

# MATH 403: Basic Short-Term Actuarial Mathematics

## Fall 2023

“The first reflection is, that a wide difference must be made between two kinds of truths: one, which relates simply of the nature of things, and their unchangeable essence, independently of their existence; the other, which relates to things existing, and especially to human accidents and events, which may or may not be, when we inquire about the *future*, but which cannot be otherwise when we inquire about the *past*.”

— Antoine Arnauld and Pierre Nicole, *La logique ou l'Art de penser*, 1662

Instructor: Wesley Calvert

Office: Neckers A 357

Office Hours: Official (guaranteed) hours, Monday 1–3, Tuesday 2–3  
Wednesday 1–4; also make an appointment or come see me.

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## Course Goals

Neither Bayesian nor frequentist conceptions of probability give me any measure of security on the particular concern of whether my car will be totaled by collision with a crazy driver on the way home from work this evening. An almost shocking fact of mathematics is that we can, by bundling this one risk with millions of others like it, we can take advantage of the law of large numbers and actually give a considerable measure of security.

This course will give you some of the basic tools to do that.

The course will focus on the so-called “short-term” risks generally encountered in property and casualty insurance (e.g. auto, home, liability), as opposed to the “long-term” risks more typical of life insurance, pensions, and health insurance.

No single university class is enough to thoroughly prepare for an actuarial exam, where the usual recommendation is hundreds of hours of study. However, this course should make you familiar enough with the material of SOA Exam FAM-S to constitute a major part of your preparation for that exam.

Of course, all of this has major applications outside the actuarial realm. Quite often in life we want to predict the frequency and severity of events and how many individual uncertainties compose into something relatively predictable. What you learn here will serve you well there, too.

## Course Content

We will start with an axiomatic construction of risk and insurance, before beginning the mathematical core of the course. This core consists of constructing models for the frequency and severity of events, models for “aggregate risk” (that is, the risk of a large portfolio of individual risks), and the estimation of parameters for these models.

Of course, all models are wrong, and the first limitation is that a model must pass the test of good business sense. We will take some account of this in our treatment of coverage modifications (which make insurance economically viable) and credibility (which tells when to trust the general reasoning and when to trust the particular experience).

Finally, we will conclude with application of these models to ratemaking (pricing) and reserving (making sure that the insurer has enough money available to meet its uncertain future obligations), including option pricing.

## Course Activities

Homework will be assigned frequently, and will be due each week on Wednesdays (unless otherwise announced). The most common thing in all of mathematics — I do it myself, as does every other mathematician I know — is to see somebody else doing a problem and say, “Yes, yes, of course. I understand completely,” and then walk away and realize that we had no idea at all what was going on. Homework is your guard against this. If you really understand how to do the homework, you’re generally in pretty good shape. If you can’t, you’ve got plenty of time to figure it out, ask me, ask a friend, or take whatever other action you see fit.

Homework will always be due at 4:30 on the appointed day. You are, of course, welcome to turn it in when you come to class. If you wish, though, you may continue to work on it, and may deliver it to my office or my department mailbox.

Cooperation on homework is strongly encouraged. There will almost certainly be problems on which it is necessary. Talk with each other, talk with me, talk with friends, use any resource. It is important, however, to be sure that you

understand the solution you present. In designing the tests, I will assume thorough familiarity with all homework problems due before the date of the exam.

You are also encouraged to visit me in my office (see note on office hours above) or to call or e-mail me. To be more clear: It's a hard class. I'd like to see you do well in it. I'd love to talk with you and to help you in any way that I can.

The homework will often be hard. You will seldom be able to solve all of the problems in one setting. Plan your time accordingly.

The class will meet on Monday, Wednesday, and Friday at 9:00am. A typical meeting will begin with a discussion of any questions folks have, with procedural matters treated first. This will be followed by a discussion of new material (often in the form of problems, on which students will work in groups) and typically an assignment of new homework.

