

Statistics for Science Projects and Surveys

The background is a solid teal color. On the right side, there are several faint, semi-transparent statistical graphics. At the top right is a large donut chart with a smaller pie chart inside it. Below it are several smaller pie charts of varying sizes. At the bottom right, there is a bar chart with four vertical bars of increasing height from left to right.

CASEF Annual Teacher Meeting
October 11, 2018

Why discuss statistics for science fair projects?

- ❖ Students need to be able to draw conclusions about their data using more than just an average.
- ❖ Judges look for statistics when scoring and they want more than just a graph of results.
- ❖ Projects that use surveys are expected to show confidence intervals with the averages to confirm that conclusions are drawn from sufficient data.



The purpose of this session is ...

- 1) To show how 95% confidence intervals can answer the question of whether experimental results are statistically significant
- 2) To show how **Google Forms** and **Google Sheets** (free to anyone with a gmail account) can be used to collect, analyze, present and share experimental results
- 3) To present examples of the analysis of science fair project data that you can use and share to do your own data analysis



You can help me generate some data to analyze

Please use the web browser on your phone to answer this quick 5 question survey made in **Google Forms**.

Here is the tiny URL

<https://tinyurl.com/yc4y2ccw>



1) 95% Confidence Intervals



What is a 95% Confidence Interval?

A 95% confidence interval is a range of variability around the average result for an experiment.

“For numerous repetitions of an experiment, there is a 95% probability that the confidence interval obtained each time includes the true mean value.”



How can you use Confidence Intervals?

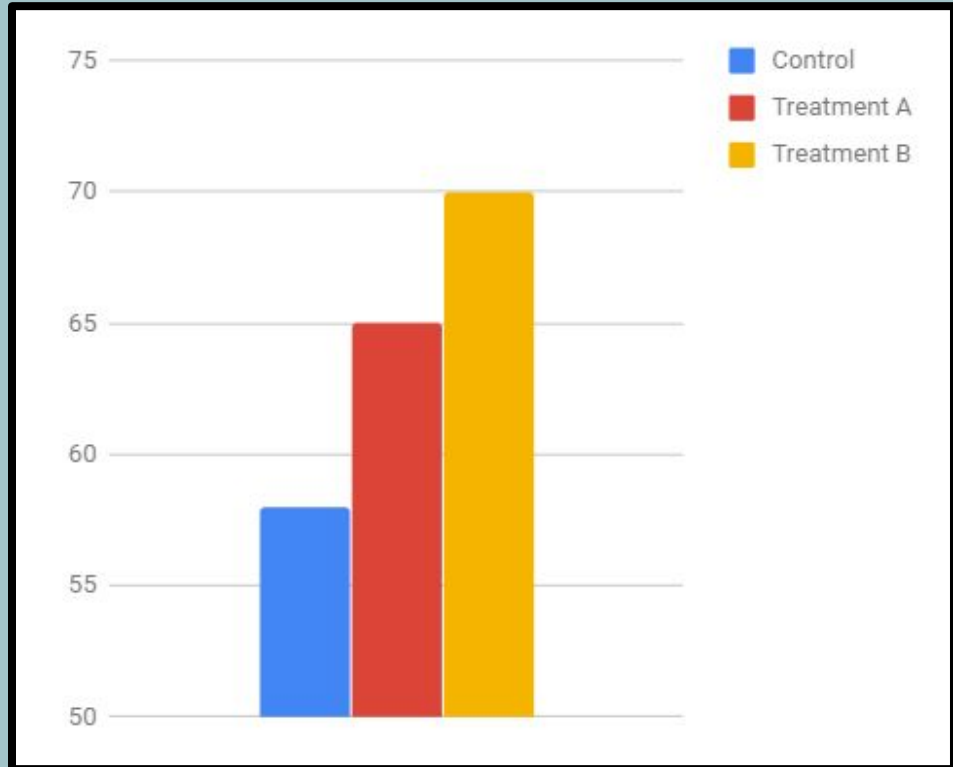
95% confidence intervals can be placed as error bars on a graph of average results from an experiment.

They allow you to make a side by side visual comparison of your results so you can conclude whether they are statistically significant or not.

For example....

