Instructor: Allan Rossman  
Class Times: MW 8:10-10  
Class Location: 14-250  
Office: Faculty Office Building East 25-107C  
Email: arossman@calpoly.edu (best way to contact me)  
Office Hours: MTW 2-3, ThF 9-10, and by appointment, and by chance  
Course Webpage: http://statweb.calpoly.edu/arossman/stat301/

Overview: Statistics is the science of reasoning from data. It is both an exciting intellectual discipline and a powerful scientific tool. Statistics is a mathematical science, in the sense that it makes use of mathematics extensively, but it is not a branch of mathematics. This course will introduce you to fundamental concepts and methods of statistics. More specifically, this course focuses on the logic and scope of statistical inference, drawing conclusions from data. Some of the key ideas to be studied include data collection strategies and their scopes of conclusion, the role of randomness in collecting data and drawing conclusions, graphical and numerical summaries of data, assessing statistical significance (strength of evidence), and estimating with confidence.

I like to believe, and I’ll try to demonstrate to you, that statistics is both an extremely important discipline in today’s world and also a very exciting one. Consider the following quote from Hal Varian, chief economist for Google, taken from an October 2008 interview (available here):

“I keep saying the sexy job in the next ten years will be statisticians…. The ability to take data – to be able to understand it, to process it, to extract value from it, to visualize it, to communicate it – that’s going to be a hugely important skill in the next decades, not only at the professional level but even at the educational level for elementary school kids, for high school kids, for college kids. Because now we really do have essentially free and ubiquitous data. So the complementary scarce factor is the ability to understand that data and extract value from it.”

Indeed, the field of statistics has gotten a good bit of positive publicity lately, including the following:

- *Boston Globe* article from 2012: “The Allure of the Statistics Field Grows” (here)
- *Wall Street Journal* article from 2013: “Data Crunchers Now the Cool Kids on Campus” (here)
- *Washington Post* article from 2012 claiming that statistician Nate Silver had the best year of anyone in 2012 for his accurate predictions of election results (here)
The popular movie *Moneyball*, chronicling the use of statistical ideas and methods to assemble a successful baseball team with a limited budget, based on the book by Michael Lewis and starring Brad Pitt.

A documentary called *The Joy of Stats*, broadcast by the BBC and featuring celebrated Professor Hans Rosling (here).

2013 was designated as the International Year of Statistics! (www.statistics2013.org/)

**Goals:** By the conclusion of the course, I hope that you have improved your ability to:

- apply and interpret the results of a variety of statistical techniques, including both descriptive and inferential methods;
- understand many of the fundamental ideas of statistics, such as variability, distribution, association, causation, sampling, experimentation, confidence, and significance;
- analyze and assess statistical arguments, such as those found in the popular press as well as in scholarly publications;
- use computer software both to analyze data and to explore statistical ideas;
- communicate your knowledge of statistical ideas effectively.

More specific goals are that you will be able to:

- understand the difference between observational studies and controlled experiments and the scope of conclusions that each permits;
- conduct and interpret descriptive analyses of data, including graphical and numerical summaries, for categorical and quantitative data;
- understand fundamental concepts of statistical inference, such as significance and confidence, including limitations of these procedures;
- use simulation analyses to draw statistical inferences;
- conduct and interpret tests of significance, including Fisher’s exact test, binomial tests, z-tests for a proportion and difference in proportions, and t-tests for a mean and difference in means;
- produce and interpret confidence intervals.

You can see the expanded course outline (available here) for more specific learning objectives and a more detailed outline of topics.

**Course Materials:** My colleague and I have written a new edition of the textbook, which you are to purchase from the address that I emailed to you. The cost is quite reasonable: $20 for a printed copy and pdf file. The pdf file has the advantage that it contains links and is easily searchable.

You will find that the textbook consists primarily of activities as well as exposition. You are expected to answer the questions in the activities as class goes along, so I strongly encourage you to bring the relevant pages with you each day. I also suggest that you obtain a three-ring binder for organizing your textbook and notes.

You must also have a scientific calculator (please bring it to every class) and access to the internet and to the statistical software package R outside of class. You might find it helpful to bring a laptop to class so you can follow along with computer work more actively.
I will post many course materials and announcements on our course webpage (here), so please look there often.