You should be in every class meeting, and should make sure that you are actively engaged. It goes without saying that when a problem is assigned for group work, you must do it. If you wait for me to tell you how to do it, then by the time I talk about the solution with the class, everybody else will understand it and will be ready to ask about issues you haven't encountered, and you will be lost. Don't do this. You should be careful to ask any questions you have. You should also feel free to be wrong. We all will be at some point in the class. That's why we gather together, instead of just reading the book on our own: we can help one another understand better, and we can try out ideas on each other, even if we aren't quite sure of them.

There will also be some exams. Exams will be given in the regularly scheduled class time and place on October 4 and November 1. In addition, there will be a final exam at a time and place to be determined. The final will test your ability to do all of the things we have worked on in class, with particular emphasis on material covered since the mid-term exams.

The general philosophy is that class sessions and homework will be very hard and tests will be pretty easy (assuming, of course, that you've suffered through the class meetings and homework leading up to them). Again, my goal with the homework is to help you to understand the material so well that you're unhappy with me for giving such a boring (easy) test.

In all activities for this class, make sure that you *do something*. It is depressing how often students who probably know something relevant to a problem do absolutely nothing, allowing no opportunity to receive credit on the part they actually know.

## Grading

Grades will be calculated from the following sources:

Homework	200
In-class exam	200
Final Exam	100

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600 pts

Failure to attend class regularly will certainly adversely affect your grades on each of these factors. For instance, while I do not artificially lower grades for bad attendance, it has consistently held that almost all grades below C- that have been achieved in classes that I have taught have been associated with significant attendance problems.

In like manner, you should not underestimate the impact of your homework. Not only does the experience of the homework problems impact your test grades, but the homework itself is a considerable portion of the grade in the class.

In all work done for this class, work is more important than answers. A correct answer without correct work (or worse, with work that does not match the answer) is not worth much at all, while generally correct work with an incorrect answer is almost as good as being completely right. Thus, getting the right answer does not guarantee a good grade on the problem, and getting a wrong answer does not guarantee a bad one.

I will make the following guarantees about letter grades. I may decide to lower these criteria (i.e. give a higher grade than the one shown here, if I see that the questions were hard enough that lower numbers more accurately reflect my true standards), but will never raise them.

Percent of total	Grade
90–100	A
80–89	B
70–79	C
60–69	D
≤ 59	E

## Catalog Description

This course examines loss models including severity models, aggregate loss, estimation, ratemaking and reserving, and estimation. This course prepares students for Exam FAM-S. Prerequisites: MATH 483 with C or better

# Syllabus Attachment

Fall 2023

MISSION STATEMENT FOR SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

SIU embraces a unique tradition of access and opportunity, inclusive excellence, innovation in research and creativity, and outstanding teaching focused on nurturing student success. As a nationally ranked public research university and regional economic catalyst, we create and exchange knowledge to shape future leaders, improve our communities, and transform lives.

## IMPORTANT DATES:

Semester Classes Begin: .....08/21/2023

Last day to add full-term course (without Dean's signature): .....08/27/2023

Last day to withdraw from the University with a full refund: .....09/01/2023

Last day to drop a full-term course for a credit/refund: .....09/03/2023

Last day to drop a full-term course (W grade, no refund): .....10/29/2023

Final examinations: .....12/11–12/15/2023

Note: Please verify the above dates with the Registrar calendar and find more detailed information on deadlines at <http://registrar.siu.edu/calendars>. For add/drop dates that apply to shorter-than-full-term courses, please look at the Schedule of Classes search results at <http://registrar.siu.edu/schedclass/index.php>

## FALL SEMESTER HOLIDAYS:

Labor Day 09/04/2023

Thanksgiving Break 11/18-11/26/2023

**DIVERSITY:** Southern Illinois University Carbondale's goal is to provide a welcoming campus where all of our students, faculty and staff can study and work in a respectful, positive environment free from racism and intimidation. For more information visit: <http://diversity.siu.edu>. Additional [informational flyer](#).

