36-225 – Introduction to Probability Theory

Fall 2020

Instructor

	Email	Office Hours
Yuting Wei	ytwei@cmu.edu	MW 10:10-11:00 AM, or by appointment http://www.stat.cmu.edu/~ytwei/

Lecture	MWF 9:20 AM – 10:10 AM Zoom ID: 807 208 2710
Optional Text	*Mathematical Statistics with Applications* (7^{th} Edition) Wackerly, Mendenhall, & Scheaffer (ISBN 978-0-495-11081-1)
Canvas Web Site	https://canvas.cmu.edu/courses/19806

Teaching Assistants: Qi Xin (qix@andrew.cmu.edu).
TA office hours (starting week 2, held by the TA group, shared between Sections A & B): Thursday 2-5pm; 5:30-10pm, Zoom ID's will be provided on Canvas. Additional OH will be announced when confirmed.

Introduction to Probability Theory comprises the first of a two-semester introduction to modeling random variation in data. I will cover material in Chapters 2-7 of Wackerly et al.: the basic rules of probability, discrete and continuous random variables, functions of random variables, univariate and multivariate probability distributions, and the central limit theorem. In addition, I will cover additional material such as the law of large numbers, Markov processes, probabilistic graphical modeling, etc., as time permits.

This is a concept-driven class: the numbers you derive while answering a problem are secondary in importance to fully understanding the concepts that you applied when solving the problem!

By the end of this course...

- You will understand and will be able to verbally describe fundamental concepts of probability: (un)conditional probability, random variables, univariate and multivariate distributions and metrics associated with them, covariance, transformations of random variables, moment-generating functions, statistics and sampling distributions, and the central limit theorem.
- You will understand how the concepts listed above fit within the overall discipline of statistics: when and why do we make use of them? How do we choose families of distributions? In what contexts do we make use of sampling distributions? Etc.
- You will be able to carry out mathematical operations to effectively model random phenomena: what is the mean of a distribution? What is the probability that the next datum I observe will have a value between a and b? If I transform my data, how does the probability density function change? Etc.

Administrative Remarks

Lectures

Zoom Meeting ID: `807 208 2710`
Passcode: See `Canvas`

Audio and video sharing. I expect and encourage you to have your cameras on during lectures. However, I also completely understand there may be reasons some of you would not want to have cameras on.

During our class meetings, please keep your mic muted unless you want to ask a question or make a comment through audio chat. You can also use the chat or the "raise hand" feature (available when the participant list is pulled up). I (or a TA or a rotating student who serves as the "voice of the chat") will be monitoring these channels in order to call on students to contribute.

Recording. The lectures will be recorded in order to accommodate asynchronous students. Recorded lectures will be made available on `Canvas` shortly after each lecture. **Please note that you are not allowed to share these recordings**. This is to protect your FERPA rights and those of your fellow students.

The instructor's office hours will also be offered on Zoom with the same meeting ID, no password required.

Lecture Notes. Notes will be made available in PDF format prior to lectures. A given set of notes will generally cover more than one lecture. New sets of notes will be posted as needed, no later than 3 PM on the day before they are needed. *It is your responsibility to print out materials, if you choose to do so.* The notes will not be complete: I will fill them in during lectures.

Textbook. The optional text provides background material that is meant to supplement lectures. Each set of lecture notes indicates what sections of the text you should read if you choose to do so.

Attendance. Class attendance is not explicitly required, although if you are absent for quizzes your grade will certainly suffer. Attendance is heavily encouraged as it is very easy to fall behind in a class such as 36-225 very quickly.

Research has shown that divided attention is detrimental to learning, so I encourage you to close any windows not directly related to what we are doing while you are in class. Please turn off your phone notifications and limit other likely sources of technology disruption, so you can fully engage with the material, each other, and me. This will create a better learning environment for everyone.

Homework

There are no exams. The grade will be based on homework assignments and quizzes.

