Syllabus
AMS5 - Summer II 18

1 General Information

1.1 Course contents and objectives

Our main goal is to help a student develop a deep understanding for experimental variability, an understanding for the inherent uncertainty when measuring quantities in the real world and how to use logic and basic scientific reasoning to extract useful information from the experiments. We intend to do this with the use of examples and situations students encounter in their day-to-day lives. We take the students through the main aspects of a statistical experiment. We begin with a description of what makes a good experiment (designed experiments), a bad experiment and also observational studies - which are less than perfect, but often are the only study one can perform. We also look at the correct ways to choose individuals for an experiment (sampling techniques) and possible maladies in the way these choices are put in practice (bias). We will then move to data-analysis techniques, how to summarize characteristics of a data set (average, standard deviation and percentiles) and how to represent it graphically (histograms and plots). We introduce the normal curve and show how useful it is in our statistical endeavors. The concepts of association between two variables (correlation) and predicting one variable value when given a value of another variable (linear regression) are also covered. We study the basics of probability and show how we can use the normal distribution to calculate probabilities. We close the course with ideas in statistical inference: these are mathematical techniques that allow someone to make a generalization based on a sample of individuals. We cover confidence intervals for population averages and percentages and confidence intervals for difference between two population parameters too. If there is time we will cover the hypothesis testing procedure.

1.2 Texbook (required)

Statistics by Freedman, Pisani and Purves, 4th Edition. Publisher: Norton.

1.3 Background

A basic knowledge in College Algebra will be useful, but more pertinent is to have **good writing habits**. This is an unusual Mathematics course in the sense that your answers will involve more explanations than calculations. Your typical answer will be an explanation of the methods with some calculations integrated with it.

1.4   Office hours

These times will be very important for your work, both because you have the opportunity to further discuss the ideas first presented in lecture and discuss the homework problems. These hours are also a wonderful opportunity to discuss previous homework problems and find out why you missed some of the points in the grading.

Tentative schedule. Please get in touch with us in case you cannot make any of the times below. Office hours are an important part of the learning process, and we want to make sure that everyone has access to at least one of the office hours sessions per week.

Bruno: Tuesdays/Thursdays, 4:30 to 5:30pm at Baskin room 373.

TAs: TBA.

(Friendly) advice: **if you foresee problems in making the dates of the midterm or final exams or if you foresee problems making the strict deadlines for homework (it's enforced to the minute!) or further still, if you think you cannot commit to working 10 to 15 hours weekly for the class (the typical workload for a 5-unit course at UCSC), you might want to consider a different course**. Unfortunately, as much as we would like to do otherwise, in classes of this size we cannot accommodate exceptions to deadlines and exam dates; any attempt to do so would affect the whole class, as you can easily guess. (If you can't guess that easily, imagine the extra work involved in preparing an extra test, and finding suitable locations and proctors; these things take time - precious time - that would be taken away from other important aspects of the course).

2   Assignments

2.1   Homework

There will be a set of homework problems per week, due every Friday (we recommend a couple of hours before 12pm) that is not a holiday. If there's a holiday that falls on a Friday, the homework will typically be due on the last official day of instruction before that Friday (for example, in Thanksgiving holiday, the homework will be due Wednesday before 5pm). Pay attention to class announcements regarding this kind of exceptions.

You will need a few more extra blue exam booklets for homework, in addition to the ones you will use for lecture/discussion section quizzes.

We strongly encourage you to work on the problems, these will work very much like small weekly tests; we found that students do very well in the course if they work on these problems and bring their questions to us in office hours. The average of homework scores will account for 20% of your final score. There are no homework re-dos; we simply do not have the manpower to grade late homework. We choose carefully the number of problems in each week so that the average student should be able to complete most of the work in half a week. Some students do have situations beyond their control that might keep them from completing the work for the week; this is why we will automatically drop the worst homework score when we calculate your final homework score average. **Any questions regarding homework's scores or their grading should be addressed to your own TA**. We recommend you check your homework scores on a weekly basis. We do not have the ability to fix any issues with these scores after the last day of instruction of the quarter, since we need to focus on the final exam and wrapping up the course. **After the last day of instruction, all homework scores (except the last one which will be due right after the last lecture) will be final**. Homework is fundamental to help you prepare for the tests.

2.2 Midterm

This test is mostly a "reality-check" test; i.e. we/you use them to confirm whether you are understanding the concepts correctly; it will contain questions similar in complexity to what you will find later in the final exam. The midterm is an in-class test and it will take place on Tuesday, August 14th. Note that only part of that test (around 1 hour 45 minutes) will be used for the test. After a break, we will use the remaining time for our lecture.

The exam's score will contribute 30% to the final grade. You are allowed only the following in the test: a simple calculator (it should only be able to do addition, subtraction, multiplication, division and square root), a pencil and an eraser. Please take this request seriously, because if you insist on using your TI (for example) on the test, you will have to put it away. After more than 13 years teaching in Santa Cruz, I finally had students abusing the allowance to use the restrooms during tests in the Winter quarter 2012; it is very sad, but I will have to ask you to make sure you are prepared to stay in class during the whole duration of the test. Whenever possible, official solutions will be posted in the glass case just above the homework dropboxes at Jack's lounge. We do strongly, strongly recommend you sit down with us in office hours and go careful over the whole exam. The final will include problems of the same type as the ones in the midterm (*i.e.* the final will include all what was taught in the quarter), so make sure you learn as much as possible from the test once you get it back. We will be glad to go over the test with you during office hours. After the last day of instruction, midterm scores will be final .

