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StatPREP



MAA

MATHEMATICAL ASSOCIATION OF AMERICA

NEWSLETTER

SMORGASBORD OF RESOURCES

BY DONNA LALONDE

Defined as a wide range of something, smorgasbord seemed an appropriate title for this newsletter entry. I've learned a lot reading the discussions on the MAA, ASA, and AMATYC online communities. The communities are a rich repository of "just in time" resources, so I wanted to highlight a few favorites.

From day one of a course, we want to be able to answer the question, "are they learning?" and it is challenging to develop good formative assessments. One resource that is available on MAA Connect is the recording of a TIPSE [Webinar](#) on Formative Assessments in Remote Settings. The presenters shared many insights that could be applied to both remote and face-to-face classes. Asking good questions is an essential component of formative assessment and on the ASA Community, Allan Rossman introduced his blog on teaching introductory statistics - [Ask Good Questions](#). The topics are both "thought provoking and practical." Of course, any formative assessment requires that we connect with our students and a recent discussion post on MyAMATYC shared the suggestion of having students send "how are things going?" reflections throughout the semester.

Looking back at the MAA Connect Online Teaching and Learning Community, I revisited the Online Learning Talkshop post which included a crowd-sourced resource [document](#). Although this was created in response to the challenges of last spring, the collection of resources remains useful for online classes and adaptable for face-to-face classes. The resources available on the ASA Online Teaching Community also begun last spring can be useful for new online classes and can be adapted for face-to-face classes too. The library includes lesson plans, R resources, and datasets. Explore the smorgasbord of MAA Connect, the ASA Community, and MyAMATYC, share your tips, and stay connected via the StatPREP community!

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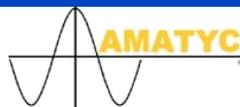
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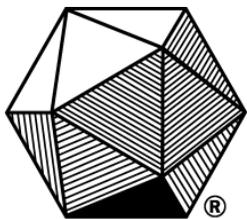
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MAA CONNECT

Need Help Joining?

[Getting Started Guide](#)

[Getting Started Video](#)

[StatPREP October Webinar](#)

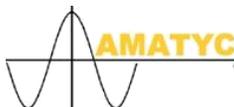
"WHAT IS A CONFIDENCE INTERVAL?" **ACTIVITY FOR LITTLE APPS**

BY KATHRYN KOZAK

In this article, I will highlight one of the many activities that you can use to help your students gain a stronger understanding of statistics. This activity gives your students an understanding of how to interpret the confidence interval and how the choice of confidence level and sample size affects the width of the interval. As we all know, this concept can be hard for students to understand. They don't really grasp how to statistically interpret a confidence interval and they don't see how the choice of sample size and confidence level affects the confidence interval. This activity provides a visual understanding of these concepts by using the Confidence in T Little App (https://maa-statprep.shinyapps.io/Little_App_T/).

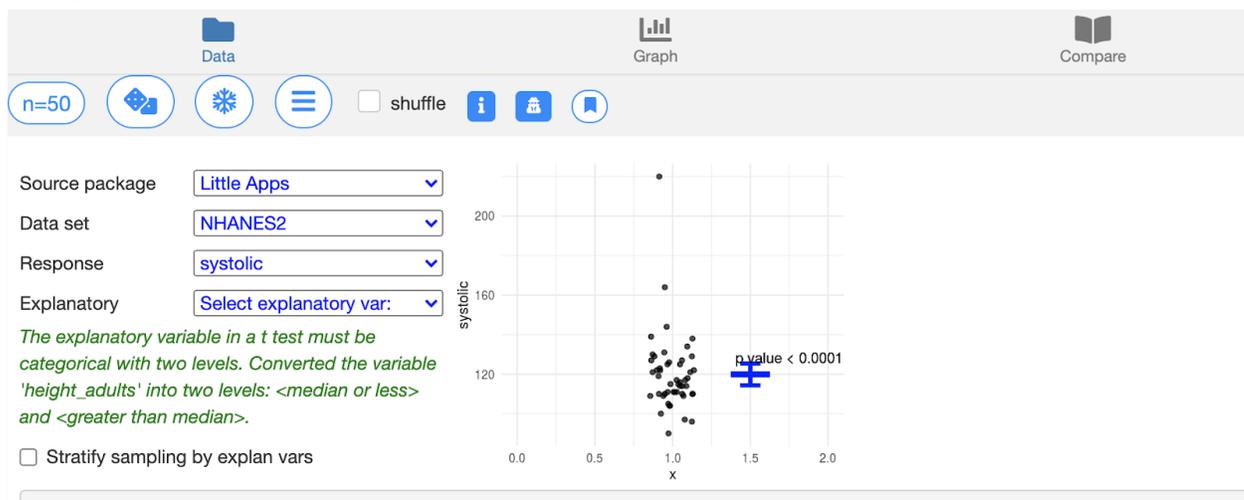
The activity walks the students through what response variable to pick and how to display the population mean and the confidence interval. The students will then generate many confidence intervals so that they can see how often the confidence interval contains the population mean. The activity then goes on to have the students explore the changes in sample sizes and the changes in confidence interval. The beauty of this is that the stu-

