STAT 218  Applied Statistics for the Life Sciences   Spring 2017

Instructor: Allan Rossman
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Email: arossman@calpoly.edu (best way to contact me)
Office Hours: M – Th, 1:30 – 2:30, and by appointment and by chance

Class Meetings: MW 8:10-10:00am in room 186-C303
(Optional) Text: Statistics for the Life Sciences (5th ed.), by Samuels, Witmer, and Schaffner

Course Webpage: http://statweb.calpoly.edu/arossman/stat218/

Overview: Statistics is the science of gaining insight, drawing conclusions, and making decisions from data. The practice of statistics involves asking questions that can be addressed with data, collecting data, analyzing data, and making inferences from data, and communicating the results. This course introduces you to fundamental concepts and methods of statistics. I believe and will try to convince you that statistics is an extremely important discipline in today’s data-rich, technological world, both in everyday life and in most professions and academic disciplines.

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 statistical software to analyze data;
  • communicate your knowledge of statistical ideas and conclusions from statistical analyses effectively.

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

Course Principles: The following principles guide my development and teaching of this course:

1. Statistics is not number-crunching. Contrary to its popular perception as a black box collection of arcane magic tricks, statistics involves much more than numerical computations. The emphasis of the course will be on understanding statistical concepts and on interpreting and communicating the results of statistical analyses. In other words, you will be expected to learn to construct and analyze numerical arguments. In contrast to most mathematics courses, we will be using phrases such as “there is strong evidence that ...” and “the data suggest that ...” rather than “the exact answer is ...” and “it is therefore proven that ...” To alleviate the computational burden, we will often use the computer program Minitab to perform calculations and produce graphical displays. You will find that interpreting and explaining are at least as important, possibly more important, than calculating in this course.
2. **Statistics involves the analysis of genuine data.** Supporting my contention that statistics is applicable in everyday life and in most fields of academic endeavor, you will analyze real data from genuine studies covering a wide variety of applications throughout the course. Some of these data sets involve information that you will collect about yourselves and your peers; others will come from sources such as published scientific studies, official statistics from government agencies, and various web resources. The contexts for these data will span a wide variety of subject matter, from medicine to law, from psychology to politics, from education to sports. My intention and hope is that most should be of interest to a general audience.

3. **Understanding results from investigation and discovery.** Class meetings will be designed for you to actively engage with the material, rather than passively taking notes while I lecture. We will work through activities carefully designed to lead you to discover statistical concepts, explore statistical properties, and apply statistical methods. Please come to class expecting to participate, think, and learn.

**Course Materials:** I will provide many handouts that we will work through in class. These handouts will be available from our course webpage; I will try to post them by 4pm on the previous day if not sooner. I strongly encourage you to print out these handouts in advance and bring them to class. I also suggest that you obtain a three-ring binder for organizing your notes. Please bring these handouts and binder to every class meeting. You must also have a scientific calculator and access to the internet outside of class. You may also find the optional textbook to be helpful.

**Class Policies:** I strongly encourage you to prepare for and participate in every class session. Not only will this 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. Participating in class will typically entail contributing to discussions and working on hands-on activities that I prepare to help you investigate and learn the material. Please be aware that because our class meets for two hours at a time, we will address a good bit of material in every class session. I also expect you to devote substantial outside-of-class time to your work for this course.

**Use of Computers:** We will use computers fairly extensively in this course. One use is for communication: I will post much information on the course website, and I will occasionally send course announcements via email. I also invite you to ask questions via e-mail.

More substantively, computer software will also prove useful for learning statistical ideas and for conducting statistical analyses. For these statistical uses, we use the statistical analysis package Minitab and also applets. No prior knowledge of these software tools is assumed; you will receive detailed instructions regarding their use when the need arises. Minitab is freely available in most on-campus computer labs. You can also download a free copy of Minitab from the Cal Poly portal, but Minitab is not available for Macs. The applets can be accessed and run through any web browser.
Grading Policies: Your course grade will be determined by the following components, with relative weights as indicated:

- quizzes (10%)
- assignments (10%)
- mini-projects (10%)
- two midterm exams (35%; 15% for lower score, 20% for higher score)
- cumulative final exam (30%)

You will notice that these weights add up to only 95%. I will add an extra 5% to whichever component is your best.

Quizzes: We will have lots of quizzes. Most quizzes will involve working with a group in class, based on topics we have studied in class that day. Missed quizzes cannot be made up or excused, but you may drop your lowest two quiz scores before calculating your overall score. These quizzes, and their solutions, will be posted on our course webpage so that you can check your work afterward.

