36-700 – Probability and Mathematical Statistics

Spring 2019

Instructor and Teaching Assistants

	Email	Office Hours
Jing Lei (Instructor)	jinglei@andrew.cmu.edu	Mo 1:30-2:30, BH 132C
Theresa Gebert	tgebert@andrew.cmu.edu	Wed 4-5, BH132 Lounge
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Beomjo Park	beomjop@andrew.cmu.edu	Wed 2-3, BH 132 Lounge

Lecture	MWF 12:30 PM – 1:20 PM Scaife Hall 125
Textbook (optional)	*All of Statistics: A Concise Course in Statistical Inference* L. Wasserman (ISBN 978-0387402727)
	Statistical Inference (2nd Edition) G. Casella & R. L. Berger (ISBN 978-0-534-24312-8)
Web Site	https://canvas.cmu.edu/
	https://piazza.com/cmu/spring2019/36700a/
	www.stat.cmu.edu/~jinglei/spring19.shtml
Prerequisites	calculus, basic linear algebra
	UG probability & statistics (optional)

Course description This is a one-semester course covering the basics of statistics. We will start with a quick introduction to probability theory, and then cover fundamental topics in mathematical statistics such as data reduction, point estimation, hypothesis testing, interval estimation, and asymptotic theory. If time permits, we will also cover more advanced and useful topics including nonparametric inference, bootstrap, regression and classification. This course will seek a balance between math concepts, statistical tools, and philosophy.

Prerequisites Required preliminary math tools are calculus and basic linear algebra. Familiarity of elementary probability and statistics will be helpful, but not required.

How does this course differ from 36-705? This course covers essentially the same set of topics in statistical inference as 36-705. This course will assume less prior knowledge of probability theory and will balance between theory, examples, and applications.
A detailed list of topics can be found at the end of this document.

Grading

Test #1	25%
Test #2	25%
Test #3	25%
Homework	20%
Participation	5%

Administrative Remarks

Lectures

Lecture Notes. The lectures will largely follow lecture notes. Notes in PDF format will be posted on Canvas as needed. A given set of notes may cover more than one lecture. The notes may be incomplete and I will fill in missing details in lecture. **It is your responsibility to print out lecture notes and bring them to the lecture.**

Textbook. The textbooks are meant to supplement the lectures, and for most lectures there will be assigned reading.

Homework and Tests

Homework assignment. Homework assignments will be posted on Fridays on Canvas, and will be due one week later, before the lecture starts. All homework must be submitted online in pdf format (see **Gradescope** below).

The post and due dates of each homework assignment are given in the course calendar at the end of this document.

Homework grading. It is your responsibility to make your homework readable. The graded homework will be viewable on Gradescope and the score will be uploaded on Canvas approximately one week after due time. It is your responsibility to check your score on Canvas. If you have questions regarding missing score or mis-grading, please request regrade on Gradescope within seven days of the publish of graded homework.

Your two lowest homework scores will be dropped. So late submissions will not be graded, regardless of the reason they are late!

Tests. There will be three tests, the dates of which are given in the course calendar at the end of this document. There will be no final exam. All tests are closed book and closed notes. Each in-semester test covers only the material presented since the previous exam (about 4 weeks of material).

If you cannot take a test at its scheduled time, please let the instructor know **at least one week beforehand** and we can attempt to come to some form of accommodation. If you miss a test, it cannot be made up.

Academic Integrity. You can collaborate with classmates or use materials in other books or papers or online. But you need to (1) write your own solution based on your own understanding, (2) clearly indicate on your submission with whom and to which extent you have collaborated on the homework assignment, and (3) give clear reference to the external sources.

Please read the university policy on academic integrity at the following url.

`https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html`

Gradescope. In this course, we will be using Gradescope (as a plug-in tool within Canvas) to grade and provide feedback on assignments and exams. This will allow our graders to provide more timely and effective feedback. In addition, Gradescope makes it easy for you to access and review all your (graded) work.
During the semester, you will use Gradescope to (a) submit work online, (b) view feedback and scores on graded work, and (c) make a re-grade request within prescribed guidelines (see below). To access Gradescope, simply log on to our course's Canvas site and click on gradescope in the left navigation menu.
How to scan assignments via iOS and Android devices:
`gradescope-static-assets.s3-us-west-2.amazonaws.com/help/submitting_hw_guide.pdf`
Where to find copier/scanners:
`www.cmu.edu/computing/services/teach-learn/tes/computer-labs/images/printers-labs.png`
Policies and advices about using Gradescope:

