STAT 850/442 Statistical Inference (U. of Saskatchewan, 2026-01)

Description

This course presents a rigorous theoretical treatment of statistical inference, offering a comparative analysis of Bayesian, and frequentist paradigms grounded in decision theory. Core topics include decision theory, Bayes rule, Bayesian methods, exponential families, sufficiency and completeness for data reduction, uniformly minimum variance unbiased estimators (UMVUE), Neyman-Pearson theorem for uniformly most powerful (UMP) tests, asymptotic theory of maximum likelihood estimators (MLE), and the Wilks' theorem for likelihood ratio test (LRT), and other likelihood-based inferential procedures.

Prerequisite(s): STAT 342.

This course requires a strong command of multivariate calculus, alongside a rigorous foundation in intermediate probability theory including asymptotic theorey for probability. Students should also possess prior exposure to applied statistical methods and familiar with basic statistical concepts such as p-value and confidence internal.

Instructor

- Longhai Li, Professor
- Department of Mathematics and Statistics, University of Saskatchewan
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Times and Places

- **Lectures:** TTH 11:30-12:20, MCLN 242.1
- **Office Hours:** TBA
- **No lab**

Textbook and Course Materials

- The course page contains the links to my lecture notes and assingments.
- **Recommended Text:** Young G. A. & R. L. Smith, *Essentials of Statistical Inference*, Cambridge University Press, 2005. *My lecture notes follow closely this textbook.*

Tentative Schedule

Week	Cal Week	Date (Mon)	Lecture Topic	Tests & Notes
1	2	Jan 05	1. Introduction, Likelihood Function, and MLE	Jan 06: First Lecture
2	3	Jan 12	2. Decision Theory: Risk, Minimaxity Theorem	
3	4	Jan 19	3. Bayesian Inference: Posterior, Bayes Rules	
4	5	Jan 26	3. Bayesian Inference: Minimax Rules, Jame-Stein Estimator	**Feb 01: Assignment 1 due**
5	6	Feb 02	3. Bayesian Inference: Hierachical Bayesian, MCMC, Case Study	
6	7	Feb 09	4. Hypothesis Testing: NP Lemma, Monotone Likelihood Test	
N/A	**8**	**Feb 16**	**—**	**Reading Week – No classes**
7	9	Feb 23	5. Likelihood Ratio Test, Wilk's Theorem, Information Criteria	**Mar 01: Assignment 2 due**
8	10	Mar 02	6. Sufficient Statistic	**Mar 05: Midterm (during class)**
9	11	Mar 09	6. Uniformly Minimum Variance Unbiased Tests	
10	12	Mar 16	7. Likelihood Theory	
11	13	Mar 23	7. Likelihood Theory (MLE)	
12	14	Mar 30	7. Likelihood Theory	**Apr 05: Assignment 3 due**
13	15	Apr 06	Review	Apr 07: Last lecture

> ! Important
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> The schedule may change depending on the course pace. The exact assignment and test dates are given on Canvas.

Evaluation

Grading Scheme

3 Assignments: 3 x 10%, 1 Term Test: 20%, 1 Final Exam: 50%.

Assignments and Tests

Assignment questions are released in the one-drive folder. You will submit your solutions via Canvas. **If you miss an assignment without proper excuse, the weight will NOT be shifted to the final.** Undergraduate students will be assigned with different assignments and tests.

Assignments

- I will accept late assignments only for three (3) days beyond the due date. The penalty for your delay is 10 percentage points per day of lateness from the value of the assignment (including weekends). **Extensions are only granted in rare instances (notably as a result of family or medical emergencies) and upon receipt of adequate documentation/proof.**
- Answer the questions in the order they appear in the assignment. Neatness is important.
- Solutions to problems are to be included. Hence, simple answers without work will receive few (or no!) marks.
- Most problems in statistics have a "real-life" basis. Hence, solutions should include not only numerical solutions but also a statement as to what the numbers say about the problem.
- The work handed in must not be an exact duplicate of others.
- Submitting Assignments: The assignment can be typed and/or handwritten. Save your assignment as **one PDF file** (for handwritten assignments, feel free to take a picture/scan of your work and save it as one PDF file). Upload the **PDF file** as an assignment submission in Canvas.
- More details will be provided ahead of each assignment.
- Due Date: See Course Schedule.

Midterm

- The midterm is given in class period.
- Midterms must be written on the dates scheduled. Students must do midterms completely on their own. More details (including syllabus) will be provided ahead of each midterm.
- Type: Short-answer questions, problem-solving, open-book.
- Calculator: A scientific calculator is allowed.
- Make-up exam will not be given. If you miss an exam for a legitimate reason (e.g., illness, emergency) and notify me within 48 hours of the scheduled exam, the weight of the missed exam will be transferred to the final exam.

Final Exam

- Scheduling: Final examinations may be scheduled at any time during the examination period; students should therefore avoid making prior travel, employment, or other commitments for this period. If a student is unable to write an exam through no fault of their own for medical or other valid reasons, documentation must be provided and an opportunity to write the missed exam may be given. Students are encouraged to review all examination policies and procedures: http://students.usask.ca/academics/exams.php.
- The final exam will cover material of the entire course. More details will be provided ahead of the exam.
- Length: 3-hour in-person exam.

- Type: Short-answer questions, problem-solving, open-book.

Criteria That Must Be Met to Pass

The **final exam is a required component of the course**. Students must complete the final exam in order to be eligible to receive a passing grade in this class.

Attendance Expectation

Attendance is highly correlated with student performance. While a syllabus and suggested readings are provided, it is not an adequate substitute for attending class. Your **attendance is highly recommended** but not required, and you will not be graded on your attendance.

Learning Outcomes

After completing this course, students are expected to:

1. **Understand Paradigms:** Be able to understand the Bayesian and frequentist paradigms for statistical inferences, and therefore develop a high-level understanding of various applied statistical methods.
2. **Apply Theory:** Be able to apply the theoretical results in statistical inference to practical statistical problems.
3. **Evaluate Methods:** Be able to evaluate different statistical methods with appropriate criteria.
4. **Compare Approaches:** Gain a comparative appreciation of different inferential paradigms.

Recording of the Course

Recording of the lectures will only be allowed in certain circumstances. Please see the instructor for information on how to receive approval. In general, there will be no videos available for in-person lectures. Therefore, **attendance is strongly recommended**.

Use of Generative AI and Electronic Devices

1. AI for Learning vs. Assessment. Students are free (and encouraged) to use Generative AI tools as a study aid to understand course concepts, debug code, or explain complex theorems. However, **all submitted work for assignments must be your own.** You must write your own solutions. Directly copying text, derivations, or code from an AI tool and submitting it as your own may receive a **severe penalty** (up to receiving a 0% on the assignment.
2. Electronic Devices During Tests. All term tests and the final exam are **Open Book**, meaning you may bring printed notes, textbooks, and lecture slides.

- **No Electronic Devices:** You are **NOT allowed** to use laptops, tablets, smartwatches, or any other electronic devices during the exam.
- **Phone Exception:** You are permitted to bring a smartphone, but it must remain stowed away during the writing period. It may **only** be used at the very end of the exam for the specific purpose of taking photos of your answer sheets for submission (if required). Using the phone for any other reason during the exam will be treated as academic misconduct.