STAT 300 (3 cr)
Modern Probability & Statistics
Fall 2017

Description
A Calculus-based introduction to probability and the application of mathematical principles to the collection, analysis, and presentation of data. Modern probability concepts, discrete/continuous models, and applications; estimation and statistical inference through modern parametric, nonparametric, and simulation/randomization methods; maximum likelihood; Bayesian methods. This course prepares students for the preliminary P/1 exam of the Society of Actuaries and Casualty Actuarial Society.

Prerequisites
MATH 191 or equivalent placement. Students should be comfortable with Calculus notation and methods. No previous knowledge of probability or statistics is assumed.

Materials
Required: Print activities and assignments from Blackboard or www.bradthiessen.com

Optional: *Essentials of Mathematical Statistics* by Albright (ISBN: 978-1-4496-8534-8)
I have other textbooks in my office if you want more practice or a different explanation.
We'll use some statistical software in class, so you may want to install it on your pc.

Student Learning Outcomes

Develop statistical literacy
- Assimilate technical knowledge from readings
- Make valid conclusions from visual displays of data
- Accurately interpret output from statistical applications

Develop statistical computation skills
- Apply Calculus to derive formulas and calculate probabilities
- Describe data using appropriate, meaningful summaries
- Use formulas to calculate basic probabilities and carry-out statistical analyses
- Conduct simulations (randomization/bootstrap methods)

Develop statistical communication skills
- Communicate statistical analyses and results using appropriate terminology and notation
- Develop appropriate, meaningful, effective visual displays

Develop statistical reasoning
- Develop and evaluate competing hypotheses
- Explain statistical processes
- Fully interpret results of analyses
- Choose appropriate analysis methods
- Identify and explain sources of variation
- Explain and evaluate assumptions for analysis methods

Develop statistical thinking
- Explain the need for data and analysis
- Develop models to simulate/explore random phenomena
- Recognize how, when, why inferential tools can be used
- Make appropriate conclusions from statistical analyses
- Quantify variability
- Explore data numerically and graphically
- Evaluate visual displays and analysis methods

// 183 specific learning objectives available on course website //

Attendance policy:
In-class experiences cannot be fully reproduced outside of class. While you will not lose points due for absences, virtually all students who have failed this class have had poor attendance.

If you'll miss class, I'd appreciate it if you let me know in advance. You must get approval before missing exams.

Academic integrity policy:
You must work alone on exams! Academic dishonesty in any form is not tolerated and will be dealt with according to university policies.

Review the SAU policy at http://web.sau.edu/Registration/documents/AcademicIntegrityPolicy.pdf

Use of electronic equipment
Computers will be used extensively in this course (for calculation; not for communicating with other students during exams). Out of courtesy to other students, please turn off the volume on any devices.

Accessibility Resource Cntr:
Students with disabilities who believe they may need accommodations are encouraged to contact the Accessibility Resource Center at 333-6275 as soon as possible to ensure accommodations are implemented in a timely fashion.

300-A: McMullen 102
M/W 2:00-3:15

300-B: McMullen 102
M/W 3:30-4:45

Instructor:
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thisisstatistics.org/students/

Hours: MWF 1-2, T 1-3
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Course Procedures & Expectations

In this course, you'll solve problems and analyze data using concepts and modern methods of probability and statistics.

Working together on in-class activities, we'll define new concepts and derive new methods. If you print and briefly review these activities before class, you'll learn these concepts more easily (and you won't need to read so quickly during class). Students who participate in these activities – by asking and/or answering questions – typically perform well in this class. You will be able to use these activities (and any notes you write on them) during exams.

Following each activity we complete in class, you will download and complete one assignment outside of class. These assignments give you a chance to apply what we learned in class on real or realistic scenarios. I encourage you to work with other students on these assignments, but make sure you understand each answer you provide. If you turn-in an assignment within a week of its corresponding activity, I will provide feedback on your solutions and will email you a copy of the solutions (which you can use during exams). While you can turn in assignments late – and still receive credit – you will not receive any feedback on your work.

Three unit exams – which contain both in-class and take-home portions – are designed to measure your mastery of the 183 course learning outcomes and your ability to apply skills to (slightly) new situations. You will use both your notes (from in-class activities) and a computer to complete the exams. Don't expect to find solutions online – students relying on Google searches perform extremely poorly on these exams. You must work alone on the exams and you must complete each exam within the allotted time. You cannot work or communicate with anyone else during the exams.

I am not interested in your ability to memorize definitions, use formulas, or calculate things by hand. Formulas and definitions are available online and computers will handle the calculations. Instead, I want you to learn to think, act, and communicate like a statistician. To do this, I expect you to participate in class discussions, complete assignments, and seek help when needed. Your goal in this class should be to master all course outcomes (and not always on your first attempt).

