Teaching Statistics Online

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Attending to the Affective Side of Learning
Getting started

- Set norms for online sessions and interactions
- Humanize remote learning
- Intrusive intervention
- Ask students what they need from us to best support their learning
- Be understanding, flexible and kind
Norms for emergency remote instruction

Principles for moving our class forward (borrowed and adapted from Chapel Hill University)

1. Nobody signed up for this
2. The humane option is the best option
3. We cannot just do the same thing online
4. We will foster intellectual nourishment, social connection and personal accommodation
5. We will remain flexible and adjust to the situation
Humanize remote learning

- Turn on your video
- Record and post brief videos of the upcoming week’s highlights
- Be available online for your students
Intrusive intervention using Canvas

Other options: Scored less than, Scored more than

Send kudos to students who submitted early
Routine check-ins with students

(10 points)

Please submit your responses to these three questions using complete sentences in the text box after clicking the box above "Submit Assignment."

Write detailed and specific responses for each question.

You are being graded on the quality of your responses as well as whether you completely answer the question, so please provide lots of details and use complete sentences.

Questions

1) Describe in detail three topics, concepts or ideas you learned during the past two weeks and feel confident about your understanding.

2) Write two questions that you have about the course material so far.

3) Describe one important connection that you made about the course material so far.

4) I am assuming that the recent changes on our campus (if you are taking other face-to-face classes on our campus) and/or current conditions in California are impacting you and your loved ones.

As we enter Week 7 and to help me plan the format of the rest of our course, do you have any issues or concerns as we move forward?
Getting started

- Set norms for online sessions and interactions
- Develop an online presence
- Intrusive intervention
- Ask students what they need from us to best support their learning
- Be understanding, flexible and kind
Lesson Planning
Work with what you already have

- Adapt face-to-face lesson plans for Zoom or Asynchronous assignments.
- Look for opportunities for student interaction in the lesson (more about this and groupwork coming up)
- Get creative with what students can do at home
Example - Calculating Confidence Intervals

**Lesson Plan for Face-to-Face**
- Students would work in groups to collect data with a cup and some Hershey's kisses.
- They would see how many Hershey’s kisses land with the base flat on the desk after 50 trials.
- Each group would calculate a confidence interval for their sample.
- Groups present findings to the whole class.

Resources - See Cuyamaca’s [In-Class Activity Packet](#), Module 17

**Lesson Plan for Online Learning - Asynchronous**
- Students work individually to collect data with household items (pennies, coffee beans, Hershey's kisses if they have them).
- They will collect a sample (n>30) and define success for their sample based on whatever household item they are using.
- Each student calculates a confidence interval for their sample.
- Each student posts their findings in a discussion board on Canvas and students comment on each other’s work.

Resources - See Cuyamaca’s [Zoom Lesson Plans](#), Lesson for Module 17
**Directions**

**Step 1:** Explain your experiment. Gather data.
What materials are you using for your experiment? What does success look like? Perform your experiment to gather the data.
(This experiment is very kid-friendly, so if you have little ones at home, they can help you collect the data! Get those young statisticians involved and entertained.)

**Step 2:** Summarize your experiment.
State your sample size (minimum of 20), sample proportion and tell us what confidence level you are using to construct an interval.

**Step 3:** Check conditions.
Before we can calculate the confidence interval, we want...

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**Video Example**

**Mod 17 Step 1**

**Mod 17 Step 2**

**Mod 17 Step 3**

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You can find and import this discussion board to your Canvas course through the Canvas Commons!
Tips for Success!

- Weekly communication is important.
- Give students a sense of how long the work should take them to complete (especially if most work is asynchronous)
- Provide materials to students before class meetings
- Have a consistent spot in Canvas for students to check and see what they need for class.
- Start/Continue a Community of Practice to share ideas with colleagues
Welcome to Week 5!

This week is where we get into the fun stuff (nerdy statistics teacher alert)! Check out this 4-minute video on sampling M & M’s for a preview of what’s coming up.

