Math494: Mathematical Statistics

Instructor:	Professor Nan LIN
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Time and location:	2- 3pm MWF, Wilson 214 (map)
Instructor office hours:	3-3:30pm MWF
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TA office hours:	1-2pm Thursday at Room 8, Cupples I

General information

Textbook: Robert Hogg, Joseph McKean and Allen Craig (2012), *Introduction to Mathematical Statistics*, 7th edition, Pearson Prentice Hall, ISBN 978-0-13-008507-8.

Reference: Jay Kerns (2010) *Introduction to Probability and Statistics Using R*, freely available at `http://cran.r-project.org/web/packages/IPSUR/vignettes/IPSUR.pdf`.

Class webpage: All homework assignments, handouts, and other information will be available on Blackboard (`http://bb.wustl.edu/`). Students should check the class webpage frequently for updates.

Course Description

This course, together with Math493 (offered in the past fall), is taught at the advanced undergraduate/master level and aims to provide solid mathematical foundations for statistical modeling and inferences. This course covers the fundamental concepts in the theory of estimation and hypothesis testing, such as order statistics, sufficient statistics, minimum variance unbiased estimation, maximum likelihood estimation, Bayesian estimation, confidence intervals, the Neymann-Pearson framework, likelihood ratio tests, and quadratic forms.

Prerequisite

The prerequisite is Math493 and Math 318 (or Math 308), or equivalent mathematical maturity and experience.

Course schedule

The following course schedule is tentative and subject to changes.

Week	Topic	Reading
1	**MLK Day**, Review of probability theory, beta and F-distributions	Sections 1.7, 2.8, 3.6
2	Sampling, Confidence intervals	Sections 4.1-4.2
3	Order statistics, Quantiles	Sections 4.4
4	Basics of hypothesis testing	Sections 4.5-4.6
5	Chi-square test,	Sections 4.7
6	Convergence in probability/distribution, delta method	Sections 5.1-5.2
7	**Midterm 1 (Mar 1)**, Maximum likelihood estimation	Section 6.1
8	Rao-Cramer lower bound, asymptotic distribution of MLE	Section 6.2
9	**Spring break**	
10	Maximum likelihood ratio test, MLE for multiparameter case	Sections 6.3-6.5
11	MVUE, Sufficient statistics	Sections 7.1-7.3
12	**Midterm 2 (April 5)**, Completeness, Exponential family	Sections 7.4-7.5
13	Most powerful tests, likelihood ratio tests	Sections 8.1-8.3
14	Location family, Sign test, Signed-rank test	Sections 10.1-10.3
15	Bayesian estimation and testing	Sections 11.1, 11.2
16	**Final exam (May 8 2017 3:30PM - 5:30PM)**	

Homework, Exams and Grades

- **Homework**: There will be weekly homework assignments. No late homework will be accepted. You will receive no credits for solutions with no work or justifications. The instructor reserves the right to deduct points for messy papers. Students are encouraged to discuss homework problems with others in class, but must write your homework independently. Duplicating others' homework constitutes a violation of the university academic integrity policy. When handing in homework, you must:
  - include your name (printed), course number (Math494) on the first page.
  - write legibly. You are encouraged to produce printed homework.
  - staple the pages together on the upper left-hand corner to prevent pages from getting lost. Do not use paper clips.

- **Exam**: There will be two in-class midterm exams (on March 1 and April 5) and one comprehensive final exam (May 8, 3:30PM - 5:30PM). On the Monday right before the midterm exams, there will be a review session. Midterm 1 covers materials during Weeks 1-6, and Midterm 2 covers those from Week 7 to Week 11.

- **Grading**: The final course grade depends on your performance on the exams and homework according to the following formula.

  Final percentage grade = 30% * Homework+ 20%* Midterm 1 + 20%* Midterm 2 + 30% * Final exam

  The letter grade is then given according to the following scale. Cr means D or better if you elect "Credit/No Credit."

$[95, 100]$	$A+$	$[83, 85)$	$B+$	$[65, 75)$	C
$[87, 95)$	A	$[77, 83)$	B	$[60, 65)$	D
$[85, 87)$	$A-$	$[75, 77)$	$B-$	< 60	Fail

Learning Tips

1. Try to show up in all the lectures. Make good notes.
2. Ask questions in class. Your questions may be others' as well. No questions are too elementary, and all deserve to be answered.
3. Discuss with your classmates about your questions.
4. Finish homework in time.

Class Policies

1. No auditing allowed.
2. Late homework: No late homework is accepted. If a student can not complete a homework assignment due to justifiable reasons (proofs required), such as illness or conflict with conferences, that homework grade will be dropped and the rest assignments will be reweighed. Students who miss more than two homework assignments will be given a grade of 'Incomplete', no matter for what reason.
3. Exam conflicts: Students need to contact the instructor about exam conflict at least two weeks in advance. Students who miss the final exam will receive 'Incomplete' regardless the reason.
4. Collaboration: I encourage discussion of homework in broad conceptual terms where one student tries to educate another without giving away the answer, but **all work turned in must be your own**.
5. Academic Integrity: All students are expected to adhere to the university's academic integrity policy. Any student who is found to have cheated on an assignment or exam will receive a zero score for that work, regardless of the extent of the offense.

Statement on plagiarism: The handouts used in this course are copyrighted. By "handouts," I mean all materials generated for this class including the syllabus, exams, in-class materials, and computer examples. Because these materials are copyrighted, you do not have the right to copy the handouts, unless I expressly grant the permission.