Do not fall behind! Email or visit me if you have any questions or need assistance. I'm happy (and I get paid) to help.

// re-assessment and other opportunities //

Occasionally, I may think of interesting questions or mini-projects to extend your learning. These opportunities may involve the use of R (a popular, free statistical programming language) which we'll use in class. If I do offer these opportunities, completing them will reduce the weight of the unit exam on your unit grade. We'll discuss the details of this as opportunities arise.

Students can also receive credit for completing two online surveys (at the start and end of the semester) and an online test (at the end of the semester). The SATS (Survey of Attitudes Towards Statistics) evaluates how your attitudes towards statistics change over the course of this semester; the online test compares your statistical literacy to students in other statistics classes across the nation. You will receive a 5% credit for completing both surveys and the test (i.e., the unit exams will count for 5% less of your grade). While you should respond honestly and answer as best you can, your responses to the surveys and performance on the online test will not affect your grade at all. In fact, I can't access to your responses until a few weeks after the semester has ended.

Your grade in this class reflects the degree to which you master all 183 course outcomes by the end of the semester. The easiest way to demonstrate mastery is to complete all assignments and perform well on the unit exams. If, however, you are not satisfied with your score on any exam, you have opportunities to improve (or, potentially, lower) each unit score. To do this, you must:

1) Use the score sheet I provide after each exam to identify some course outcomes you have yet to master
2) Correct mistakes on **all** test problems related to those outcomes. Show your work and briefly explain why you missed each problem (identify your misconceptions or explain why your approach did not work).
3) Provide evidence that you mastered those outcomes. This evidence should include completion of additional practice problems (problems I identify from the textbook, problems I identify online, or problems you find independently). It should also include at least 2 original questions you write and solve on your own.
4) Show me this evidence and schedule a time with me to demonstrate your mastery of the outcomes. I may have you take a short quiz on the topic (with or without notes), complete a project, or teach a short lesson to me. If you do those 4 things, your unit grade will update to reflect your current level of mastery

Notes: This opportunity is only available to students who complete all assignments within each unit.
This opportunity may not be available for the final unit in the course (due to limited time at the end of the semester).
This opportunity is subject to my availability. Do not attempt to reassess if you have not mastered the outcomes!

You'll notice that I've identified useful problems from our (optional) textbook and from an online source. Completing these problems is optional. If you choose to complete the problems, I will give you access to the solutions to check your work. We won't use class time to review these problems, so contact me if you'd like help.

Assessment & Grading

Based on evidence from your exams and assignments, your grade will reflect the degree to which you master the course outcomes by the end of the semester.

This course consists of three units: (1) probability/inference basics; (2) applied probability models; (3) statistical inference. Within each unit, scores will be calculated according to one of three weighting systems:

	Exams Only	Exams + Assignments	Exams + Assignments + Other
Unit Exams	100%	80-90%	60-70%
Assignments*	0%	10-20%	10-20%
Survey/Test	0%	0%	5%
Mini-projects	0%	0%	15%
TOTAL:	100%	100%	100%

To calculate your final course grade, I will average your three unit scores and use the following grading scale:

A (100-90%) B (90-80%) C (80-70%) D (70-60%) F (60-0%)

If you choose not to complete any assignments, the online surveys, or mini-projects, your grade depends entirely on your performance on the exams. While it's theoretically possible to earn an A without completing any assignments, no student has ever done this in the 14 years I've taught the course.

Completing all the assignments in any unit earns is worth at least 10% credit. Each assignment you complete correctly (with, at most, a couple mistakes) is worth double-credit, so you can earn up to 20% credit. These assignments really do prepare you for the exams – and give me a chance to see what topics I need to reinforce – so I strongly recommend you plan on completing every assignment.

// FAQ //

Do I need to buy the textbook?

It depends. I chose a textbook that is extremely accessible while aligning with the outcomes of this course. It's not the most interesting book to read, but it provides succinct, clear explanations and examples. If you will actually read the textbook and work through the examples, it will help you master the course outcomes. I will keep a copy of the textbook (and other helpful textbooks) in my office and I can also point you to exceptional resources that are freely available online.

What grade should I expect to earn?

It depends. Over the past 7 years, the distribution of grades from students enrolling in this course has been:

27% = A 25% = B 22% = C 26% = D, F, W

That distribution doesn't necessarily reflect the grade you should expect. If you participate in class, complete the assignments, and reassess when necessary, you should expect an A or B in the course. If you don't do those things, you should expect a D or F.

Do I need to complete homework problems from the textbook or from the course website?

