8th Grade Math

Title of lesson

Subject Area: Math Grade Levels: 8 August 2, 2013

Lesson Overview

The purpose of this lesson is to have students create scatterplots reflecting a real world situation. Students will analyze the data to find potential problems in creating a solid foundation by looking at data in a variety of ways.

Materials Included in this Lesson

- 8 Pile Driving Data sheets (Depth to Number of Strikes per Foot)
- Information sheet regarding what student will find – Teacher Reference (see below)
- Grading rubric

Other Materials for this Lesson

- Graph Paper
- Colored Pencils
- YouTube Video of a Pile Driver (http://www.youtube.com/watch?v=GBiZ5nMphKI) This one is 10 minutes, but it shows what is being driven into the ground and a about 3.30 it starts driving the pile.

Skills the Student will Learn

- How to construct scatterplots in two variables.
- Why points are discrete in a scatterplot.
- How to look for and find clusters of points, outliers, and an informal trend line in scatterplots.

Student Deliverables

- 8 unique scatterplots for each drive
- 1 combined scatterplot
- Observations about the data – clusters, outliers, and any questions
- OR "Rule of 4"

Length of Lesson: 2 - 5 Days

Activity Day One

Introduce the Topic through a YouTube Video
Give brief introduction to what students are seeing in the data sheets
Partner or Group students (no more than 4 for each group)
EACH Initial Pile Drive data is graphed its' own sheet of graph paper
The group should produce 8 in total

Depending on length of class period, students may need to finish for homework.

Activity Day Two

Partner / Group will look at all 8 of the scatterplots.
Students are looking for patterns or differences.

Discuss after about 20 minutes.

Partner up: Graph all 8 scatterplots on the same sheet of graph paper.
Each Pile Driving Log should be done with a different colored pencil
One student can read out the information while the other graphs
For this project, it will help to connect the points (Explain that is only to make it easier to see)

Activity Day Three

Finish the compilation scatterplots
Working with partner, students should look for outliers or things that do not fit.
Partners should compile a list of questions they have about the data
Partner should compile a list of patterns
(There is a trend line in the data)

Activity Day Four – Wrap Up

Review the questions students had about the data, and answer questions you can
If students did not see the trend line, point it out to them.

EXTENSION: You can have them create a "Rule of Four" for this lesson

Enrichment Suggestions

Rule of Four:
The original group of up to 4 students creates a poster – which can be a piece of paper. The paper is divided into 4 quadrants.
Quadrant 1: Data Points

- What observations do they see in the data points?
- Are there trends in the data points?

Quadrant 2: Individual Scatterplots

- What observations do they make in the scatterplots?
- Are there outliers, and or groupings?
- Are there trend lines?

Quadrant 3: Combined Scatterplots

- What observations do the make in the combined scatterplots?
- Are there outliers, and or groupings?
- Is there a trend line?
- Is there anything else that stands out in the data?
- What questions do they have about the data?

Quadrant 4: Overall Learning

- How does looking at the data differently effect what you see about it?

Students grade each other's projects

Student Resources

YouTube Video of a Pile Driver (http://www.youtube.com/watch?v=GBiZ5nMphKI)
Pile Driving Records – Data Sheets

Foundation Academic Standards

- **8th Grade – Statistics and Probability – Standard 1:** Students construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association and non linear association.

- **8th Grade – Statistics and Probability – Standard 2:** Students know that straight lines are widely used to model relationships between two quantitative variables. Informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.

- **8th Grade – Statistics and Probability – Standard 4:** Students understand that patterns of association can be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Use relative frequencies calculated for rows or columns to describe possible association between the two variables.

CTE Pathway Standards

Engineering and Architecture

5.1 Identify and ask significant questions that clarify various points of view to solve problems.
5.4 Interpret information and draw conclusions, based on the best analysis, to make informed decisions.

Lesson Plan Relevance To Externship

When building a large structure in parts of California, it is important for the foundation to be secure. There are a number of reasons for this including earthquakes and the weight of the building. The information for this lesson comes from the Initial Test Pylons placed at one of ENGEO's construction sites.

Rubric for the Pile Driving Scatterplots Project

Student Deliverables	4 Exceeds Expectations	3 Meets Expectations	2 Approaches Expectations	1 Fails to meet Expectations
Individual Graphs (each) [32 pts]	• Scatterplot is created in Quadrant IV. • The points are accurate • A trend line is sketched.	• Scatterplot is created in Quadrant IV. • The points are accurate. • Trend line is NOT in evidence	• Scatterplot is NOT in Quadrant IV. **OR** • The points are not all accurate. **AND/OR** • Trend line is in evidence	• Scatterplot is NOT in Quadrant IV. **OR** • The points are NOT accurate **AND/OR** • The trend line is NOT in evidence.
Combined Scatterplot [32 pts]	• Scatterplot is created in Quadrant IV. • The points are accurate • A trend line is sketched.	• Scatterplot is created in Quadrant IV. • The points are accurate. • Trend line is NOT in evidence	• Scatterplot is NOT in Quadrant IV. **OR** • The points are not all accurate. **AND/OR** • Trend line is in evidence	• Scatterplot is NOT in Quadrant IV. **OR** • The points are NOT accurate **AND/OR** • The trend line is NOT in evidence.
Project Analysis [32 pts]	• The questions posed have deep relevance to the project. They reflect that students understand the information the data reflects. • The analysis of the	• The questions posed have relevance to the project. • The analysis of the data shows thought and effort went into looking at what it means.	• The questions posed have little relevance to the project. • The analysis of the data is slight, showing SOME thought and effort. • There is SOME use	• The questions posed have no relevance to the project. • The analysis of the data is minimal to none, showing a lack of thought and effort. • There is no use, or