- If you are writing your assignment by hand (on paper), be sure to use a dark pencil or pen, and write clearly!
- When you upload your work to Gradescope, be sure to (a) indicate where each question is located within your submission via the click-and-select interface and (b) after you submit, review each page of your uploaded submission to make sure everything is clear and legible.
- Give yourself some extra time to prepare and submit your assignment online to Gradescope, especially for the first few assignments when you are still getting familiar with it.
- Keep a soft copy of each scanned assignment for your records.
- Re-grading request must be made online within seven days the score is uploaded on Canvas Grades, which shall be about seven days after the homework due time. **So check your grades on Canvas often.** Each re-grading request must clearly state the issue and reason for re-grading. Without such information, the re-grading request will be ignored without notification.
- If you need help with technical issues related to Gradescope, email: `canvas-help@andrew.cmu.edu`.
- **It is your responsibility to make your homework readable**. If the grader cannot read your submission, there is no way to award points, so the default grade will be 0.

Communication, Email, and Piazza. This semester we will be using Piazza for class discussion. Rather than emailing questions to me or the TA, I encourage you to post your questions on Piazza. The Piazza course page can be accessed from within Canvas.
When you really prefer sending email, please put "36700" at the beginning of the subject line so that I know the message is not spam. I may choose to respond on Piazza when it is appropriate.

Disability Resources. If you have a disability and are registered with the Office of Disability Resources, I encourage you to use their online system to notify me of your accommodations and discuss your needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at `access@andrew.cmu.edu`.

36700 – Course Calendar – Last Updated February 6, 2019 – Jing Lei
All topics are tentative; dates of the exams and assignments are fixed.

Lect. #	Date	Lecture Topic	In Wasserman	Assignment
1	Jan 14	overview, probability space	Sec 1.1-1.4	
2	Jan 16	independence, conditioning, Bayes theorem	Sec 1.5-1.7	
3	Jan 18	random variables	Sec 2.1-2.2	
–	Jan 21	**No Lecture** - MLK Day		
4	Jan 23	important random variables	Sec 2.3-2.4	
5	Jan 25	bivariate, marginal, conditional, independence	Sec 2.5-2.10	HW 1 Due
6	Jan 28	transformation of random variables	Sec 2.11-2.12	
7	Jan 30	expectation, variance	Sec 3.1-3.4	
8	Feb 1	conditional expectation	Sec 3.5	HW 2 Due
9	Feb 4	probability inequalities	Sec 4.1-4.2	
10	Feb 6	convergence of random variables	Sec 5.1-5.2	
11	Feb 8	LLN and CLT	Sec 5.3-5.5	HW 3 Due
12	Feb 11	point estimation: basics	Sec 6.1-6.2, 6.3.1	
13	Feb 13	review		
–	Feb 15	**Exam 1**	Sec 3.4-3.7	
14	Feb 18	point estimation: MOM and MLE	Sec 9.1-9.4, 9.6	
15	Feb 20	point estimation: Bayes estimator	Sec 11.1-11.3	
16	Feb 22	asymptotic theory: basics		HW 4 Due
17	Feb 25	consistency of MLE	Sec 9.5	
18	Feb 27	asymptotic normality of MLE	Sec 9.7	
19	Mar 1	Fisher information	Sec 9.8	HW 5 Due
20	Mar 4	hypothesis testing: basics	Sec 6.3.3	
21	Mar 6	Wald, χ^2, likelihood ratio tests	Sec 10.1-10.6	
–	Mar 8	**No Lecture** - Mid-Semester Break		
–	Mar 11	**No Lecture** - Spring Break		
–	Mar 13	**No Lecture** - Spring Break		
–	Mar 15	**No Lecture** - Spring Break		
22	Mar 18	permutation test, p-value	Sec 10.1-10.6	
23	Mar 20	confidence intervals	Sec 6.3.2	
24	Mar 22	asymptotic confidence intervals		HW 6 Due
25	Mar 25	nonparametric CDF estimation	Sec 7.1	
26	Mar 27	review		
–	Mar 29	**Exam 2**		
27	Apr 1	nonparametric density estimation	Sec 20.3	
28	Apr 3	nonparametric estimation of functionals	Sec 7.2	
29	Apr 5	bootstrap: basics	Ch. 8	HW 7 Due
30	Apr 8	bootstrap	Ch. 8	
31	Apr 10	bootstrap confidence intervals	Ch. 8	
–	Apr 12	**No Lecture** - Spring Carnival		
32	Apr 15	Linear regression	Sec 13.1-13.2	
33	Apr 17	MLE and properties	Sec 13.3-13.4	
34	Apr 19	multiple regression	Sec 13.5	HW 8 Due
35	Apr 22	logistic regression	Sec 13.7	
36	Apr 24	information criteria	Sec 13.6	
37	Apr 26	cross-validation		HW 9 Due
38	Apr 29	review		
39	May 1	review		
–	May 3	**Exam 3**		