STAT 301 (3 cr) Statistical Modeling Fall 2017

Description

The development, application, and evaluation of statistical models. Univariate and multivariate general linear models (ANOVA, ANCOVA, MANOVA, linear regression), generalized linear models (logistic and Poisson regression), and nonlinear models. Experimental design and model estimation (robust and randomization-based methods), fit, and interpretation. Students are introduced to multivariate and statistical learning techniques, e.g., multidimensional scaling, principal components analysis, cluster analysis, & structural equation modeling.

Prerequisites

A previous statistics course (e.g., STAT 213 or MATH/STAT 300) that introduces statistical inference. I assume you have a conceptual understanding of probability, sampling distributions, the Central Limit Theorem, statistical inference, confidence intervals, hypothesis testing, and sources of error. We will briefly review as needed.

Materials

Required: Download (and maybe print) activities from Blackboard or www.bradthiessen.com

Optional: *R for Data Science* by H. Wickham (available free at http://r4ds.had.co.nz)
We'll use R and RStudio in class, so you may want to install them on your pc.

Student Learning Outcomes

Develop statistical computation skills

- Use formulas to carry-out statistical analyses
- Use statistical software to conduct analyses and explore data

Develop statistical reasoning

- 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
- Apply knowledge in novel situations

Develop statistical communication skills

- Communicate statistical analyses and results using appropriate terminology and notation

Develop statistical thinking

- Develop models to simulate and explore random phenomena
- Recognize how, when, and why inferential tools can be used
- Make appropriate conclusions from statistical analyses
- Quantify variability
- Explore data numerically and graphically
- Describe common pitfalls & sources of error in statistical analyses
- Evaluate fit and validity of statistical models

Develop statistical literacy

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

// 157 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.

301-A: McMullen 008
T/R 12:15-1:30

Instructor:
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thisisstatistics.org/students/

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

In this course, you'll build, evaluate, and use statistical models to gain insight and make informed decisions. As much as possible, we will actively analyze real data from a variety of sources.

Working together on in-class activities, we'll define new concepts and derive new methods. If you 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 in-class activity, you will complete one assignment and one Your Turn outside of class to apply and extend your learning. I encourage you to work with other students on these; just make sure you understand what you're doing. When you submit an assignment or Your Turn (typically within a week), I will provide feedback on your solutions. Sometimes, I may ask you to use that feedback to re-submit your work. You can use these assignments, along with any feedback, on the exams.

Two unit exams – containing in-class and take-home portions – measure your mastery of the 157 course learning outcomes and your ability to apply skills to new situations. You will use your notes 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. For the third unit, you will complete a data analysis project (which we'll discuss later).

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 //

Your grade in this class reflects the degree to which you master all 157 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!

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) ANOVA, Experimental Design; (2) General Linear Model; (3) Project. For units 1-2, scores will be calculated with the following weights:

	Weights
Unit Exams	50%
Assignments	20%
Your Turns	30%
TOTAL	100%

The project will count for 100% of your unit 3 score. The average of your three unit scores will determine your final grade:

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

Week	Activities & Supplements	Assignments	Test Bank Practice	Online homework
8/24	Course overview / introductions What do you hope to get from course?			ThisIsStatistics.org
8/29 8/31	Introduction to R (if available)	R Tutorial		
9/5 9/7	2 Simulation & sampling distributions 3 ANOVA and randomization	Comparing variances ANOVA assignment	9.5 10.1 - 10.2	Chi-squared distribution through Trouble with graphs
9/12 9/14	4 A priori, post hoc tests 5 AxB ANOVA, randomization	Post hoc tests Unit #1 Quiz	11.1	Tukey HSD through Factorial ANOVA
9/19 9/21	6 Experimental design Review ANOVA and experimental des.	Experimental Design assign. **Discuss possible topics for presentation**		Within-subjects ANOVA Experimental design
9/26 9/28	Catch-up week Review for exam	Finish all assignments & activities		
10/3 10/5	**••• Exam #1 •••** 8 Categorical analysis	Chi-square historical Chi-square exercises	14.1	Benford's Law through Goodness-of-fit
10/10 10/12	9 Correlation	Correlation exercises	12.5	Correlation chapter through Bootstrap/Randomization
10/17 10/19	10 Simple linear regression Regression diagnostics	Regression exercises **Choose topic for presentation**		Prediction through Box-Cox transformations R Tutorial
10/24 10/26	11 Multiple linear regression	Multiple Regression exercises	13.1, 12.1	Online Statbook through Lasso
10/31 11/2	12 Advanced regression topics	Advanced Regression exercises		Polynomial reg (Wikipedia) through Bootstrap #2
11/7 11/9	13 Generalized Linear Model	GLM exercises		Logistic regression chapter through GLM Chapter
11/14 11/16	Catch-up week Review for exam **••• Exam #2 •••**	Finish all assignments & activities		
11/21 11/23	No class: Thanksgiving Break			
11/28 11/30	Student presentations	Complete topic assignments		Complete topic assignments
12/5 12/7	Student presentations	Complete topic assignments		Complete topic assignments
FINAL	Final student presentations			

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