	concise. It makes mathematical relevant observations and/or connections • There is a clear explanation of the work so that the reader does not need to guess what is being done. The mathematical terminology is accurate and relevant.	of mathematical terminology. There is a clear explanation of the work.	terminology. The explanation is unclear.	mathematical terminology.

Project Analysis Grading Rubric

	4 - Exceeds Expectations	3 - Meets Expectations	2 - Approaches Expectations	1 - Fails to meet Expectations
Reflection SMP 1 SMP 7	• The questions posed have deep relevance to the project. They reflect understanding of the information the data reflects. • The answered question shows a concentrated effort to reflect on the project and draw mathematical meaning from it.	• The questions posed have relevance to the project. They reflect understanding of the information the data reflects. • The answered question shows effort to reflect on the project and draw mathematical meaning from it.	• The questions posed have little relevance to the project. They reflect some understanding of the information about the data. • The answered question shows little effort to reflect on the project and draw mathematical meaning from it.	• The questions posed have no relevance to the project. • The answered question shows no effort to reflect on the project and draw mathematical meaning from it
Strategies and Understanding SMP 3 SMP 4 SMP 7	• The analysis of the data is deep and concise. • It makes mathematical relevant observations and/or connections.	• The analysis of the data makes mathematical relevant observations. • Shows thought and effort. .	• The analysis of the data is slight. • Shows SOME thought and effort.	• The analysis of the data is minimal to none. • Shows a lack of thought and effort.
Communication: SMP 6	• There is a clear explanation of the work so that the reader does not need to guess what is being done. • The mathematical terminology is accurate and relevant.	• There is a clear explanation of the work. • There is accurate use of mathematical terminology.	• The explanation is unclear. • There is SOME use, of mathematical terminology.	• The explanation is unclear or non-existent. • There is no use, or inappropriate use of mathematical terminology.

Teacher Reference Sheet – Initial Pile Driving Scatterplot

During the Initial Pylon Driving Test (the data listed in the excel file), the strikes are counted as the pylons are forced into the soil. As the pylons move further into the ground, it creates more friction on the cylinder which in turn causes more blows per foot to be struck. There are also changes as the cylinder goes from one type of soil to another.

After a week, the team returns back out to the site to finish driving the pylons into the ground and further recording the data. All of this information gives the Geotechnical Engineers additional information about the stability of the soil under the building. The stability of the soil enables the pylons (eventually 6 are grouped fairly closed together) to help each takes the stress of a moving building during an earthquake without failing.

Other information can be obtained from the Initial Test Pylons if the builder or contractor see fit. For example, the pylons can be tested for their failure rate. Tremendous pressure is placed on the pylon until cracks and fails. Steel girders or used to set up the test and to distribute the weight on the pylon. These tests are time consuming, and the amount of money spent in down time may not off-set the cost of material savings in construction materials that the tests may prove.

The test pylons are eventually part of the support of the building (unless they are tested to failure and then another is driven near the intentionally failed one to take its place).

A note on failures: In construction, creating failures give engineers and builders MORE information than success. The failures show potential flaws in the design or building materials can the more easily be rectified in the earlier building stages than after a building is complete.

Observations by the students should include many of the following:

In this data, all of the pylons (except for 8) were started at a depth of 12 to 14 feet. Students should see that pylon 8 does not match the rest of the data (and the pylon was rejected by the engineering company – another had to be driven).

Many of the initial feet do not have any blows recorded – the weight of the 80 foot pylon caused it to settle further into the ground without any additional aid.

Students should observe and possibly question why the blows increase with the depth. They should be encouraged to think of their own answers to this question.

Once the graphs are put together, there were some blows obviously outside of the norm. This is because of the soil layer they were coming to. The soil caused more resistance as it was punctured. *Rocks would be the logical conclusion to this information, but there were no large rocks in this region.*

Notes for the Teacher:

You will want the student to spread out the points on the x-axis (they only go as high as 15)

Teacher Reference Sheet – Initial Pile Driving Scatterplot

Everything will be graphed in quadrant IV since the pylons are being driven into the ground. (Tell the students or not? Up to you)

Observations on the data set will be sparse most likely. It is a bit overwhelming.

The main question is for this lesson is:

"How does the students' perception about the data change when it shown in different ways"?

"What stands out when you graph all the data together that you did not see when it was graphed separately"?

Have the students go back to the data set and see if they can see the trends in the numbers that they found in the graphs.

"Which is more obvious, the graphs or the data set"?

"Why is important to have many ways of illustrating the same information?"

All of these questions can be part of the final wrap up worksheet or the Rule of 4 – Quadrant 4