**DISABILITY SUPPORT SERVICES:** SIU Carbondale is committed to providing an inclusive and accessible experience for all students with disabilities. Disability Support Services coordinates the implementation of accommodations. If you think you may be eligible for accommodations but have not yet obtained approval please contact DSS immediately at (618) 453-5738 or <https://disabilityservices.siu.edu>. You may request accommodations at any time, but timely requests help to insure accommodations are in place when needed. Accommodations and services are determined through an interactive process with students and may involve consideration of specific course design and learning objectives in consultation with faculty.

**MILITARY COMMUNITY:** There are complexities of being a member of the military community and also a student, and military and veteran related developments can complicate academic life. If you are a member of the military community and in need of accommodations please visit Veterans Services at <http://veterans.siu.edu/>.

**STUDENT MULTICULTURAL RESOURCE CENTER:** The Student Multicultural Resource Center serves as a catalyst for inclusion, diversity and innovation. As the Center continues its work, we are here to ensure that you think, grow and succeed. We encourage you to stop by the Center, located in the Student Services Building Room 140, to see the resources available and discover ways you can get involved on the campus. Visit us at <https://smrc.siu.edu/>.

**SALUKI CARES:** The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distress—physical, emotional, financial, or personal. By working closely with faculty, staff, students and their families, SIUC will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. For information on Saluki Cares: Call (618) 453-2461, email [siucares@siu.edu](mailto:siucares@siu.edu), or <http://salukicare.siu.edu/>.

**SAFETY AWARENESS FACTS AND EDUCATION:** Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: <http://safe.siu.edu>.

**SIU COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS):** Mental health counseling services are available by calling [CAPS](tel:6184535371) at (618) 453-5371. CAPS offers confidential same-day services and ongoing counseling. For after hours crisis care, students are encouraged to call 988, 911, or present to their nearest emergency room.

**WITHDRAWAL POLICY (Undergraduate Only):** Students who officially register for a session must officially withdraw from that registration in a timely manner to avoid being charged as well as receiving a failing grade for those classes. An official withdrawal must be initiated by the student, or on behalf of the student through the academic unit, and be processed by the Registrar's office. For the proper procedures to follow when dropping courses and when withdrawing from SIUC visit: <http://registrar.siu.edu/students/withdrawal.php>.

**SIUC'S EARLY WARNING INTERVENTION PROGRAM (EWIP):** Students enrolled in courses participating in SIUC's Early Warning Intervention Program might be contacted by University staff during a semester. More information can be found at the University Core Curriculum's Overview webpage: <https://corecurriculum.siu.edu/for-faculty/>.

**EMERGENCY PROCEDURES:** We ask that you become familiar with Emergency Preparedness at SIU. Emergency response information is available on posters in buildings on campus, on the Emergency Preparedness at SIU website, and through text and email alerts. To register for alerts visit: <http://emergency.siu.edu/>.

## CATALOGS:

[catalog.siu.edu](http://catalog.siu.edu)

[gradcatalog.siu.edu](http://gradcatalog.siu.edu) - Graduate policies often vary from Undergraduate policies. To view the applicable policies for graduate students, please refer to the graduate catalog.

## CENTER FOR LEARNING AND SUPPORT SERVICES:

Tutoring: <https://class.siu.edu/>

Math Labs: <http://math.siu.edu/courses/course-help.php>

**WRITING CENTER:** <http://write.siu.edu/>

**PLAGIARISM:** See the Student Conduct Code: <http://srr.siu.edu/student-conduct-code/>

**INCOMPLETE POLICY (Undergraduate Only):** <http://registrar.siu.edu/grades/incomplete.php>

**REPEAT POLICY:** <http://registrar.siu.edu/students/repeatclasses.php>

**MORRIS LIBRARY HOURS:** <https://libcal.lib.siu.edu/hours/>

**ADVISEMENT:** <http://advisement.siu.edu/>

**SIU ONLINE:** <https://online.siu.edu/>

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Need additional help with an issue? Visit **SALUKI SOLUTION FINDER** at <http://solutionfinder.siu.edu/>