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ACTIVITY FOR LITTLE APPS Continued...

dents visually see all of these changes without having to calculate all the intervals. The activity also allows the students to pick their own variables so they can explore more with the activity.



In your classes, you could have the students in groups working through and answering all the questions. If your class is in person, then there needs to be at least one computer or iPad for each group. If your class is virtual, then your students probably have a computer or device to use with this activity. In synchronous virtual classes, you could set up the groups using whatever system you are using, and then ask the students to discuss what they are doing and what conclusions they come up with.

This is just one of the many activities that you can use in your class. Please check out the rest of the activities at <https://statprep.github.io/LittleAppSite/Activities.html>. The August issue of the newsletter also gives a general description of all the activities available.

**Want more StatPREP? Check out:
<http://statprep.org/>**

BUILDING COMMUNITY THROUGH DISCUSSION BOARDS: TRUECAR COMMERCIAL (NORMAL DISTRIBUTIONS, PROBABILITY)

BY AMBIKA SILVA

To enhance student understanding of the normal distribution, check out this ad <https://www.ispot.tv/ad/oyio/truecar-the-truecar-curve>. In one variant of this TrueCar commercial, you will find the following visual.



This screenshot shows a TrueCar price estimate of \$38,061 for a particular vehicle. What are the implications of this for the buyer?

Sample prompt and Student Responses

- What is this graph saying?
- What makes sense about the graph?
- What is the shape of the graph?
- What would be in the middle of the graph and what does that mean?
- If a person would get the car for \$38,061 what does that mean for the buyer?
- If the car price is directly on the "Good Price", what does that entail?

You can also go more general and have students try out the website after watching the commercial: <https://www.truecar.com/#/> (Links to an external site.)

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BUILDING COMMUNITY Continued..

After the commercial, go to the TrueCar website:

1. Click on "Select a vehicle"
2. Under new car, click the car you like.
3. See what deals are available, what is a good price for the car?
4. Click back and choose a few other cars. Do you notice that there are differences in the graph?
5. Why did I show you the commercial? Does the graph they present show us at what price we should buy the car for? And why is the graph the shape it is? Did you find good data for buying a car? What did you discover?

Student sample responses can vary wildly, and a few are given here to demonstrate the type of first responses students may give:

Student #1 Initial Post *(unedited):*

I wasn't familiar with TrueCar before this-- although my hubby says he's seen their commercials before. I guess I just need to watch more tv!!

I think you had us watch the commercial to give us some background about what TrueCar is. The outline shell of the graph has the shape of a normal distribution, which is then it is divided up- possibly in line with the Empirical Rule as to car prices: Exceptional, Great, Good and Above Average. It seems to make looking for car prices simple and easy to understand. I think it would help someone who is in the market for a new car in avoiding the back and forth negotiations with the car dealership; they would have an idea of car prices before going in to shop. Knowledge is power!! :)

Student #2 Sample Response *(unedited):*

I started out with a new 2016 Toyota Prius. The graph shows that the average price paid is \$22,910. A good price is less than \$23,817; a great price is less than \$22,694; an exceptional price is less than \$21,118. The graph shown appears to be approximately uniform. Next, I researched a new 2016 Toyota Prius C. The average price paid is \$18,046. A good price is less than \$18,569; a great price is less than \$17,923; an exceptional price is less than \$17,016. The graph is approximately skewed to the left.

