MATH 458/558: Short-Term Actuarial Mathematics 2

Spring 2026

Course Information

Class: M/W/F 2:00 p.m.–2:50 p.m., Robert Bell 107

Instructor: Dr. Zhixin Yang (zyang6@bsu.edu)
You can expect a response to emails within 24–48 hours.

Office Hours: M/W/F 10:00–11:00 a.m. or by appointment, Office RB 428

Course Website: Assignments, solutions, and other class materials will be posted on Canvas.

Course Materials

- **Textbooks:**
  - Klugman, S. A., Panjer, H. H., and Willmot, G. E., *Loss Models: From Data to Decisions*, 5th ed., 2019.
  - Brown, R. L., and Lennox, W. S., *Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance*, 4th ed., 2015.
  - Hardy, M. R., and Saunders, D., *Quantitative Enterprise Risk Management*, 2022.
- **Calculator:** TI-30XS MultiView

Course Description

Topics include severity distributions, extreme value distributions, coverage modifications, convolution and recursive formulas, aggregate claims distributions, sums of compound Poisson models, parameter estimation and model selection, Bühlmann and Bühlmann-Straub models, empirical Bayesian estimation in nonparametric and semiparametric cases, premiums for short-term insurance coverages, and techniques for estimating outstanding claims and reserves.

Course Objective

Students will apply probability concepts to key problems involving insurance products. They will become proficient in loss modeling and master actuarial methods essential for loss models. Additionally, students will learn the foundational principles of ratemaking and reserving for short-term coverages. The material in this course directly prepares students for the ASTAM professional examination provided by the Society of Actuaries.

Course Content

Topics include the derivation and characteristics of generalized extreme value and generalized Pareto distributions; estimating the effects of coverage modifications (deductibles, policy limits, maximum covered loss, coinsurance, and stop-loss reinsurance); and applying convolution and recursive formulas for aggregate claims distributions with $(a, b, 0)$ or $(a, b, 1)$ frequency and discrete severity distributions. We will also cover parameter estimation using maximum likelihood and other parametric methods, computing the variance of parameter estimates, and using the delta method to estimate the variance of the maximum likelihood estimator for a function of the parameters. Additional topics include Kolmogorov-Smirnov and Chi-square goodness-of-fit tests, judgment and scoring-based approaches for model selection, and ratemaking and reserving for short-term products such as property/casualty and health insurance.

- Severity Models (*Loss Models* sections 5.1–5.2)
- Aggregate Models (*Loss Models* sections 9.3–9.7; *QERM* chapter 5)
- Coverage Modifications (*Loss Models* chapter 8)
- Construction and Selection of Parametric Models (*Loss Models* chapter 15)
- Credibility (*Loss Models* chapter 18)
- Reserving and Pricing for Short-Term Insurance Coverages (*Loss Models* sections 4.8, 5.3–5.4)

In-Class Activities

In-class activities account for **100 points** of your grade. The lowest score will be dropped. Activities are designed to provide practice with recently studied material. If you miss a class with an activity, you will receive a zero unless the absence is pre-approved for a legitimate reason.

Homework

Homework assignments account for **200 points** of the course grade.

- The lowest homework score will be dropped.
- Late assignments (within one week) may receive a 50% grade reduction. After one week, they will not be accepted.
- Submissions must be neat, stapled, and organized.

Collaboration: You may work together, but submitted work must be your own. If identical solutions are submitted, both parties will be in violation. Re-solve problems independently after group study to ensure your work is distinct. Correct answers without supporting work may receive no credit.

Tests and Final Exam

Three tests will account for **300 points** of the total grade. The final exam is a project and will account for **100 points** of your total grade.

Grading

Component	Weight
In-Class Assignments	100 pts
Homework	200 pts
Tests	300 pts
Final project	100 pts
Total	**700 pts**

	$[93, 100]$ A	$[90, 93)$ A^{-}	$[87, 90)$ B^{+}	$[83, 87)$ B
Letter Grades:	$[80, 83)$ B^{-}	$[77, 80)$ C^{+}	$[73, 77)$ C	$[70, 73)$ C^{-}
	$[67, 70)$ D^{+}	$[63, 67)$ D	$[60, 63)$ D^{-}	< 60 F

Attendance Policy

Regular attendance is strongly advised due to the pace of the course. Inform me in advance of any absences and check Canvas for materials.

Important Dates

- January 19: MLK Day (no class)
- March 2–6: Spring Break (no class)
- March 19: Withdrawal Deadline (5:00 p.m.)
- May 1: Final Project due at 4:15 p.m.

University Policies & Resources

Student Support Services

Students can benefit from free tutoring and coaching at the **Learning Center** (tutoring can be done through virtual Zoom appointments or in-person appointments at NQ 350), writing practice and feedback at the **Writing Center**, mental health assistance at the **Counseling Center**, and assistance with basic needs at the **Basic Needs Hub**.

University Statement

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse. If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

Freedom of Expression

In this course, we are committed to fostering a learning environment that values intellectual diversity, encourages free expression, and promotes open inquiry. As members of the Ball State Community, we treat each person in the Ball State community with civility, courtesy, compassion, and dignity and respect and learn from differences in people, ideas, and opinions. Please review Ball State University's Statement on Freedom of Expression, the resources on Ball State's Freedom of Expression webpage, and Ball State's Beneficence Pledge.

Important Links

- Student Academic Ethics Policy:
  https://www.bsu.edu/about/administrativeoffices/vice-provost/student-services/academic-integrity
- Code of Student Rights and Responsibilities:
  https://www.bsu.edu/about/administrativeoffices/student-conduct/policiesandprocedures/studentcode

Copyright

The instructor owns the copyright of course materials including worksheets and exam questions. Students may not reproduce, distribute, or publicly post course materials without the instructor's permission. Selling or distributing course materials may violate the Ball State Code of Conduct and/or the Information Technology Users' Privileges and Responsibilities Policy. Any violations will be referred to the Director of Student Rights and Community Standards.

Syllabus is subject to change.