Assignments: Regular assignments will ask you to investigate a concept or application in some depth. These will be assigned occasionally, roughly an average of 1-2 per week. These assignments are somewhat open-ended, requiring both writing and computer work. You may work with a group of as many as three students on these assignments, submitting one report with all names, provided that all of you genuinely contribute to the work. These reports must be word-processed, with computer output should be integrated into the report as appropriate.

To give you some additional time to work on assignments, they will be due at 4pm on the indicated day. You can turn them in at the beginning of class or at my office. Late assignments will not be graded, and missed assignments cannot be made up.

You may drop your lowest assignment score. The assignments and solutions will be posted on our course webpage, and no hard copies of these assignments will be distributed.

The purposes of both the quizzes and assignments are to:

- further your discovery and exploration of course material,
- 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, and
- prepare you for the kinds of questions that will be on the exams.

Mini-projects: We will have a small number (3-4) of mini-projects, which ask you to find and analyze data or articles concerning statistical issues. Detailed instructions will be provided on our course webpage.

Exams: We will have two mid-term exams and a final exam. Dates will be announced at least one week in advance; a rough indication can be found in the schedule below. You may make up a missed 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. You will be provided with preparation advice before each exam. One thing to keep in mind is that interpretations and explanations will be as important as calculations.

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

1. Organize handouts and notes. I suggest obtaining a three-ring binder for storing and organizing your handouts/notes. I think you’ll find your handouts/notes to be your most valuable study materials, so please keep them well organized and refer to them often. Some topics will be covered in the handouts that are not covered in the (optional) text.

2. Print handouts in advance. For most class periods I will post a handout on our course website. I will make these handouts available by 4pm on the previous day, usually much earlier than that. These handouts consist of activities and questions that I design to help you learn and understand the course material. I think you’ll find it very helpful to bring these handouts to class each day and take notes directly on these handouts.

3. Come to class. Come to class every day. I’ll do my best to make every class period interesting and worthwhile. You are responsible for heeding all announcements made in class, whether you are in attendance that day or not.

4. 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.

5. 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. This is especially important because our class only meets twice per week. Feel free to ask questions as they occur to you, and make use of office hours.

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 dots on the graph are at seven and above.”

7. Expect more than number-crunching. Statistics is about much more than performing calculations. I also expect you to understand statistical concepts and interpret results from applying statistical methods. Try not to concentrate so much on a specific task that you lose sight of the big picture.

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

9. Use technology. We’ll use computer software both for exploring statistical concepts and also for analyzing data. The applets that we’ll use are freely available and should work with any browser.

10. Study together. Please feel free to study together and help each other to learn the course material. The policy on assignments is that you can work with a group of as many as 3 students and hand in one report with all names, provided that all of you contribute
substantially to the work. On many quizzes you will be invited to work with partners. You can always work together on optional problems from the text and to study for exams.

11. **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, solving optional problems, and preparing for exams.

12. **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.

13. **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.

14. **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 of advice, important enough that I’ll put it in both bold and italics: **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.

**Courtesy:** I ask you to please observe some common courtesies, specifically to:
- arrive to class on time;
- do not talk to others when I am talking;
- do not allow your cell phone to ring or send text messages during class;
- staple pages together when you hand in a multi-page assignment;
- include your name when you send me an e-mail message.

**Tentative Schedule:** The following is always subject to change, but this should give you a sense for what topics we will cover and when:

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<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>April 3, 5</td>
<td>Statistical significance (one proportion)</td>
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<tr>
<td>2</td>
<td>April 10, 12</td>
<td>Normal distributions, sampling</td>
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<tr>
<td>3</td>
<td>April 17, 19</td>
<td>Confidence intervals (one proportion)</td>
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<tr>
<td>4</td>
<td>April 24, 26</td>
<td>Exam, observational studies, experiments</td>
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<td>5</td>
<td>May 1, 3</td>
<td>Analyzing 2×2 tables, comparing two proportions</td>
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<td>6</td>
<td>May 8, 10</td>
<td>Analyzing quantitative data, inference for mean</td>
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<td>7</td>
<td>May 15, 17</td>
<td>Comparing two means, paired data</td>
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<td>8</td>
<td>May 22, 24</td>
<td>Exam, chi-square tests</td>
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<td>9</td>
<td>May 31</td>
<td>Analysis of variance</td>
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<td>10</td>
<td>June 5, 7</td>
<td>Correlation, regression</td>
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<tr>
<td></td>
<td>Mon June 12</td>
<td>Final Exam (7:10-10am)</td>
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