It depends. Participating in class, completing the in-class activities, completing out-of-class assignments, and reviewing the solutions to those assignments will best help you master the course outcomes. I'd recommend you spend 6-9 hours per week doing those things. While the homework problems will give you extra practice, I'd complete them as needed as part of the reassessment process.

Do I need to complete mini-projects?

It depends. Do you want to solve fun problems? Do you want to develop some proficiency with R, a skill that's in demand? Do you want to earn some additional credit?

I need help! What should I do?

Meet with me (or at the very least, email me)! Probability can be tricky and statistical methods aren't always intuitive. If you don't understand something from class, let me know. If you meet with me and you're still having problems, tell me! There are a variety of ways to explain these concepts and solve problems, so we'll work together to find a way that makes sense to you. I also encourage you to work with other students in the class (on everything except the exams!).

Week	Activities & Supplements	Assignments	Textbook Homework	Online homework
8/23	Course overview / introductions 1: Randomization-based inference	SATS-36 survey 1 Lab	Read section 1.1	See course website for suggested readings (and homework problems/solutions)
8/28 8/30	2 Probability basics 3 Counting techniques	2 Tricky, ice cream 3 Buses, Nurse Gilbert	1.2: 1, 3, 9 1.3: 1, 3, 5, 7, 9, 17 1.4: 3, 7, 9, 17	2.2: 11-25 2.3: 29-41
9/6	4 Conditional probability 5 Independence	4 Infection, practice **Lab #2** 5 Satellite, shipyard	1.5: 1, 3, 7 1.6: 3, 7, 9, 13 1.7: 3, 5, 7 2.2: 3, 19	2.4: 45-59 2.5: 71-108
9/11 9/13	6 Discrete random variables 7 Binomial & Sign tests Chance to win 1 million points	6 Bayes, E[x], Var[x] 7 Exam Practice **Lab #3**	2.3: 1, 3, 5, 7, 9, 11, 13 2.5: 1, 9, 11, 13 7.2: 1, 3	3.1: 1-7, 3.2: 11-17
9/18 9/20	••• **Exam #1** •••	Review all activities and assignments	Get a jump start on unit #2	3.3: 29-34, 3.4: 46-57
9/25 9/27	8 Discrete distributions	8 Coaches, Tests, Practice	2.4: 3, 5, 7, 9	Chapter 3: 69-85
10/2 10/4	9 Continuous random variables 10 Continuous distributions	9a Robot | 9b Battery 10 Fishing	3.2: 1, 3, 5, 9	4.1: 1-5, 4.2: 11-15 4.4: 59-61
10/9 10/11	11 Normal distribution 12 Visual and statistical summaries RStudio example: Baby names	11 Normal practice 12 Derive mean and median **Lab #4**	3.3: 9, 11, 19 3.4: 1, 3, 9, 13, 17	4.3: 28-47 4.4: 33-39, 1.4: 47-51
10/16 10/18	13 Maximum likelihood 14 Sampling distributions	13 Point estimates, MLE 14 Sampling, CLT **Lab #5**	4.1: 1, 5, 7, 9 4.2: 3, 5, 6, 9, 13, 17 2.7: 1, 3, 11 (optional) 4.3: 1, 5 (optional) 4.4: 4	6.1: 1-5, 6.2: 20 6.3: 37 5.4: 46-53 5.5: 59-65
10/23 10/25	••• **Exam #2** •••	Review all activities and assignments	Get a jump start on unit #3	
10/30 11/1	15 Interval estimation	15 Bootstrap intervals **Lab #6**	3.8: 1, 3, 5, 7 4.6: 1, 3, 5, 7	7.1: 1-5, 7.2: 13-23 7.3: 29-37, 8.1: 1-7
11/6 11/8	16 Hypothesis testing 17 Two means tests	16 Hypothesis test practice 17 Concept Quiz	5.2: 1, 3 5.3: 3, 5, 9, 11 4.5: 3, 5, 9, 11	8.2: 17-25, 8.4: 45-53 8.3: 35-39
11/13 11/15	18 2+ group comparisons	18 2-group comparisons **Lab #7**	4.8: 1, 3 5.4: 1, 3, 5	9.1: 1, 9.2: 21-27 9.3: 39-41
11/20 11/22	No class: Thanksgiving Break			
11/27 11/29	19 Matched, ANOVA, BEST, E.S.	Review all activities and assignments	5.6: 3, 5, 9, 11, 15 4.8: 7, 9, 15	
12/4 12/6	Other topics in statistics Review for final exam	SATS-36 survey Complete CAOS		
FINAL	••• **Exam #3** •••			

R code, online readings, and instructional videos are available on the course website: http://www.bradthiessen.com

Click any of the activities, assignments, or labs listed above to download

All materials are also available through the course Blackboard page