NGCSU Lesson Plan

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Standards

State-Based Standards:

Note: Since this lesson is the introduction lesson in a unit, the standards listed here are those for the entire unit, since I will want to be sure to provide introductory material to get the students thinking about and anticipating all of the learning activities/outcomes that will arise in the course of the unit.

From GPS:
Topic: Data Analysis and Probability
MM2D1: Using sample data, students will make informal inferences about population means and standard deviations.
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.

Lesson Plan

Unit/Lesson Topic:

Topic Name:	Introduction to Sampling and Linear Regression
Grade Level:	Math 2 (see Lesson Modifications for adaptations to Core Math 3 and Accelerated Math 1)
Content Area:	Mathematics
Type of Lesson:	Introduction

Understandings:

Students will understand that when examining large populations it is not always possible to count or examine every member of the population, and as a result, sampling techniques must be used.

Students will understand that there are different methods that can be used for sampling, and that knowledge of the strengths and weaknesses of each method is needed in order to decide which to use.

Students will understand that some information can be gathered through direct measurement.

Students will understand that it is possible to determine relationships between data by creating algebraic models of the data.

Essential Questions:

What is sampling (censusing) and how is it used?

Are there different methods of sampling and what determines which method you use?

How do I choose what data to collect and how might I go about collecting it?

When I have multiple sets of data, how do I determine if there is a relationship?

Knowledge/Skills:

Students will know . . .

- the terms “sampling”, “algebraic model”, “linear regression”

Students will . . .

- investigate the straight line, which is the graph of a linear function
- explain the basics of sampling, data collection, linear regression

Assessment Evidence:

Performance Tasks

- none for this lesson

Other Evidence

- understanding of basic concepts as demonstrated during class discussion and question/answer session

Learning Plan:

Time Alloted	Teaching and Learning Strategies
10 min	Intro to sampling Give definition: A way to obtain information about a large group (population) by examining a smaller, randomly chosen selection (the sample) of group members. One specific type of sampling is “population estimate”. What information about the large group do you think we’ll be looking for with a “population estimate”? Comprehensive info on sampling at: http://en.wikipedia.org/wiki/Sampling_(statistics)
20 min	Different methods to perform population estimates As done by the U.S. Census Bureau http://www.census.gov/popest/estimates.php - estimates are done by applying “change” formulas to a previous “hard count” - accuracy of the “hard count”? pros/cons of hard counts: ask for a student volunteer to come up to the board and record ideas from the class

What if you can't do a "hard count"?

Various methods exist for estimating population size, each involving a different set of assumptions and a different statistical method for calculating the estimated population size.

- Quadrat method: map out small plots, hard count in the plots, and extrapolate to entire population

One of the simplest methods is the Lincoln-Petersen Method. More info at:
http://academic.hws.edu/bio/oldsite/Pages/Petersen2.html

Other methods:
- Jolly-Seber
(http://academic.hws.edu/bio/oldsite/Pages/Jolly.html)
requires multiple mark-recapture events

How are population estimates actually performed:

- show "electrofishing" web page from "shocking truth about electrofishing" PDF file on local hard drive

bug counting in Mexico
http://www.bioone.org/bioone/?request=get-document&issn=0046-225X&volume=031&issue=03&page=0515

10 min Getting to know the regression line
(from "The Regression Line: Lesson 1 of 4", http://illuminations.nctm.org/index_d.aspx?id=454)

provide the following background information:
In analyzing the relationship between two variables in an experiment, one may try to fit a straight line or any simple curve to a plot of the data points. For example, the weight of a person often depends on their height. Both weight and height are variables. We would like to find a formula for weight as a function of height in general, a formula that we can use to predict any person's weight given only their height. To find such a formula, we take a sample of 40 (say) people and measure both the height and weight of each. For each person, we end up with a pair of numbers (x, y), where x is the height and y is the weight. We plot the 40 height-weight pairs as points in the xy-plane to make what is called a scatterplot. Note that height is on the horizontal axis and weight is on the vertical axis. The "input" (independent variable) is height, which goes on the horizontal axis, and the "output" (dependent variable) is weight, which goes on the vertical

axis.

We then try to fit a curve to these points that somehow represents the overall shape of the scatterplot and find the equation of that curve. The equation is then used to represent the relationship between height and weight in general and therefore to predict any person's weight if we know only their height.

There are many different kinds of curves one could fit to data. The graphs of linear, exponential, logarithmic, and power functions are all useful curves. In this lesson, you will investigate the simplest one, the straight line, which is the graph of a linear function.

We're going to plot points using a regression tool program:
http://illuminations.nctm.org/index_d.aspx?id=454#first

The tool will automatically find a straight line for you that" fits" the points. The line is called the "least squares regression line" of y on x. The tool will also calculate the equation of the line for you and its Pearson correlation coefficient r, which we will study in a later lesson. The equation and the correlation coefficient are displayed in the top left corner of the tool; n is the number of points.

20 min Explorations using the regression tool
(all actions in the tool performed by teacher)

1. Plot one point and then click SHOW LINE. Why do you think a line is not graphed?

2. CLEAR the graph and plot two points that have whole number coordinates.

• On your whiteboards, find an equation for the line through these two points. Hold up boards to show me your results.

• Click SHOW LINE. Compare the equation for the line drawn to the equation you calculated. Explain and resolve any differences.

3. CLEAR the graph and plot 3 points. Think about a line that "fits" these three points as closely as possible.
• Is it possible for a single straight line to contain all three of the points I plotted?

• On your whiteboards, sketch a line that you think best fits the three points, and show me the results.

• Click SHOW LINE. Do you think that the line graphed fits the points well? How does it compare to the line you drew?

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.

a) Can we plot 4 points so that the regression line is horizontal? Do this in several different ways, taking point suggestions from students.

b) Can we plot 3 points (not all on a line) so that the regression line is horizontal?

5 min Summarize the concepts of sampling and regression

Questions to consider:
How do you think sampling and regression might be used together?

How do you think you would communicate conclusions that are made when sampling and regression has been used?

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

For other curriculum paths:
Core Math 3: spend more time covering new vocabulary terms and perhaps add some guided practice or an assignment related to the vocabulary

Accelerated Math 1: go into more detail in those areas where the AM1 students will also be going into more detail during the individual lessons

Resources

Resources:

1) Computer with overhead projector and Internet connection (for use by the teacher)
2) Handouts with articles to read about sampling and environmental studies that are similar to the activities that will be done later in the unit.
3) Individual whiteboards for working problems.

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