Homework. Homework assignments will be posted on `Canvas`, and will be due on Fridays beginning the second week of class. We will use `Gradescope` as our assignment submission and grading platform. You will need to provide a clean, easily readable scan of your assignment, either through the use of a scanner or your phone. (For more information about `Gradescope`, see `https://www.cmu.edu/teaching/gradescope/index.html`.)

Late homework submission. Homework assignments that are turned in late but no more than 6 hours late will receive 75% credit; those turned in more than 6 hours late but no more than 24 hours late will receive 50% credit; those turned in more than 24 hours late will not be graded and will receive 0 credit, regardless of the reason they are late! **Homework will be due every Friday except for Weeks 1, 8, 13, and 15, including during Week 7 when there is no class on Friday.** Homework solutions will be posted on Canvas 24 hours after due time.

Homework scores. Homework will be graded and the scores will appear on `Gradescope` and `Canvas` within one week of submission. You must bring any missing homework score to my attention within one week of the homework being graded, so check your grades on `Canvas` often. Feel free to discuss homework assignments with others, but realize that the work you hand in must be your own. Simply copying someone else's work (or any solutions floating around on the web, dark sectors or otherwise) is plagiarism; see "Cheating" below. **Your lowest two homework scores will be dropped; your highest score will count double.**

Quizzes

Quizzes will be given on Mondays in Weeks 4, 6, 8, 10, 12, and on Friday in Week 15. The quiz coverage is not cumulative. The coverage of each quiz ends at (including) the last homework submitted before that quiz. For example, Quiz 1 convers Homework 1 and 2, and Quiz 2 covers Homework 3 and 4, etc. Quizzes will contain a few multiple choice questions and no more than two free response questions that will be similar to, *but not identical to*, problems from the covered homework assignment(s). Quizzes are open book and open notes. You are allowed to use basic calculators. Discussion with others is not allowed for quizzes.

The quiz will be given on `Canvas` (or `Gradescope`, if it turns out to be a better platform for quizzes). You can choose any 40-minute time span between noon (12pm) and midnight (11:59pm) to work on the quiz and upload the answer (if necessary). Further instructions will be available on `Canvas` before the first quiz.

Your lowest quiz score will be dropped; your highest score will count double.

Accommodations. If you cannot take a quiz due to time conflict, you must contact me at least two weeks before the quiz time (see also "Disability Resources" below). I will not grant last-minute accommodations because you are sick or because of a family emergency, or technical problems (such as internet, laptop), etc., etc., *without the explicit written/emailed consent of your academic advisor*! Contact your advisor first, and have your advisor contact me directly.

If you miss a quiz without previously contacting me, and/or without having your advisor previously contact me, it cannot be made up!

Grades

Your final numerical grade will be 40% from homework and 60% from quizzes, where the two lowest homework scores are dropped and two hightest count double, and the lowest quiz score is dropped and the highest counts twice.

Your final letter grade will be based on a curve. The characteristics of the curve depends on how the class does as a whole and will be determined at the end of the semester. Note that your final letter grade will never be lower than what I would assign via a straight-scale grading model ($\geq$90 for an A, 80-90 for a B, etc.). For instance, a final numerical grade of 72 would earn you at least a

C regardless of the curve.

Software

In this course we will occasionally use computer simulations to assist understanding of randomness and probability computation. Sometimes we will also use software packages to numerically evaluate some distribution functions. These can be conveniently achieved by using the software package `R`. Tutorials for basic use of `R` will be provided on Canvas when necessary. You are also free to choose other tools, such as `Python`, if you prefer.

ISLE. Alternatively you can also try `ISLE`, the *Integrated Statistics Learning Environment*. See `http://www.stat.cmu.edu/isle/` for details.

A Simple Calendar

All homework assignments are due on Fridays, and Quizzes 1–5 will be on Mondays. For example, hw1 will be due on Friday September 11, and quiz 1 will be on Monday September 14. The only exception is Quiz 6, which will be on Friday December 11.