**Week 5 Overview:**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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</thead>
<tbody>
<tr>
<td>• Feedback and corrections for Modules 12 &amp; 13 discussions</td>
<td></td>
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<td>• Catch up on missing work in Modules 12 &amp; 13</td>
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<td>Complete Modules 14 &amp; 15</td>
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Estimated time to complete: 3-5 hours

**Modules 14 & 15 - Inferential Statistics**

In Modules 4-7, you were introduced to descriptive statistics, where we learned how to use the measures of center and spread to describe and compare groups of data. Now, in Modules 14 & 15, you’ll be introduced to something different called inferential statistics. This is where we use samples and probability to say something about the population we are studying. For example, if we wanted to guess how many brown M & M’s exist in the world right now, we could take a sample (a bag of M&M’s) and from that sample make an educated guess using probability. This is inferential statistics! Module 14 is VERY SHORT and should take you no more than an hour to complete. So most of your time this week will be working through and understanding Module 15.
Use Canvas Pages or Announcement to communicate with students about what they need for class!
Online Resources for Lesson Planning
Rossman/Chance Applet Collection

Data Analysis
- Descriptive Statistics (js)
- Guess the Correlation (js)
- Least Squares Regression (js)

Sampling Distribution Simulations
- Reese's Pieces (js)
- Sampling Words (js)
- Sampling from a Finite Population/Model/Bootstrap (js)
- Simulating Confidence Intervals for Population Parameter (js)
- Improved Batting Averages (Power) (js)
- ANOVA simulation (js)
- NEW: Guess the p-value (js)

Classics (j)
- Histogram Bin Width
- Dotplot Summaries
- Sampling Pennies
- Sampling Change
- Sampling 2005 Senators
- Friendly Observers
- Dolphin Study applet
- Yawning Study applet
- Two-way Table simulation applet
- Randomization Test for quantitative response (two groups) (f)
- Simulating Confidence Intervals for Population Parameter
- Simulating t-intervals for different population shapes
- Random Babies
- Guess the Correlation
- Reese's Pieces
- Sampling Words
- Sampling Regression Lines - Population Model (j)
- ANOVA simulation

Probability
- Random Babies (js)
- Monty Hall (js)
- Secretary Problem (j)
- Normal Probability Calculator (js)
- Probability Calculator (js)
- Randomizing Subjects (js)
- Random number generator (js)

Statistical Inference
- One proportion inference (js)
- Goodness of Fit (js)
- Analyzing Two-way Tables (js)
- Matched Pairs (js)
- Randomization test for quantitative response (multiple groups) (js)
  - two means
- Randomization test for categorical response (multiple groups) (js)
- Dolphin Study applet
- Analyzing Two Quantitative Variables (js)
- Theory-based Inference (js)

Under Development
- Randomized Block Design ANOVA tables (js)
- Bootstrapping with two groups (js)
- Two-way ANOVA (js)
- Randomization test with shift (js)
- Multilevel variables (js)
- Comparing groups (js)

Click here to access old applets page

j = java applet (click here for help on running java on macs, pcs)
js = javascript
f = flash
Rossman/Chance Applets

- Free applets to simulate many concepts in statistics
- Use with Zoom to model statistics with students

http://www.rossmanchance.com/applets/
Ask Good Questions
A blog about teaching introductory statistics

About me (Allan Rossman)

I have written articles and co-authored textbooks on teaching introductory statistics with active learning, and I have given more than 100 conference presentations and conducted more than 100 faculty workshops.

I have been teaching statistics, primarily at the introductory level to undergraduates, for thirty years.

I lived in Pennsylvania for the first 39 years of my life. I grew up in Ellwood City and went to college 10 miles from home at Geneva College in Beaver Falls. Then I went to graduate school 40 miles from home, where I received a Ph.D. in Statistics from Carnegie Mellon University. Then I traveled 200 miles from home to teach at Dickinson College for 12 years.

And then I moved to California, where I have been teaching in the Statistics Department at Cal Poly - San Luis Obispo since 2001. I have taught introductory statistics to students from throughout the university, and I have also taught courses in probability, simulation, and mathematical statistics.

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About this blog

This weekly blog provides ideas, examples, activities, assessments, and advice for teaching introductory statistics, all based on a three-word teaching philosophy: Ask good questions.
#41 Hardest topic, part 1

by allanrossman on April 13, 2020

As I recounted in post #38 (here), a student recently asked what I think is the hardest topic to teach in an introductory statistics course. My response was: how the value of a sample statistic varies from sample to sample, if we were to repeatedly take random samples from a population. As you no doubt realize, I could have answered much more succinctly: sampling distributions.