The reason you suggested we review this video is to see how people can be misled with data depending on its interpretation. The video claims you can be an expert on interpreting the

BUILDING COMMUNITY Continued...

(continued) data in less than 1 minute. When viewing the site, prices are labeled qualitatively in a misleading way. For example, a price above the average is labeled a good price. The graphs shows basically the car's price range, tries to label good prices, but in actuality that is their opinion and not necessarily mine.

The two cars I researched had two different shaped graphs. This is most likely due to sample sizes. I believe this is a good starting point for looking at car prices. However, the sample sizes may be too small to give an accurate picture of what a fair price really is.

Within the discussions, students will respond to each other:

The graph that they present us with does show us at what price we should buy a car and it also shows us what prices are above market. The graph is bell shaped and it is like this because of the Empirical Rule and the website bins the price range; exceptional, great, good, and above market. With the data that we were presented really gives us a better understanding of what we really should pay for the car. Overall it's a great website and I'm definitely going to use it when buying my next car.

Yes I agree, im so into it now.

i agree-- in fact my mother-in-law is in the market for getting a new car and I'm going to direct her to at least do some preliminary research concerning car pricing through this website... I actually thought it was sort of fun to load up my dream car and figure out what it would cost. :)

What do I want them to discuss?

For a normal distribution, I want them to recognize what data on the left side of the graph versus the middle or right side means. I also want them to start thinking about using data when they make purchases, especially large purchases like a car! Moreover, I want them to see how data can be helpful. This is also a great discussion to start talking about mean and standard deviation in a graph leading to the empirical rule and z scores!

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BUILDING COMMUNITY Continued...

Student Motivation for Participating in Discussions

Aside from earning points for participating in discussions and gaining an opportunity to connect with classmates, students are motivated to participate because I often put questions on exams that are related to discussion board questions. In this case, an instructor can make several versions of the same type of question by going to the TrueCar website and generate your own graph and ask questions about it. Or instead, just write about a scenario, and give the mean and standard deviation, and have students decide on the price and if it's a good deal or not for the buyer.

Join the Discussion!

Do you have thoughts on using this as a discussion post? Join the conversation online at MAA Connect, <https://connect.maa.org/home>.



DATA: IT'S NOT JUST FOR TEACHING STATISTICS ANYMORE

BY MICHAEL BRILLESLYPER & DANNY KAPLAN

StatPREP is changing how introductory statistics is taught. At the heart of StatPREP is data. A major goal of the program is to bring real-world data into the introductory statistics classroom and to use modern computing software to analyze, visualize, and interpret multivariate data. This is a powerful paradigm shift away from the long-standing traditional course and allows students an entry point into the world of data science. Many of the tools and applications employed in StatPREP are the same as those used by professionals in a variety of fields. While statistics courses are a natural fit for working with data, those courses are not the only arena in which the StatPREP philosophy finds fertile ground.

At the United States Air Force Academy, we are undertaking a large-scale pilot study on modernizing calculus through the use of data, mathematical modeling, and R for computing. For the 2020-21 academic year, Professor Kaplan (Coors Endowed Chair for Educational Innovation) and Professor Brilleslyper (Department of Mathematical Sciences) are leading an effort involving three instructors and over 160 students in a

DATA Continued...

StatPREP-inspired Calculus I & II. The overall structure of the course is based on the highly successful Applied Calculus course taught at Macalester College over the past decade.

Statistics instructors are familiar with the difficulties students have with algebraic formulas. This is one reason for the rapid growth in interest in simulation-based inference. Strong algebraic skills are practically a pre-requisite for success in calculus. This is probably the leading reason why so many students are discouraged from following a STEM pathway.