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W1:  8.31  - 9.4
W2:  9.7   - 9.11  (no class on 9.7, Labor Day) hw1 due
W3:  9.14  - 9.18  hw 2 due
W4:  9.21  - 9.25  quiz 1; hw 3 due
W5:  9.28  - 10.2  hw 4 due
W6:  10.5  - 10.9  quiz 2; hw 5 due
W7:  10.12 - 10.16 (no class on 10.16, Comm. Engage.) hw6 due
W8:  10.19 - 10.23 (no class on 10.23, Mid. Sem.) quiz 3
W9:  10.26 - 10.30 hw 7 due
W10: 11.2  - 11.6  quiz 4; hw 8 due
W11: 11.9  - 11.13 hw 9 due
W12: 11.16 - 11.20 quiz 5; hw 10 due
W13: 11.23 - 11.27 (thanksgiving, no class)
W14: 11.30 - 12.4  hw 11 due
W15: 12.7  - 12.11 quiz 6 on Friday
```

You must receive a C or higher in this course to be eligible to take 36-226. You must receive an A in this course to be eligible to take 36-326, the "honors" version of 36-226, if it is offered in Spring 2021.

Note: the drop deadline is the Monday of Week 7 (October 12th), while the withdrawal deadline is the Monday of Week 11 (November 9th).

Miscellaneous

Piazza. The main mode of electronic communication between students and staff, as well as amongst students, will be through Piazza (`http:www.piazza.com/`). It is intended for general questions about the course, clarifications about assignments, student questions to each other, discussions about material, and so on. We strongly encourage students to participate in discussion, ask and answer questions through this site. The course staff will monitor discussions closely.

(a) Do not provide answers to homework problems, or discuss quiz problems, etc., until after homework is turned in, or all quiz solutions have been posted, etc. Violations of this rule will result in what I will call a "doubling penalty": the first time, a 1% final grade penalty; the second time, a 2% final grade penalty; etc. The penalties are cumulative, e.g., after the second violation your final grade will be reduced by 3% total, etc.
(b) Be considerate! This is *not* an Internet comment board (though you should be considerate on one of those as well, I guess). Inappropriate content will be removed. Repeated lack of consideration will lead to my implementation of the "doubling penalty," at my discretion.

Cheating. Cheating or plagiarism on homework, quizzes, or tests will be dealt with as allowed under CMU policies: `http://www.cmu.edu/policies/student-and-student-life/academic-integrity.html`. *Note that if a problem happens to be a reused one and you copy from a previously posted solution set, you will receive a grade of zero for the assignment the problem is on.*

Disability Resources. If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and 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`. *I will make no allowances without appropriate documentation.*

Email. All the course materials related questions should go to Piazza. If you have personal issue, you can email me at `ytwei@cmu.edu`. Note, however, that sending email does not shift any responsibility from you to me; you are still responsible for completing your assignments.

On a final note... Many of your syllabi will have verbiage about taking care of yourself. This is especially important in this unusual environment.

My take on this is that you have to realize that in the greater scheme of things, your performance in this course is not as important as your physical and mental health. Use your time wisely during the day, and sleep at night. Sleep during the day too, if you need to. (If you sleep in class, make sure you are muted on Zoom!) Don't take on more courses and more responsibilities than you can reasonably handle. For some of you, this is easier said than done, but do try to scale back if you need to.

If, however, you find that you are struggling and need support, feel free to seek me out. (Would I hold your struggles against you? No, of course not.) Or seek out other resources, such as Counseling and Psychological Services (CaPS; 412-268-2922 or `http://www.cmu.edu/counseling/`) or the Re:solve Crisis Network (888-796-8226). If you or someone you know is in a life-threatening situation, however, forget these resources and call the police immediately (8-2323 on campus, 911 off campus).