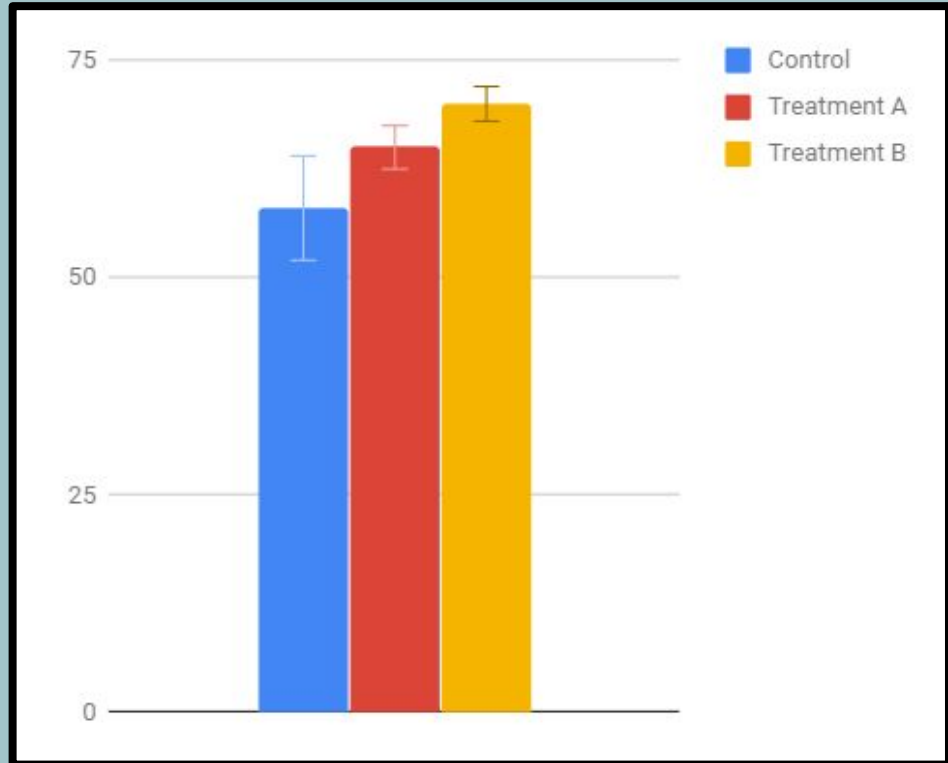
What Can You Conclude from This Bar Graph?

Average of Treatments
A and B as Compared to
the Control



What Can You Conclude Now?

Average of Treatments A and B as Compared to the Control with 95% Confidence Error Bars





Here is a concluding statement using the results in the second graph:

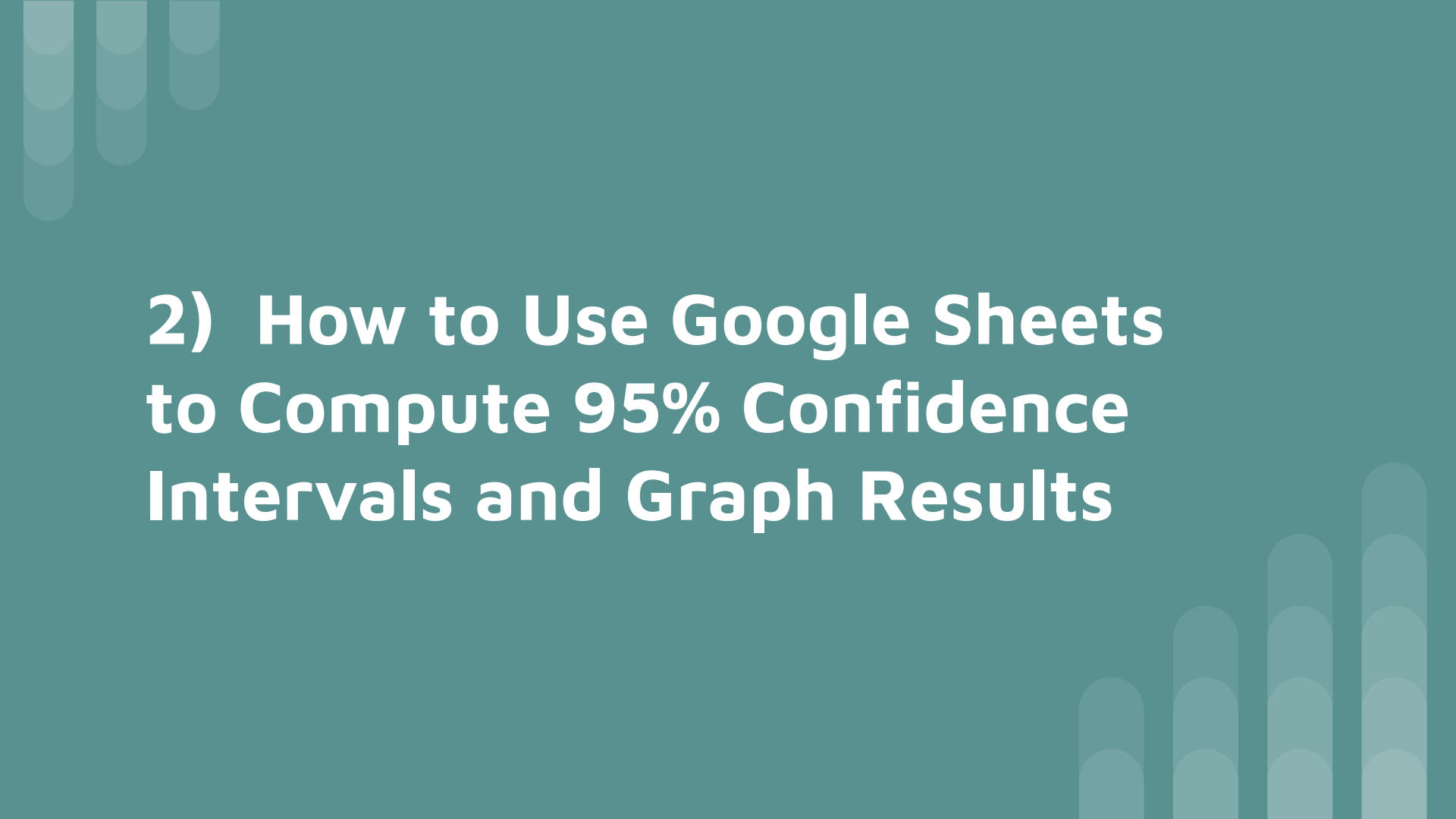
- ❑ With 95% confidence, it can be concluded that treatment B represents a significant improvement over the control.
- ❑ Treatment B is also significantly better than treatment A at 95% confidence.
- ❑ Treatment A appears to show improvement over the control but this result cannot be stated with 95% confidence.



Confidence Intervals are useful for comparing average results of different treatments to decide if they are significantly different

Example experiments that can use 95% confidence intervals:

- Compare different brands of paper towel for absorbency
- Compare survey attitudes by gender or age group
- Compare quantity or type of fertilizer used to grow plants
- Compare animal food flavor preference



2) How to Use Google Sheets to Compute 95% Confidence Intervals and Graph Results



How wide a confidence interval is depends on just three things

1. **The standard deviation** (or spread) of the data - more spread in the data, the wider the interval
2. **The number of data points** collected - the more data points, the narrower the interval
3. **The desired confidence level** - 95% confidence is wider than 90% confidence



Computing 95% confidence intervals involves these steps

Computing confidence intervals from a set of repeated data:

1. Calculate average
2. Calculate standard deviation
3. Count the data
4. Calculate size of confidence interval

Google Sheets Functions:

1. =**AVERAGE**(RANGE)
2. =**STDEV**(RANGE)
3. =**COUNT**(RANGE)
4. =**CONFIDENCE**(0.05, STDEV,COUNT)



Let's Check Those Survey Results in Google Sheets

Link to Survey:

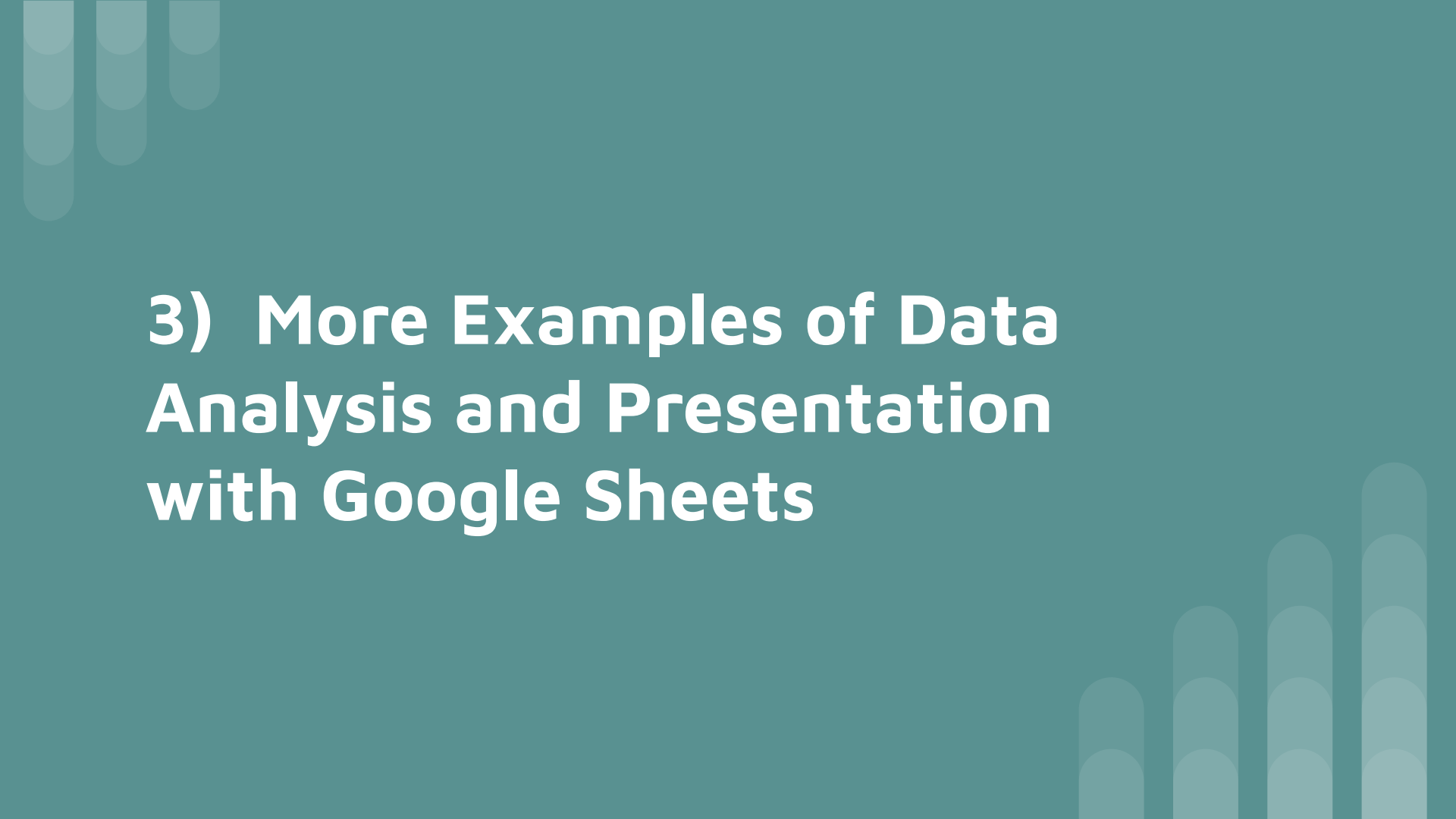
<https://tinyurl.com/yc4y2ccw>

[Survey Responses and Data Analysis](#)



Benefits of Google Sheets for Statistical Analysis

- ❑ **FREE** to anyone with a gmail account
- ❑ Allows shared collaboration with science fair teams and teachers
- ❑ Can share examples of data analysis with all students
- ❑ Spreadsheet automatically created and all responses saved when Google Forms is used to make surveys



3) More Examples of Data Analysis and Presentation with Google Sheets

Here are several examples of data analysis using 95% confidence intervals:

[The Effects of Watering on Plant Growth](#)

[Data Analysis Practice File](#)

[The Moisture Content of Plastic Resin](#)

[The Puncture Resistance of Trash Bags](#)

Thank you for your time today!

If anyone wants the links to the Google Sheets files I showed you today, just give me your email address and I will send the links to you. You can view the files or make copies for your own use.