final will be used as replacement.

**Exams:** The dates for the exams are:

Semester Exam 1: Thursday, February 15

Semester Exam 2: Thursday, April 5

**CUMULATIVE FINAL EXAM:** Friday, May 4 5:15PM - 7:15PM

**Special Note on the Final Exam:** All students must take the cumulative final exam at the scheduled time on **Friday, May 4, 2018, 5:15PM - 7:15PM**. There will be no exceptions, and so you should not plan to leave campus **before 7:15PM on Friday, May 4, 2018**.

## Special Note on the Drop Deadline:

Academic Drop Deadline and the Financial Drop deadline will both occur on **Tuesday, February 6** (three weeks from the first day of classes). Students may still withdraw from courses after February 6 but before the withdraw deadline Tue, April 17, 2018; this would place a “WD” grade on their transcripts.

**Homework:** Homework will be assigned regularly and some of the problems may be asked to be turned in. You may discuss these problems with other students, but each of you is expected to write up your own solutions independently. The best way to learn this material is to do homework problems. Try as much as possible to do the homework on your own.

**Quiz:** There will be quizzes given frequently. These quizzes will be one or two problems very similar to the examples done in lecture and homework problems. The specifics will be announced in lecture ahead of time.

**Attendance:** You are expected to attend every class and every exam. If you miss a class, it is your responsibility to obtain a copy of the lecture notes for that class from another student. You are also responsible for any announcements about changes to the course schedule, the exam schedule, or the course requirements that were made during that class.

**Phone, Laptop, Tablet in class policy:** Phones, laptops, and tablets are not allowed to be out during class. **This policy will be strictly enforced in class.** *Repeated violations of this policy will be recorded. Students who repeatedly violate this policy will be asked to leave the room and the overall course grade will be affected by such behavior.* Particularly, calculators on cell phones cannot be used on quizzes/tests.

**Academic Integrity:** Syracuse University’s Academic Integrity Policy reflects the high value that we, as a university community, place on honesty in academic work. The policy defines our expectations for academic honesty and holds students accountable for the integrity of all work they submit. Students should understand that it is their responsibility to learn about course-specific expectations, as well as about university-wide academic integrity expectations. The policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same work in more than one class without receiving written authorization in advance from both instructors. Under the policy, students found in violation are subject to grade sanctions determined by the course instructor and non-grade sanctions determined by the School or College where the course is offered as described in the Violation and Sanction Classification Rubric. SU students are required to read an online summary of the University’s academic integrity expectations and provide an electronic signature agreeing to abide by them twice a year during pre-term check-in on MySlice.

Specifically for this course, the academic integrity aspects relate to quizzes/exams. A student is not allowed to use ANY electronic device except for their calculator during the quiz/exam until the quiz/exam is handed in. Accessing material beyond standard calculator functionalities and any statistical table provided during the quiz/exam will be a violation of academic integrity.

The Violation and Sanction Classification Rubric establishes recommended guidelines for the determination of grade penalties by faculty and instructors, while also giving them discretion

to select the grade penalty they believe most suitable, including course failure, regardless of violation level. Any established violation in this course may result in course failure regardless of violation level. Related link: <http://class.syr.edu/academic-integrity/policy/>

**Students with Disabilities:** If you believe that you need academic adjustments (accommodations) for a disability, please contact the Office of Disability Services (ODS), visit the ODS website <http://disabilityservices.syr.edu>, located in Room 309 of 804 University Avenue, or call (315) 443-4498 or TDD: (315) 443-1371 for an appointment to discuss your needs and the process for requesting academic adjustments. ODS is responsible for coordinating disability-related academic adjustments and will issue students with documented Disabilities Accommodation Authorization Letters, as appropriate. Since academic adjustments may require early planning and generally are not provided retroactively, please contact ODS as soon as possible. Making arrangements with ODS takes time. Do not wait until just before the first test. Students taking exams at ODS should take them at times which overlap the exam time for the rest of the class.

**Religious observances policy:** SU religious observances policy recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to are religious observance provided they notify their instructors before the end of the second week of classes. For fall and spring semesters, an online notification process is available through MySlice (Student Services > Enrollment > My Religious Observances) from the first day of class until the end of the second week of class. Related link: <https://policies.syr.edu/policies/university-governance-ethics-integrity-and-legal-compliance/religious-observances-policy/>.

**Learning Objectives:** After taking this course, students will be able to:

- calculate, estimate, and manipulate probabilities and random variable distributions commonly used in risk/insurance areas;
- conduct, with and without the aid of technology, probability model determinations and assessments;
- interpret the output of statistical software;
- choose appropriate mathematical models to solve actuarial problems.

**Notes About Actuarial Exam Preparation:** While exam 1/P is based mostly on MAT 521 topics, the actuarial exam questions expect a much deeper understanding of the material and the ability to manipulate the relationships between different quantities of interest at a quick pace. Similarly, other actuarial exam questions expect a solid familiarity with the corresponding topics and terminology.

In the introduction to ASM study manual for Exam P, the author introduces the following rule:

*Fundamental Rule for Passing Actuarial Examinations*

You should greet every problem you see when you are taking the exam with these words: "Been there, done that."

...

There is simply not enough time to think on the exam. *Thinking is always the last resort on an actuarial exam.* You may not have seen this very problem before, but you must have seen a problem like it before. If you have not, you are not prepared.

As such, it will require the student to put in dedication through this course and **extensive preparation beyond this course** on their own to successfully pass the examinations. This course is only meant as an introduction to the foundational probability topics behind the problems that appear in these exams. It is unrealistic in a semester course to work through every particular type of problem that could show up. It is the student's responsibility to complement this course with individual practice/preparation after this course preparing for the exams.

### Tentative Course Calendar:

Week	Topics
Week of Jan-15	Review of rules of probability, counting, Venn-diagrams, conditional probability, independence, and Bayes rule
Week of Jan-22	Review of commonly used univariate/bivariate distributions. Models incorporating deductibles, policy limits, and premiums.
Week of Jan-29	Moment Generating functions and Joint MGF's. Transformations of random variables/vectors and distributions of max/min of IID RV's
Week of Feb-05	Conditional Expectation/Variance, Wald's Identity, Law of Total Variance, and Random Sums Inequalities: Markov, Chebyshev, and Chernoff
Week of Feb-12	Limit Theorems: WLLN and CLT <b>Exam 1</b>
Week of Feb-19	Loss/Severity and Frequency models: Extensions of distributions learned in MAT-521, generating new distributions by scaling/powers/exponentiation
Week of Feb-26	Loss/Severity and Frequency models (cont'd): Specific families (linear exponential, $(a, b, 0)$ , $(a, b, 1)$ ), aggregate loss and approximations
Week of Mar-05	Survival models: Age-at-death and time-until-death random variables, Force of Mortality Specialized distributions used in actuarial science (Gompertz, Makeham, Weibull)
Week of Mar-12	<b>Spring Break</b>
Week of Mar-19	Non-parametric Estimation of models: (Kaplan-Meier, Nelson-Aalen)
Week of Mar-26	Parametric Estimation of models (MME, MLE)
Week of Apr-02	Catchup <b>Exam 2</b>
Week of Apr-09	Model assessment/selection: Chi-Sq Goodness of Fit
Week of Apr-16	Model assessment/selection (cont'd): Kolmogorov-Smirnov, Anderson-Darling
Week of Apr-23	Computations of premiums, reserves, risk measures (variance premium, Value-at-Risk, tail-VaR)
Week of Apr-30	Wrap-up