Now I will offer suggestions for helping students to learn about this most challenging topic. Along the way, in keeping with the name and spirit of this blog, I will sprinkle in many questions for posing to students, as always in italics.

1. Start with the more basic idea of sampling variability.

Just as you can’t run before you can walk, you also can’t understand the long-run pattern of variation in a statistic until you first realize that the value of a statistic varies from sample to sample. I think many teachers consider sampling variability to be so obvious that it does not warrant mentioning. But have you noticed how many of your students struggle to conceptualize this idea?
ASA Online Teaching Resources & Discussion

If you are not an ASA member, they are extending a free trial membership offer to K-12 and community college educators.

https://ww2.amstat.org/membership/k12teachers/
False positive, false negative, sensitivity, specificity of COVID testing (for teaching)

Jennifer Ward 5 days ago

Hello everyone, I teach introductory statistics and I'm having a hard time finding information about the false positive rates, false negative rates, sensitivity, and specificity of COVID testing. I'm not sure where or in what kinds of medical literature to find these details, either. If there is more than one diagnostic test, won't these 4 rates vary by manufacturer?

If you're from the medical/statistical world and want to share more background information about these probabilities, please share!

Thanks for your help. I look forward to using what I learn as a teaching tool this term. 😊

Jennifer
Jennifer, yes, you've got the correct terminology.
David, great resource (http://for-sci-law.blogspot.com/!

Quick-and-easy definitions for those new to diagnostic tests:
- False positive result: Positive test result for someone who does not have the condition of interest (here, COVID).
- False negative result: Negative test result for someone who does have COVID.
- Sensitivity: Ability of a test to identify (give a positive result for) someone with COVID; percentage of people with COVID whose test values are positive (denominator = # of people with COVID).
- Specificity: Ability of a test to give a negative result for someone who does not have COVID; percentage of people without COVID whose test results are negative (denominator = # of people without COVID).

Also of interest are predictive values - because when someone gets tested, they don't yet know whether they have COVID. These depend on prevalence of COVID, which could vary by state, suspected risk factors, etc. When evaluating test performance in a group of interest (representative prevalence):
- Positive predictive value (PPV): Percentage of people with a positive test result who have COVID (denominator = # of positive test results).
- Negative predictive value (NPV): Percentage of people with a negative test result who do not have COVID (denominator = # of negative test results).

It often surprises people that in populations with a low prevalence of disease, tests with extremely high sensitivity and specificity (extremely low false negative and false positive rates) have very low positive predictive values. Making a 2-by-2 table shows why: Take a large population with a low prevalence of disease. Obtain expected cell counts using sensitivity and specificity. Most of the positive test results are from people without the condition of interest - because there are orders of magnitude more of them to begin with!

When evaluating test performance in an enriched group - let's say, using a new test on some number of people already confirmed to have COVID and an equal number of people already confirmed to be COVID-free - we have to adjust back to the prevalence in the population of interest.
Facilitating Group Work
Low-Stakes Collaborative Practice

Less lecture and more student engagement through the use of...

- Zoom Breakout Groups
- Zoom Polling
- Canvas Discussion Boards
Zoom Breakout Groups

- Take group work that would happen in class and put students into groups on Zoom!
- Randomly assign groups or choose them.
- Teacher can “pop” into groups - accountability!
- Students can request help in groups
- Teacher can broadcast a message to all groups

Tips For Success
- Do a practice group session with something low-stakes
- Make sure all students have a handout to look at while in groups
- Encourage (but do not require) videos on
- Set new norms - ambassador from each group to report out when we return
- Pause recording during group work
Zoom Polling

- Anonymous - but teacher can download results
- Teacher can publish poll results for students to see
- Great way to keep students actively engaged during a lecture
- Could be used to collect data that students later analyze!