Actually, the relationship between calculus and algebra is more subtle than textbooks suggest. Historically, algebra was the computational tool and notation available to people doing calculus. But with computers, and computer notation, the basic operations of calculus on which courses spend so much time and drill can be performed easily. Avoiding unnecessary algebra not only makes calculus concepts and principles more accessible to a wider range of students, it lets us focus on calculus as a tool for addressing real-world problems.

Parallel to the shift in statistics education from "tests" to "modeling," we designed the USAFA calculus course to shift student effort from esoteric algebraic derivatives and integrals to including derivatives and integrals as tools for modeling and interpretation of models. Two very significant departures from the traditional Calc I/II curriculum illustrate the modeling emphasis. First, functions are multivariate from the first day of class. Second, we introduce "linear combinations" as a model-building strategy, including in the first half of the first course critical ideas of vectors, linear combinations, orthogonality, and projection. We draw examples from a variety of STEM and social science disciplines, using real-world data to motivate and derive our models and calculus to understand and interpret them. To further strengthen relationships between calculus and other fields, we break with mathematical tradition and use software widely employed in those fields: R.

Through a user-friendly, web-based interface, students engage on a lesson-by-lesson basis with R, through a tutorial approach designed around careful scaffolding. We are cautious not to assess students' programming skills, but rather our goal is to expose them to a professional programming language to illustrate the importance of computing in STEM fields. We are avoiding standard programming constructs such as loops and "if...then..." statements in favor of using packages that allow multivariate plotting, curve fitting, and visualization of data in conjunction with

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DATA Continued...

the basic operations of differentiation, integration, and optimization. Figure 1 (*on next page*) shows a typical problem in our course.

Applications to differential equations and optimization have replaced the traditional emphasis on algebraic rules for finding derivatives and anti-derivatives. By putting data, modeling, and the applications of calculus ideas at the forefront of our course, we engender an interest and appreciation for mathematics early in our students' college careers. The ideas and computing tools developed for StatPREP are the driving force behind our initiative.

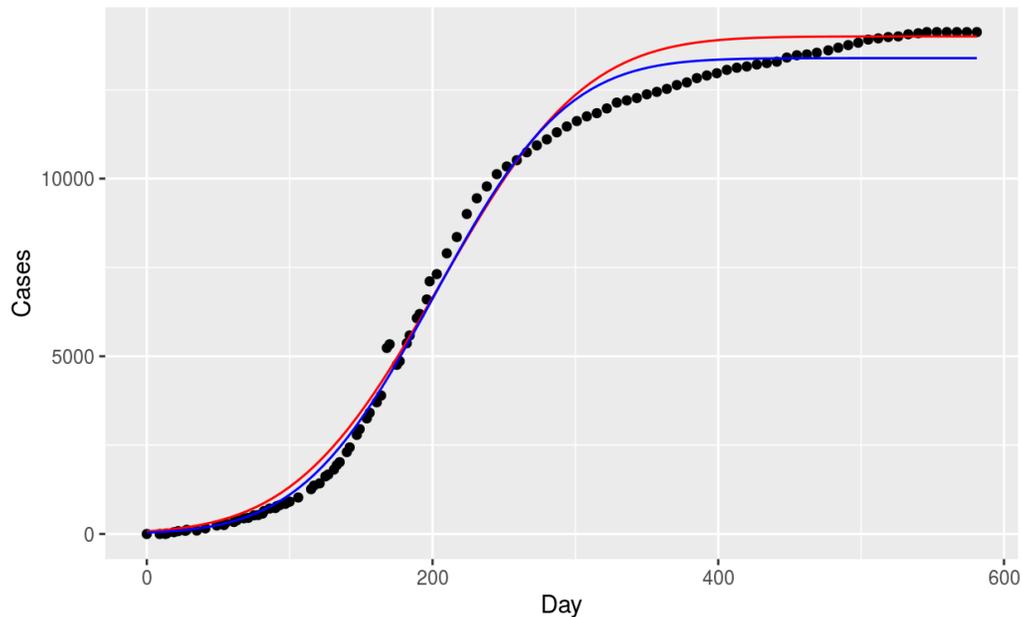


Figure 1. Ebola cases in Sierra Leone with two fitted sigmoidal models. The setting wraps together data, exponential-growth modeling, derivatives, and integrals