Math 311

Probability

Fall 2018

Who:	Jim Bentley	Office: 227 AHN (ext. 8621)
When:	MWF 11:00–12:20	
Where:	AHN 216	
Text:	Wackerly, Mendenhall, and Scheaffer, *Mathematical Statistics with Applications*, 7th ed., ISBN 978-0-495-11081-1	
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GOALS: Math 311, *Probability*, is an introduction to probability theory. The emphasis of the course will be on both a conceptual understanding of probability and the underlying mathematical theory. Whenever possible we will use real data in application of the topics. Mastery of the following topics should prepare you for further classes in probability or for a class in mathematical statistics.

TOPICS:

1. Introduction

    (a) Probability and Statistics

    (b) Graphical Methods

    (c) Numerical Descriptives

2. Probability

    (a) Review of Set Theory

    (b) Notation

    (c) Sample Spaces and Events

    (d) Axioms and Propositions

3. Conditional Probability

    (a) Bayes' Rule

    (b) Independence

4. Random Variables

    (a) Cumulative Distribution Functions (cdf's)

    (b) Probability Mass Functions (pmf's)

    (c) Probability Density Functions (pdf's)

    (d) Expectation

    (e) Variance

    (f) Discrete Distributions — bernoulli, binomial, Poisson, geometric, negative binomial, and hypergeometric

    (g) Continuous Distributions — uniform, normal, exponential, gamma, cauchy, and beta

5. Joint Distributions

    (a) Joint cdf's

    (b) Sums of Random Variables

    (c) Joint Conditional Distributions

6. Expectation, Variance and Covariance

    (a) Of Sums of Random Variables

    (b) Conditional Expectation

    (c) Moment Generating Functions (mgf's)

7. Distributions of Functions of a Random Variable

    (a) Additivity in the Discrete Case

    (b) By CDF

    (c) By Transformation

    (d) By mgf's

8. Limit Theorems

    (a) Chebyshev's Theorem

    (b) Central Limit Theorem (clt)

    (c) Jensen's Inequality

9. Simulation, *etc.* as Time and Interests Permit

GRADING:

- 30% Homework: Work will not be accepted for credit once grading of the assignment has begun. Since answers for some of the problems are given in the back of the book, to gain credit you must support your answers by showing evidence of your thought process—your reasoning. Use one side of the page, write legibly (in pencil unless you are perfect and never need to erase), and staple your pages together. Please be sure to order your answers sequentially and place them in a single column. In short, put yourself in the grader's place and think about how you can make their life easier.

  Much of what we will do in this class will take more time than is available during an exam. Since your time is essentially "unlimited" outside of the classroom (yes, I know you have other classes), homework problems are a perfect place to see what you can do with problems which are less contrived than would be appropriate for a test. Homework is thus an important part of the learning experience in this course. Please feel free to work together, but be sure to turn in your own version of the solution — copied solutions are unacceptable. If you choose to get help from others (including faculty), be sure that you fully understand whatever information they have given you. If you choose not to do the homework, or receive failing grades for those assignments you do turn in, the highest overall course score you can achieve is a 70% (or a C–). Historically, those individuals who did not earn a passing grade on their homework also earned low scores on their exams and thus failed the course. Please take the homework assignments seriously. . . I will.

- 40% Two midterms (Tentatively Fri. Oct. 5 and Wed. Nov. 7): Make up exams will only be given if you let the instructor know *in advance* that you will not be able to make the scheduled test. You must posses a reasonable excuse for your absence. **Any unauthorized use of a cell phone, tablet, computer, or similar device during an exam will result in a failing grade.**

  Midterms are intended to encourage you to review the material presented in class and in the text. They also test *your* knowledge of the key topics and *your* ability to combine these topics in a creative manner. If you have not taken an active part in producing solutions to homework problems it will become apparent. Remember, time is limited, so focus on the important ideas.

- 30% Final (Sat., Dec. 15, 9:00 AM): The final will be 50% cumulative and 50% material from the last third of the class.

OFFICE HOURS: MWF 9:30–10:50, MW 3:50–4:15, or by appointment. These are times when I will be in, or near (*ex.* in a computer lab or near the copier) my office. I'll be around at other times, so if my door is open and nobody else is getting help, turn your cell phone off, knock and then come on in. If I'm busy I'll ask you to come back at another time. Don't be offended, just come back later.

ATTENDANCE: You are encouraged to attend all class sessions. Remember that mathematics builds upon itself. You may not realize that the material you missed by being absent for a day is really important until knowledge of it is assumed a couple of weeks later. If you must miss a class, be sure to get notes from a classmate and fully understand the material before the next class meeting.

The last day to drop is Wed., October 10. Fall Break is Sat., October 6 through Tues., October 9. Thanksgiving Break is Wed., November 21 through Sun., November 25. The last day of classes is Mon., December 10.

CELL PHONE: In consideration of your classmates, please turn your cell phone off before entering our classroom. You may not be able to hear the vibration when your phone rings or the clicking as you send text messages, but many of your classmates and I can. By distracting me you are detracting from the quality of the experience that I can provide for everyone else in the room.

ACADEMIC HONESTY: Please familiarize yourself with the University's policy on academic honesty (see the Catalog). You are encouraged to work together when appropriate. However, it is expected that the work you turn in on individual assignments and exams will be yours alone. If there is evidence that you have copied any part of your work, you will be subject to University disciplinary action for plagiarism.

LEARNING OUTCOMES: At the end of this class you should:

1. be able to use basic counting techniques (multiplication rule, combinations, permutations) to compute probability and odds.

2. be able to compute conditional probabilities directly and using Bayes' theorem, and check for independence of events.

3. be able to work with discrete random variables. In particular, understand the Bernoulli, binomial, geometric and Poisson distributions.

4. be able to work with continuous random variables. In particular, know the properties of uniform, normal, gamma, beta, and exponential distributions.

5. know what expectation and variance mean and be able to compute them.

6. understand the law of large numbers.

7. be able to compute the covariance and correlation between jointly distributed variables.

GRADING SCALE: Major components of this course will be graded on a percentage scale. The individual grades will be combined using the given weights. I reserve the right to modify the percentage scale using a variance stabilizing transformation or other means if I feel that the distribution for the class is too low.

Percentage	12 point	U of R	Grade	Percentage	12 point	U of R	Grade
$96.7 \leq X \leq 100$	12	4.0	A+	$76.7 \leq X < 80.0$	6	2.3	C+
$93.3 \leq X < 96.7$	11	4.0	A	$73.3 \leq X < 76.7$	5	2.0	C
$90.0 \leq X < 93.3$	10	3.7	A-	$70.0 \leq X < 73.3$	4	1.7	C-
$86.7 \leq X < 90.0$	9	3.3	B+	$67.7 \leq X < 70.0$	3	1.3	D+
$83.3 \leq X < 86.7$	8	3.0	B	$63.3 \leq X < 67.7$	2	1.0	D
$80.0 \leq X < 83.3$	7	2.7	B-	$60.0 \leq X < 63.3$	1	0.7	D-
				$X < 60.0$	0	0.0	F