Tips For Success
- Set your polls up before the meeting begins
- In a pinch, have students type responses into chat in Zoom.
Canvas Discussion Boards

- Can require students to post before seeing others replies
- Allows students to comment and reply to each other
- Teacher can use Canvas speedgrader to easily grade and provide individual feedback

Tips For Success
- Set clear expectations for student-to-student interaction - consider a grading rubric
- Break the class up into smaller groups using Canvas Groups
- Don’t allow students to edit posts. Instead ask them to reply to self with corrections
More on Discussion Boards

- Use discussion boards to create a place for students to post questions they have from class or on homework
- Students can help each other!
- Cuts down on emails to teacher

Tips For Success
- Takes some training for students - when they email you, encourage them to post that question in the appropriate discussion board.
Assessments
Minimizing Cheating

- Set a time limit for the assessment in Canvas
  - Be flexible as to when students can complete it
  - Adjust for DSPS students.
- Disable certain Canvas features (Modules, Pages, Gradebook) while students are working on an assessment
- Canvas allows you to “Moderate the Quiz” in real time
- Do not do proctored exams over Zoom. Please.
- Consider non-traditional assessments
Additional examples

- Students choose their own data sets OR provide multivariable data sets
  - Exploratory data analysis
  - Linear regression
  - Hypothesis testing
- Write open-ended questions
- Offer longer time windows for submitting work
- Set up Zoom Q&A time blocks to check student understanding (groups of 3 to 5 students)
Additional examples

Write an essay that summarizes your observations that support your answer to the following research question:

Do male and female students at this university appear to have similar drinking habits?

1. Start your essay by developing a thesis statement that clearly addresses the research question.

2. Use the concepts from Unit 2 to make observations about shape, center, spread and outliers (if any) in a way that supports your position. Also include other observations that support your thesis.
Other examples

Research Questions

1) Which is a better predictor of Rotten Tomatoes movie ratings: IMDb ratings or Metascore ratings? Support your answer using concepts from Unit 3. (Tip: Carefully read this question to determine your explanatory variable and response variable for each linear regression model)

2) For the BETTER linear regression model you chose from part 1,
   - Describe the overall pattern and deviations from the pattern of the scatterplot (direction, form, strength, possible outliers). Include the value of r, if appropriate.
   - Identify the values of the slope and y-intercept of your chosen regression equation. Interpret the slope and y-intercept values in the context of the data.
   - Identify the values of r-squared and Se for your chosen regression model and interpret the values of r-squared and Se in the context of the data.
   - What is the predicted Rotten Tomatoes rating for a movie that has an IMDb rating of 7 and a Metascore of 80? Use Unit 3 concepts to comment on the accuracy of your prediction.
Project Presentation: Data Visualizations (Instructions)

**DEADLINE:** Presentation must be given by Week 9 (Wednesday 04/15)

**Assignment**

Select and present to the class an interesting infographic (online or print).

*An infographic is a visual image such as a chart or diagram used to represent information or data.*

In your presentation, help your audience understand the story behind the data. Thus, it's helpful to select an infographic that is embedded in an article with a narrative about the data and its source.

Choose one that has not been previously shown during class or featured in our class assignments or videos. Also, it's best if you choose a topic that you are very interested in or passionate about. It shows during your presentation!

**Students are responsible for answering questions during the Q&A**
Post-Presentation Reflection

Data Visualizations

Please submit your responses to these questions AFTER you complete your in-class presentation (within 2 class sessions following your presentation).

**Be detailed and specific in your explanations.**

**To submit this assignment:**

Go to the upper right corner and click "Submit Assignment." You may want to type your responses in a Word document and then copy/paste it into the text box provided.

There are a total of 7 questions. Please number your responses as indicated below.

1) Copy and paste the website URL of the infographic(s) you presented. If your infographic is on paper, then please submit a printed copy to the instructor.

2) How does your selected infographic relate to what you are learning in Math 140? Please be detailed and specific in your explanation.

3) Why is the infographic you chose interesting to you? Please be detailed and specific in your explanation.

4) What did you learn from the infographic you chose?

5) What were the highlights of presenting and sharing your infographic with the class?

6) How could you have improved your presentation?

7) On a scale of 1-100, what is the grade you feel you earned on this assignment? Include the reasons that support the grade you stated. (Consider both the class presentation (75%) and the quality of your responses to questions 1-6 above (25%)
Presentations – Data Visualizations

Those who get news mostly on social media less likely to be following coronavirus news

% of U.S. adults who say they have been following news about the COVID-19 outbreak...

Among those who say ___ is the most common way they get political and election news

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<thead>
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<th>Source</th>
<th>Recreational</th>
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<th>Private</th>
<th>Commercial</th>
<th>Airline Transport</th>
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Note: Respondents who did not give an answer not shown. Source: Survey of U.S. adults conducted March 10-16, 2020.

PEW RESEARCH CENTER
Questions?

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