

AMS 412: Mathematical Statistics

Spring 2025

Course Information:

Instructor: Kai Li
Office: Harriman 202
Class: Tue, Thu 6:30-7:50pm, Frey Hall 201
Email: kai.li@stonybrook.edu
Office Hours: Tue, Thu 4:50-6:20pm or by appointment
Course Page: Brightspace

Graduate Teaching Assistant: Touhid Hossain
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Office Hours: Fri 3:00-5:00pm

Course Description: Estimation, confidence intervals, Neyman-Pearson lemma, likelihood ratio test, hypothesis testing, chi-square test, regression, analysis of variance, nonparametric methods. This course is the second in a two-part series (AMS 310/311 and AMS 412) which cover the fundamentals of mathematical statistics and statistical inference. AMS 412 focuses on the statistical inference part and covers topics such as decision theory, point estimation, interval estimation, hypothesis testing, regression, ANOVA, and nonparametric tests.

Prerequisite: AMS 311

Credits: 3

Textbook: *John E. Freund's Mathematical Statistics with Applications* by Irwin Miller and Marylees Miller, 8th edition, 2014, Pearson

Topics to be Covered: Chapters 10 (excluding Section 10.9), 11, 12 (excluding Section 12.3), 13, 14 (excluding Section 14.7), 15 (excluding Sections 15.3-15.6), and 16 (excluding Section 16.6) from *John E. Freund's Mathematical Statistics with Applications*

Homework: Assignments will be posted weekly on Brightspace and must be submitted as a single, legibly composed PDF file via Brightspace. Each homework will consist of required and recommended problems. All assigned problems should be completed, but only two of the required problems will be graded. No late homework will be accepted and will be due at the beginning of class on the due date, except for the last homework. If you want to correct your submission (before the deadline), you may upload a revision. Only your last submission will be graded. There will be approximately 11 homework sets, equally weighted. The lowest two homework scores will be dropped before computing your average.

You may discuss homework problems with other students taking the course and with the instructor and teaching assistant. The work that you turn in should always be your own write-up, and you should show that you personally understand everything that you write. You are not to view other student writeups or use them (or use internet resources) while writing your own solution. Please make certain that your writing is neat and clear (if handwritten), and that you have expressed your reasoning.

Exam: There will be three in-person exams. Midterm 1 will be during class, tentatively scheduled for Tuesday, March 4. Midterm 2 will be during class, tentatively scheduled for Thursday, April 10, and will not be cumulative. The final will be held during the university-assigned date and time, on Tuesday, May 20, from 5:30pm to 7:30pm. The final exam will be cumulative, but it will emphasize the recent material. Unless otherwise announced, exams will be held in our regular classroom (Frey Hall 201). All exams are closed book and closed notes, following the instructions provided with the exams. All necessary formulas, theorems, and statistical values will be provided on the exams. You may use a nongraphing calculator during the exams.

Grading Policy: Your total average score will be calculated based on 15% homework, 25% midterm 1, 25% midterm 2, and 35% final. Final grades may be curved based on the class's overall performance, but such curving may only fairly apply to the entire class, not individually.

Learning Outcomes: By the end of this course, students will be able to:

- Calculate and evaluate point estimators.
- Formulate, construct, and interpret confidence intervals about parameters in a statistical model.
- Formulate statistical hypotheses, construct appropriate hypotheses tests and interpret results.
- Formulate linear regression models, fit these models and interpret the results.
- Formulate one-way ANOVA models, fit these models and interpret the results.
- Construct distribution-free hypotheses testing procedures.

Student Accessibility Support Center Statement: If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Academic Integrity Statement: Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management: Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Tentative Course Schedule

Week	Date	Topics	HW Due Date
1	Tue, 1/28 Thu, 1/30	Introduction, Unbiased Estimators (10.1-10.2) Efficiency, Consistency (10.3-10.4)	HW1: Thu, 2/6
2	Tue, 2/4 Thu, 2/6	Sufficiency (10.5) Robustness, Method of Moments, Method of Maximum Likelihood (10.6-10.8)	
3	Tue, 2/11 Thu, 2/13	Introduction, Estimation of Means (11.1-11.2) Estimation of Differences Between Means (11.3)	HW2: Thu, 2/13 HW3: Thu, 2/20
4	Tue, 2/18 Thu, 2/20	Estimation of Proportions, Differences Between Proportions, Variances, and the Ratio of Two Variances (11.4-11.7) Introduction, Testing a Statistical Hypothesis (12.1-12.2)	
5	Tue, 2/25 Thu, 2/27	Neyman-Pearson Lemma (12.4) Review	HW4: Thu, 2/27
6	Tue, 3/4 Thu, 3/6	Midterm 1 (6:30-7:50pm) Power Function of a Test (12.5)	
7	Tue, 3/11 Thu, 3/13	Likelihood Ratio Tests (12.6) Introduction, Tests Concerning Means (13.1-13.2)	HW5: Thu, 3/13 HW6: Tue, 3/25
8	Tue, 3/18 Thu, 3/20	No Class (Spring Break) No Class (Spring Break)	
9	Tue, 3/25 Thu, 3/27	Tests Concerning Differences Between Means and Variances (13.3-13.4) Tests Concerning Proportions and Differences Among k Proportions (13.5-13.6)	HW7: Tue, 4/1
10	Tue, 4/1 Thu, 4/3	Analysis of an $r \times c$ Table, Goodness of Fit (13.7-13.8) Introduction, Linear Regression, Method of Least Squares (14.1-14.3)	
11	Tue, 4/8 Thu, 4/10	Review Midterm 2 (6:30-7:50pm)	HW8: Tue, 4/8
12	Tue, 4/15 Thu, 4/17	Normal Regression Analysis (14.4) Normal Correlation Analysis, Multiple Linear Regression (14.5-14.6)	
13	Tue, 4/22 Thu, 4/24	Introduction, One-Way Designs (15.1-15.2) Introduction, The Sign Test (16.1-16.2)	HW9: Thu, 4/24 HW10: Thu, 5/1
14	Tue, 4/29 Thu, 5/1	The Signed-Rank Test (16.3) Rank-Sum Tests: The U Test, The H Test (16.4-16.5)	
15	Tue, 5/6 Thu, 5/8	Rank Correlation Coefficient (16.7), Review Review	HW11: Sat, 5/10
17	Tue, 5/20	Final (5:30-7:30pm)	