**Computer Use:** We will make extensive use of computers in this course. They will prove useful in at least three ways:
- for performing calculations and creating graphics necessary for analyzing data
- for conducting simulations to approximate long-run behavior of random phenomena
- for addressing “what if” questions that allow you to explore statistical concepts

We will make frequent use of Java applets and the statistical software packages R and RStudio. No prior knowledge of this software tool is assumed; you will receive detailed instructions regarding its use when the need arises. R and RStudio are freely available software that you can download for your own computer (following instructions here); R and RStudio are also available in our Studio classroom and in the library. The Java applets can be accessed and run through any java-enabled web browser. Data files and Java applets will be available from a link here on our course webpage.

**Classroom Culture:** Most class meetings will consist of some lecture but also your working through activities through which you discover and explore statistical ideas and techniques. Please come to class prepared and eager to work during class time and to collaborate with your peers and to ask questions of me. This will not only help you to learn the material and perform well in the course, but it will also produce a much more enjoyable learning environment for all of us. Class attendance is very strongly encouraged, as the in-class activities should prove to be valuable learning experiences. You might find it helpful to bring a laptop to class so you can follow along with computer work more actively.

In case you have to miss a class, or just to serve as a convenient reminder, information about what we do in class each day will be compiled here. Needless to say, you are responsible for everything presented in class.

I also expect you to devote substantial outside-of-class time to your work for this course, typically involving about 8 hours per week. I anticipate that this work will be divided among:
- finishing in-class activities
- reviewing your notes
- working on assignments
- conducting project work
- preparing for exams

Please be courteous to your classmates and me, for example by:
- arriving to class on time (but if you are late, please enter without disrupting class);
- printing assignments ahead of time on your own (please do not use the printers in our classroom for this purpose);
- not talking to others when I am talking (but please do talk to your classmates when working on collaborative activities);
• not allowing your cell phone to ring during class (or else you are to bring cookies for everyone to the next class session);
• not reading or sending text messages during class
• stapling pages together when you hand in a multi-page assignment (to minimize the chance that I lose a page or get them mixed up);
• including your name at the end of any e-mail message that you send to me (it’s often impossible to discern your name from an e-mail address).

Grading Policies: Your course grade will be determined by the following components, with relative weights as indicated:
• quizzes (10%)
• project (10%)
• assignments (15%)
• two midterm exams (15% for lower score; 20% for higher score)
• final exam (25%)
You’ll notice that these percentages only add up to 95%. An additional 5% will be applied to whichever of these components produces your highest score.

Quizzes: We will have many quizzes, probably around 20. During many class periods you will be asked to answer a few short questions. Because we meet for two hours at a time, we may even have two quizzes during some class sessions. Specific rules for each quiz will vary and will be announced as we go. For example, some quizzes will be taken at the beginning of class to assess how well you understood concepts presented in the previous class, others will be given at the end of class to assess your understanding of what was presented that day, and still others will be assigned on a take-home basis due at the beginning of the next class meeting. You will be expected to work alone on some quizzes, and you may work with a partner or team on others. You will be allowed to use your textbook and notes on some quizzes but not others. To account for illnesses and emergencies and other reasons that you might have to miss a class, you may drop your lowest two quiz scores from the calculation of your overall average.

Assignments: Homework assignments will be given regularly. Because we meet for two hours at a time, we may even have two assignments due for some class sessions. These assignments will be posted here, but no hard copies will be distributed. Assignments are due at the beginning of class on the indicated day; late assignments will not be accepted. You may work with one partner on these assignments, submitting one report with both names, provided that both of you contribute substantially to the work. Word-processed assignments are much preferred to hand-written ones, but I do expect you to turn in hard copies. You may drop the lowest homework score from the calculation of your overall average. I hope that these assignments will:
• give you the problem-solving practice necessary to learn, understand, and apply the concepts and techniques presented,
• provide you with feedback regarding your understanding of the material,
• further your discovery and exploration of course material, and
• prepare you for the kinds of questions that will be on exams.

Project: The project assignment will provide another way to demonstrate that you have learned important concepts and skills related to collecting and analyzing data to address interesting
research questions. You will generate a research question that can be addressed with a well-designed study, collect and analyze relevant data, and write a detailed report of your findings. Detailed expectations will be provided here.

