NGCSU Lesson Plan

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Standards

State-Based Standards:

From GPS:
Topic: Data Analysis and Probability
MM2D2: Students will determine an algebraic model.

Topic: Process Standards
MM2P1: Students will solve problems (using appropriate technology).
MM2P3: Students will communicate mathematically.
MM2P4: Students will make connections among mathematical ideas and to other disciplines.

Looking ahead (foundation for future courses):
Topic: Data Analysis and Probability
MM3D3: Students will demonstrate understanding of the differences between experimental and observational studies by posing questions and collecting, analyzing, and interpreting data.

From NCTM standards:
Data Analysis & Probability 9-12

- display and discuss bivariate data where at least one variable is categorical.
- recognize how linear transformations of univariate data affect shape, center, and spread.
- for bivariate measurement data, be able to display a scatterplot, describe its shape, and determine regression coefficients, regression equations, and correlation coefficients using technological tools.

Lesson Plan

Unit / Lesson Topic:

Topic Name: Linear Regression
Grade Level: Math 2
Content Area: Mathematics
Type of Lesson: Application

Understandings: Students will understand that linear regression can be used to determine if two sets of data are related in the form of a linear equation.

Essential Questions: How can we determine if two sets of data are related?

What are the different possible relationships?

Knowledge / Skills: Students will know . . .

- definition of “scatterplot”, “linear regression”, “regression line”

Students will be able to . . .

- use a linear regression tool to enter data and plot the “best fit” line

Assessment Evidence:

Performance Tasks

- students will plot their collected data and print a copy of the generated line to be turned in; their analysis of the regression will also be written (on the printout or a separate page) and turned in

Other Evidence

- students will complete a quiz on definitions and concepts related to linear regression

Learning Plan:

Time Alloted	Teaching and Learning Strategies
10 min	Students will be asked to keep their hands off the computers and follow along with the teacher while we do a review of using a linear regression tool We're going to plot points using a regression tool program: http://illuminations.nctm.org/index_d.aspx?id=454#first (repeating some steps from Day 1 intro) 4. CLEAR the graph and plot several points. Think about a line that best fits these points. • Click SHOW LINE to see the "least-squares regression line" that fits these points. • What do you think will happen to the regression line if you plot a new point? Try it and find out. (NOTE: When you plot a new point without clearing the graph, then the new regression line is drawn automatically.) • Plot some more points and see what happens. Ask students to describe any patterns or trends that they see. 5. The line that the computer draws is called the least-squares regression line. It "fits" the data points according to criteria that you will learn about later. Roughly, the least-squares regression line is the line that minimizes the squared "errors" between the actual points and points on the line. This makes the line fit the points. Just to get a better feel for the regression line, try the following tasks.
5 min	Introduce a different linear regression tool (use the moment to teach the students that there are always many different tools available to perform a task with, and part of the problem solving process is identifying and selecting the proper tool) http://www.ucalgary.ca/~enosal/Applets/Linear/Linear.html

This linear regression tool allows us to enter data directly in a tabular format. Please open our class home page in a browser window, and then click on the "Linear Regression Tool – data entry version" link

10 min Let's get out your data sheets from yesterday's labs and enter the population data and the data you collected from your group's water samples

Enter the water sample data as the first (X) coordinate, since we are hypothesizing that this could be the "explanatory" variable, and enter the population data as the second (Y) coordinate, since we are hypothesizing that this could be the "dependent" variable

Walk around and help students get their data entered correctly, help them set the scaling on the tool to display the scatterplot and regression line well, and to print out their graph.

10 min Discussion of the results

Does the graph of the data help you to "visualize" things you noticed about the data yesterday?

What things from the scatterplots and regression lines jump out at you?
(students in one of the groups should have several "outlier" data points that hopefully they will recognize and point out; if not, they will need to be prompted)

20 min What you are seeing in that group's data are called "outliers". Let's follow along with me now and look at the effects of outliers in more detail

(from "The Effects of Outliers: Lesson 2 of 4" http://illuminations.nctm.org/index_d.aspx?id=455)

1. CLEAR the graph. Plot about 8 points that seem to be approximately on a line that has positive slope (slanted up as you move left to right). Click on SHOW GRAPH to see the regression line.

- Does the line fit the points well?
- Does the equation show a positive slope?

2. Add an outlier point, that is, a point that does not at all follow the trend established by the other points.

- Describe what happens to the regression line. Explain.
- Grab this outlier and drag it around. Observe how the regression line changes. Describe any patterns that you see.

3. As you have seen, an outlier can significantly affect the regression line. CLEAR the graph and begin again with about 8 points that seem to be approximately on a line that has positive slope.

• Experiment with dragging an outlier point to find locations of an outlier that cause the regression line to drastically change slope.

• Find other locations of an outlier that cause the regression line to shift without changing slope.

- In our other work, you were asked to look at a real-world example where you would find a line of best fit. In that real situation, what would be (was) an outlier?

1. How would you summarize the effect of outliers on the regression line?
2. Think back to the example in part 1 of using the regression equation to predict a person's weight when you know their height. What would be an outlier in this case? Could you justify leaving out that point and using just the remaining points to calculate the regression equation?
3. Think back to your lab data. Could you justify leaving out an outlying point to calculate the regression equation? What would the possible consequences be?

5 min Wrap-up

Tomorrow we will look at one final aspect if linear regression – the correlation coefficient – which gives us a mathematical measure of just how well our data fits the regression lines we've been creating and just using our eyeballs to judge the fit on.

Lesson Modifications: This section should include how you will modify the lesson to meet individual student needs.

Resources

Resources:

1) computer lab (separate lab, or mobile laptop lab set up in classroom) with one computer for each student; each computer should have a connection to the Internet, or connection to a local server where the "regression tool" applets have been set up

2) computer and projector for use by teacher

3) on my computer, I should open three different regression tool windows and plot the data from the three groups ahead of time; that way, during discussion, I can quickly switch between windows to show the graphs from each group, or I can resize the windows so that all three plots will show on the screen

Lesson Reflection

Analysis of Lesson:

Use this area to reflect on:

- What worked or didn't work
- Why it worked or didn't work
- Which students learned or didn't learn
- Why did they learn or not learn
- What assessment data lead to your conclusions
- If I were to teach this lesson again, what would I do differently