2.3 Final exam

This is the most important item in your final grade, it will cover everything that was taught during the quarter. There is a minimum grade requirement, and contrary to all the other scores in this class, there is no possibility of curving to be applied to the scores. The final will take place Thursday, August 30, 6:008:00 p.m. in the same room where we have our lectures.

This will be an in-class test. During this test you will only be allowed the same simple calculator described in the midterm test section above, a pencil and an eraser. **Notes are not allowed in the final exam**. Once again, you should be prepared to stay in the room for the duration of the exam; no one is allowed to leave the room until they are done with the test. The exam's score will account for 50% of the final grade. Since the final exam is the only chance we have of testing you (individually) on your knowledge of the full content of the course, we require a minimum of 60% in the final exam in order to pass the class (regardless of your total final average score). You will see that this is not such a big hindrance to getting a good grade if you have worked a lot with us during the quarter. The final exam is the last work you do for the class; we have no ability to give extra credit work for any student after the final exam. We love helping students who are committed to the course and work hard so if you think you might need help, don't wait until after the final exam to ask for help; come over and work with us during the quarter.

3 Passing this course and letter grade

The final score is calculated with the following formula: 0.2*(average of homework scores) + 0.3*midterm score + 0.5*(final exam score). You will have a C (or a 'Pass') if you have at least 60% in the final exam and at least 60% as final course score (this last condition can be relaxed in quarters where students show exceptional commitment to improve on less than perfect midterm scores; pay attention to Bruno's announcements, regarding this item, in class during the last week of instruction).

Your letter grade for the class is based on your total score as calculated using the formula above. A+ : 97.5% and above A : 94.5% to 97.49% A- : 89.5% to 94.49% B+ : 79.5% to 89.49% B : 74.5% to 79.49% B- : 69.5% to 74.49% C : 60% to 69.49% D : 50% to 60% F : 50% and below or if student cheats.

Students will get a D if they don't get more than 60% in the final exam but their total score or their final exam score is above 50%. Here are the rules regarding the grade of incomplete:

`http://registrar.ucsc.edu/navigator/section4/performance/incomplete%20.html`. A student only qualifies for an incomplete if he or she cannot complete the coursework for reasons beyond their control (these only include very, very serious and confirmable situations) and their work, up until the time they have to stop working, has been of passing level.

4   Students with disabilities

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by appointment, as soon as possible in the academic quarter, preferably within 1 week of the quarter beginning. I also am open to and want to encourage you to discuss with me ways I/we can ensure your full participation in this course. If you have not already done so, I encourage you to learn more about the many services offered by the DRC. You can visit their website (`http://drc.ucsc.edu/`), make an appointment, and meet in-person with a DRC staff member. The phone number is 831-459-2089 or email drc@ucsc.edu.

5   Anxiety and related issues

If any of you feels a bit overwhelmed (in any way) during the quarter, please be assured that there is someone you can talk to. Our campus has wonderful services available to you. Check, for instance our Counseling and Psychological services (`http://caps.ucsc.edu/`).

6   Academic misconduct

No type of collaboration or communication between students is allowed in the midterm or the final exam. Not complying with this rule will initiate a very unpleasant procedure for both the students and us, so please don't let yourself get to the point where illegal collaboration becomes an option; start working from the first day of class and stay engaged with us in sections, office hours and tutoring sessions.

Cheating will not be tolerated under any circumstances. Any student caught cheating will be reported for academic misconduct (`https://www.ue.ucsc.edu/academic_misconduct`) to their college provost. The academic penalty is always an automatic fail. Cheating includes, but is not limited to: Copying a fellow student's work during exam conditions (quiz, midterm, final) Using any material, during an exam, which is not explicitly allowed by the instructor (such as phones, getting outside help, calculators with any function outside of adding, subtracting, multiplication, division, square-root.) Notice that the campus rules on academic conduct cases considers both parties culpable and both students are both treated as having violated the code of conduct (`http://deanofstudents.ucsc.edu/student-conduct/`) of UCSC students.

7   Tentative course schedule

This schedule is tentative because, many times, we have to slow down to help students with more complex ideas, other times we might go faster because students do better than expected in a particular section of the material.

Week 1

Jul 31

Introduction to AMS5, Chapter 1. Controlled Experiments.

Chapter 2. Observational Studies. Chapter 19. Sample Surveys.

Aug 2

Chapter 3. The Histogram.

Chapter 4. The Average and Standard Deviation.

Week 2

Aug 7

Chapter 5. The normal approximation to data.

Chapter 6. Measurement Error.

Chapter 7. Plotting Points and Lines.

Chapter 8. Correlation.

Aug 9

Chapter 9. More About Correlation.

Chapter 10. Regression.

Week 3

Aug 14

Chapter 11. The R.M.S. Error for Regression.

Midterm test.

Aug 16

Chapter 12. The Regression Line.

Chapter 16. The Law of Averages.

Week 4

Aug 21

Chapter 17. The Expected Value and Standard Error.

Chapter 18. The Normal Approximation for Probability Histograms.

Aug 24

Chapter 20. Chance Errors in Sampling.

Chapter 21. The Accuracy of Percentages.

Chapter 23. The Accuracy of Averages.

Week 5

Aug 28

Chapter 23. The Accuracy of Averages (cont).

Comparing Two Averages using confidence intervals (not covered in the book, make sure you attend lecture).

Chapter 26. Tests of Significance.

Aug 30

Final exam.