AMS 412: Mathematical Statistics

Spring 2024

Course Information:

Instructor: Kai Li
Office: Harriman 202
Class: Tue, Thu 5:30-6:50pm, Melville Library W4540
Email: kai.li@stonybrook.edu
Office Hours: Tue, Thu 3:50-5:20pm or by appointment
Course Page: Brightspace

Graduate TA: Yu Chen
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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 part in a series of two courses (AMS 310/311 - 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

Textbook: *John E. Freund's Mathematical Statistics with Applications* by Irwin Miller and Marylees Miller, 8th edition, 2012, Pearson

Topics to be Covered: Chapters 10 (excluding Section 10.9), 11, 12 (excluding Section 12.3), 13, 14 (excluding Sections 14.6 and 14.7), 15 (excluding Sections 15.3, 15.4, 15.5, and 15.6), and 16 (excluding Section 16.6) from *John E. Freund's Mathematical Statistics with Applications*

Homework: Assignments will be given weekly, posted on Brightspace, to be turned in via Brightspace, as a single PDF file, and must be legibly composed. For each homework, all assigned problems should be completed, but only two predetermined problems will be graded. No late homework will be accepted and will be due at the beginning of class on the due date. 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, February 27. Midterm 2 will be during class, tentatively scheduled for Thursday,

April 4, and will be noncumulative. The final will be held during the university-assigned date and time, on Tuesday, May 7, from 5:30pm to 8:00pm. The final exam will be cumulative, but it will emphasize the recent material. Unless otherwise announced, the exam location will be our regular classroom (Melville Library W4540). 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.

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 possibly be curved based on the overall performance of the class, but such curving may only fairly apply to the entire class, not individually.

Learning Outcomes: By the end of this course, students should successfully 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	Chapter	Topic	Notes
1	Tue 1/23	CH10	Introduction, Unbiasedness	
	Thu 1/25	CH10	Efficiency, Consistency	HW1 due 2/1
2	Tue 1/30	CH10	Consistency, Sufficiency	
	Thu 2/1	CH10	Robustness, Method of Moments	HW2 due 2/8
3	Tue 2/6	CH10	Method of Maximum Likelihood	
	Thu 2/8	CH11	Introduction, Estimation of Means	HW3 due 2/15
4	Tue 2/13	CH11	Estimation of Means	
	Thu 2/15	CH11	Estimation of Differences Between Means	HW4 due 2/22
5	Tue 2/20	CH11	Estimation of Proportions, Differences Between Proportions, Variances, and the Ratio of Two Variances	
	Thu 2/22		Review	
6	Tue 2/27		Midterm 1	
	Thu 2/29	CH12	Introduction, Testing a Statistical Hypothesis	HW5 due 3/7
7	Tue 3/5	CH12	Neyman-Pearson Lemma	
	Thu 3/7	CH12	Power Function of a Test, Likelihood Ratio Tests	HW6 due 3/19
8	Tue 3/12		No Class (Spring Break)	
	Thu 3/14		No Class (Spring Break)	
9	Tue 3/19	CH13	Introduction, Tests Concerning Means, and Differences Between Means	HW7 due 3/26
	Thu 3/21	CH13	Tests Concerning Variances, Proportions, and Differences Among k Proportions	
10	Tue 3/26	CH13	The Analysis of an $r \times c$ Table, Goodness of Fit	HW8 due 4/2
	Thu 3/28	CH14	Introduction, Linear Regression	
11	Tue 4/2		Review	
	Thu 4/4		Midterm 2	
12	Tue 4/9	CH14	Method of Least Squares, Normal Regression Analysis	HW9 due 4/18
	Thu 4/11	CH14	Normal Correlation Analysis	
13	Tue 4/16	CH15	Introduction, One-Way Designs	
	Thu 4/18	CH16	Introduction, The Sign Test	HW10 due 4/25
14	Tue 4/23	CH16	The Signed-Rank Test	
	Thu 4/25	CH16	Rank-Sum Tests: The U Test, Rank-Sum Tests: The H Test	HW11 due 5/2
15	Tue 4/30	CH16	The Rank Correlation Coefficient	
	Thu 5/2		Review	
16	Tue 5/7		Final	5:30-8:00pm