Exams: There will be two midterm exams and a final exam. Dates will be announced at least one week in advance. You may be excused from an exam only with a written medical excuse. The final exam will focus on more recent material but will also have a cumulative component. These exams will be open-book and open-notes, except for a small portion of the final exam. You will be provided with preparation advice (here) before each exam. One thing to keep in mind is that interpretations and explanations will be more important than calculations.

Study Advice: I offer the following dozen suggestions for learning the course material well and succeeding in this course:

1. Take notes directly on the textbook pages. The textbook consists of activities and questions that my colleague and I designed to help you learn and understand the course material. I think you’ll find it very helpful to bring the relevant pages to class each day and take notes directly on them. You’ll also be able to use your textbook/notes on exams as well as assignments, so please keep them well organized and refer to them often.

2. Come to class. Please come to class every day. I realize that our class time is early in the morning, but I really think you’ll benefit from coming to class regularly, no matter how tired you may feel. I’ll do my best to make every class period interesting and occasionally lively. You are responsible for heeding all announcements made in class, whether you are in attendance that day or not.

3. Participate in class. Coming to class is of little value if you do not participate. Please think about and respond to the questions asked in class. Try to stay focused on course material, and by all means do not distract others from remaining on task.

4. Don’t get behind. The material in this class builds on itself progressively throughout the entire quarter. As a consequence, it can be very hard to get caught up if you allow yourself to fall behind. Please feel free to ask questions as they occur to you, and make use of office hours.

5. Don’t get discouraged. We will study important and challenging concepts very early in the course, and then we will revisit those same concepts in different scenarios throughout the course. My hope and expectation are that this spiraling approach enables you to deepen your understanding of key ideas as the course progresses. Please do not be discouraged if your level of understanding is incomplete at the beginning of the course.

6. Pay attention to context. Statistics is about data. Data are numbers with a context. I spend a good bit of time and effort on finding genuine studies and real data to present in class and on assignments, in part to show you some of the broad applicability of statistics. When working on assignments and quizzes and exams, be sure to express your conclusions in context. In other words, say “most students in our class got at least seven
hours of sleep last night” instead of “most of the dots on the graph are at the values seven and above.”

6. Write well. Statistics is about much more than performing calculations. I also expect you to understand statistical concepts and interpret results from applying statistical methods. Doing these things requires writing very clearly. Recognize that interpretations and explanations, clearly communicated, are at least as important as calculations.

7. Make use of online resources. I will post lots of information and resources on our course website. There you’ll find daily notes, quizzes and solutions, assignments and solutions, exam information and preparation advice, and more. Please make frequent use of these resources. I will also occasionally distribute announcements via email. You are welcome to ask questions of me via email as well.

8. Help each other. Please feel free to study together and help each other to learn the course material. The policy on investigation assignments is that you can work with one partner and hand in one report with both names, provided that both of you contribute substantially to the work. On some quizzes you will be invited to work with one or more partners. You can always work together on optional problems from the text and to study for exams.

9. Invest time. There’s no reason that you can’t do very well in this course, but you will need to spend time outside of class working on it. Your out-of-class activities should consist of reading the textbook, reviewing your notes, working on assignments, conducting project work, and preparing for exams.

10. Take pride in your work. Please do your best with all aspects of the course. Do not turn in sloppy, half-hearted work. Take pride in what you produce, make your work look nice as well as convey substance. Express yourself clearly.

11. Have fun with the material. We’ll be examining many interesting studies, some of which are meant to be entertaining and perhaps even silly. Please enjoy the fun aspects of the course.

12. Think! I believe you’ll find that you really are expected to think in this course. You’ll need to figure some things out for yourself and wrestle with some challenging ideas. Please be prepared to think hard as well as work hard. Of course, developing the ability to think well is what a Cal Poly education is all about.

A common theme emerges from this list: You are responsible for your own learning. As your instructor, I view my role as providing you with contexts and opportunities that facilitate the learning process. Please call on me to help you with this learning in whatever ways I can.

Schedule: I like to have the flexibility to adjust our schedule on the fly, so I will not provide a detailed schedule here. Consult the day-by-day notes (here) frequently to see what we have
covered and when. You can also refer to the expanded course outline (here) for more information about course objectives and material to be covered.