

MATH4429 – Credibility Theory and its applications
Course Outline
Spring Semester 2024-2025

1. Instructor

Name: Dr. Leung Chi Man (Call me LCM if you wish)
Office: Room 3419 (Lift 17-18)
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Office hours: (Every Fri) 5:00p.m.- 6:30p.m.

2. Teaching Assistant

Name: Duan, Yitian
(*Contact information and office hours will be announced by TA)

3. Meeting time and Venue

Lecture: Tues and Thurs, 12:00p.m.- 1:20p.m. @Room 1410
Tutorial: Thurs 6:00p.m.-6:50p.m. @Room 4619

4. Course Description

Credit point: 3 credits

Prerequisites: Probability (MATH2421/MATH2431). A good knowledge in multivariable calculus.

The course aims to provide a rigorous mathematical treatment on Credibility theory and study its application in actuarial mathematics. The Topics include limited fluctuation credibility theory, greatest accuracy credibility theory, credibility premium, Buhlmann models, Buhlmann-Straub models and application of credibility theory in insurance problem.

(*The course will cover the part of the materials (Bayesian Analysis and Credibility Theory) that covered in Exam FAM and ASTAM offered by Society of Actuary (SOA).

5. Student Learning Resources

We will use our own Lecture notes in this course. Additional problem sets (optional) will be provided. All materials can be found in canvas: (<https://canvas.ust.hk>)

The following reference books are also useful:

1. "Klugman, Panjer and Wilmot, "Loss models: From data to decisions", 4th edition, SOA. (Chapter 15, 17-19)
2. Buhlmann, H., Gisler, A., (2005) "A course in Credibility Theory and its Applications", Springer

(*The lecture material is written based on these two books. I would recommend the first book if you are new to credibility theory.)

6. Intended Learning Outcomes

Upon successful completion of the course, the students should be able to

1. Understand the basic idea of credibility theory. Be able to apply Limited fluctuation credibility theory and understand the criteria for both full and partial credibility.
2. study the solution of credibility problem using Buhlmann model and Buhlmann-Straub model.
3. apply empirical Bayes estimation in non-parametric model and semiparametric model. Understand the strengths and weaknesses of nonparametric model and semiparametric model.
4. apply Bayesian analysis and credibility theory in insurance problem.

7. Teaching and Learning Activities

Lectures (3 hours per week) + Tutorials (1 hour per week)

8. Tentative Course Schedule

Chapter 1: Limited fluctuation credibility

- Standard criterion for full credibility
- Full credibility for claim frequency, claim severity and aggregate loss
- Partial credibility

Chapter 2: Greatest Accuracy credibility

- Parametric models and parameter estimation
- An introduction to Bayesian Analysis
- Bayesian Analysis on incomplete data
- Buhlmann credibility model
- Buhlmann-Straub Credibility model

Chapter 3: Non-parametric credibility theory

- Empirical Bayes Estimation for the Buhlmann Model
- Semiparametric Empirical Bayes Credibility Estimation

Chapter 4: Treatment of Large Claims in Credibility

- Semi-linear credibility with truncation in Buhlmann model
- Semi-linear credibility with truncation in a model with weights
- Other methods for treating large claims

Chapter 5: Hierarchical Credibility (if time allowed)

- Introduction of Hierarchical Credibility Model
- Credibility Estimator in the Hierarchical Model
- Quadratic loss
- Estimation of the Structural parameter in the Hierarchical Model

9. Assessment Scheme

There are 2 assessment tasks in this course:

	Weight	CILOs assessed
Assignment	25% + Bonus	1,2,3,4
Final examination	75%	1,2,3,4

(a) Assignment (25% of the total grade + Bonus)

There will be 4 assignments for this course.

Each assignment contains required problems and optional problems. You are required to complete all required problems. Also, you may complete some of the optional problems for bonus score (which may improve your final grade).

(b) Final Examination (75% of the total grade)

It will be a 3 hours closed book exams. The final exam will cover all materials (including proof) covered in the course. The date and venue of the final exam will be confirmed by ARR. The detailed arrangement of the exam will be announced later.

- You may use standard calculator (scientific or financial one) in the exam.

Determining the final grade

We will adopt criterion-referencing scheme when assigning your final grade: Your final grade will be assigned based on your overall performance in this course only.

- You are guaranteed to pass the course and receive C- or above if you obtain at least **40%** in overall total (including bonus score).
- You are guaranteed to receive B- or above if you obtain at least **60%** in overall total (including bonus score).
- You are guaranteed to pass the course and receive A- or above if you obtain at least **80%** in overall total (including bonus score).
- You are guaranteed to get the highest grade A+ of the course if you can obtain at least **88%** in overall total (including bonus score).

Grade Descriptors:

Letter Grades	Short Description	Elaboration of subject grading description
A+/A/A-	Excellent Performance	The student has mastered all knowledge and techniques on credibility theory. In particular, the student is able to understand all concepts taught and is able to apply those knowledge in solving various real life problems involving the use of credibility theory.
B+/B/B-	Good Performance	The student has good understanding on knowledge and techniques on credibility theory. The student is able to apply the knowledge in solving some common real life problems related to credibility theory.

C+/C/C-	Satisfactory Performance	The student meets the minimum expectation of the instructor: The student has acquired good understanding on basic concepts and techniques involved in credibility theory. In addition, the student is able to apply the knowledge in solving some simple real life problems related to credibility theory.
D	Marginal Pass	The student only know some very basic concepts in credibility theory. He is able to complete some simple calculation only.
F	Fail	

Regarding Use of GenAI policy

- The students are allowed to use GenAI to support their study in this course. However, they are expected to write the assignments on their own.
- On the other hand, the use of GenAI is not allowed in the on-campus final exam.