MATH 305: Modern Data Analysis | Semester Year | Day/Time/Classroom

Instructor information:

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Catalog description:

Case study approach to topics in the statistical analysis of data. Collecting, coding, validating data; exploratory data analysis; effective quantitative displays; survey/experimental design and sampling; power and error rates; measurement theory; multivariate statistical methods; data mining techniques.

Prerequisites:

Previous statistics course, such as MATH 300, MATH 301, STAT 213, or ENGR 250

By the end of this course, students will...

1. Strategically plan and design data collection, sampling, and analysis strategies
2. Locate, use, and evaluate tools for data collection, storage, analysis, and presentation
3. Explain the stages of data analysis
4. Explain common pitfalls, including Simpson's paradox and error propagation
5. Evaluate the accuracy and validity of conclusions made from the analysis of data
6. Deal with missing data, including multiple imputation techniques
7. Create and evaluate effective visual displays of data
8. Deal with large datasets (data reduction techniques - principle components, multidimensional scaling)
9. Create, apply, and evaluate statistical models, including simulation techniques
10. Create, apply, and evaluate measurement models to estimate error

Course materials:

Required: Huber, P.J. (2011). *Data Analysis: What Can Be Learned From the Past 50 Years* -- ISBN: 978-1-1180-1064-8
Stata 12 Courseplan license ($32 - $1195, depending on version): http://www.stata.com/coursegp.html
Binder for class activities and notes

Optional: Hamilton, L.C. (2009). *Statistics with Stata* -- ISBN: 978-0-495-55786-9
Ramsey, F. (2002). *The Statistical Sleuth: A Course in the Methods of Data Analysis* -- ISBN: 978-0-5343-8670-2
Tufte, E. *Visual & Statistical Thinking: Displays of Evidence For Making Decisions* -- ISBN: 053446551X

Optional Apps: SPSS - available in computer lab)
R (powerful, free; takes some time to learn): http://cran.r-project.org/

Grading methods & criteria:

Student mastery of learning outcomes will be evaluated within each topic through in-class work, assignments, projects, and exams. The following weights will be given to each component:

	Weight
Projects	50%
Assignments/Quizzes/In-class work	25%
Exams	25%

Each project you complete in this course will be evaluated holistically on a simple 4-point scale:
4=Above expectations; 3=Meets expectations; 2=Approaches expectations; 1=Below expectations; 0=Not completed

Your final grade (calculated as the average of the scores you get in each topic) will be based on the following scale:

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

Extra credit / exam retake policy:

As we work through the topics in this course, I may think of extra credit opportunities (novel projects to extend your learning). We will discuss these opportunities as they arise, but do not count on extra credit to pass this course.

I allow students to demonstrate their mastery of course objectives through a variety of methods (exams, in-class activities, assignments, projects). The easiest way for you to succeed in this course is to successfully pass the unit exams.

If you earn a unit score less than 70% (and assuming you want to earn at least a C in the course), you will be required to:

1) Identify the student learning outcomes you have yet to master
2) Solve all the problems on the test related to those outcomes. Show all your work. Briefly explain why you missed each problem (identify your misconceptions or explain why your approach did not work).
3) Demonstrate that you have put significant effort into mastering those outcomes. Significant effort must include reading about the topic (textbook or online), completing practice problems (10+ problems from homework or online sources), and writing/solving 3+ original problems.
4) Identify how you would like to demonstrate your learning. You could take a short test on the topic (without notes), complete a project, teach a short lesson to me, or identify another way to demonstrate your learning

Completing the above tasks will update your grade to reflect your mastery of course outcomes. Note that evaluating problems, creating tests, and reviewing projects are all time consuming. The ability to retry any student learning outcomes is subject to my availability. Make sure you have mastered the outcomes before attempting to retry!

Attendance policy:

Many concepts and methods will be presented in class through activities that cannot be fully reproduced outside of class. Because of this, it is important that you attend class and arrive on-time. While I will not deduct points from your grade for absences, I have found that students with poor attendance generally do poorly in the class.

If you must miss class, I'd appreciate it if you let me know in advance. You **must** get approval before missing scheduled exams or turning in assignments late. Any assignments turned-in past the due date will earn a score no higher than 70%.

Accommodations policy:

Students with disabilities who believe they may need accommodations in this class are encouraged to contact the Office of Services for Students with Disabilities at 333-6275 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Academic integrity policy:

I encourage you to collaborate in studying or completing in-class activities, homework, or projects. **You must work alone on exams**. Review the SAU policy at http://web.sau.edu/Registration/documents/AcademicIntegrityPolicy.pdf

Policy on the use of electronic equipment:

Calculators and computers will be used extensively in this course. Out of courtesy to other students, please turn off the volume on your phones and other devices.

Course procedures and expectations:

The topics covered in this course will be presented primarily through three types of case studies.

1. Full Case Studies: When a topic is introduced, we will walk through fully annotated case studies as a class. By mimicking the analysis methods used by real researchers, students will gain an appreciation for the thought processes behind the analysis of real data. Students will also gain an opportunity to see how experts draw conclusions and present those conclusions to an audience.

2. Guided Case Studies: Working as a class or in small groups, students may be asked to complete a guided case study, in which appropriate analysis procedures are identified, but not supplied. Students will explore the data, plan an analysis strategy, carry out the analysis, and present conclusions based on their analyses. Working through these guided case studies, students will learn how to deal with real-world data.

3. Open Case Studies: Individually or in small groups, students will work through open-ended case studies. Students will be provided a research question and/or a sample of real data (along with a description of the data and some information on the context of the issue at hand). Using what was learned from the full and guided case studies, students will conduct a full analysis of a real dataset and present valid conclusions.

Note: Most mathematics students are used to courses in which there are clearly defined methods for finding answers (and there is always a correct answer). These students may be uncomfortable with the fact that statistical analyses can produce very different, often contradictory results. In this course, there will be many paths to a "correct" analysis of data. This does not mean there are no wrong answers -- there will also be many incorrect paths.