Vision - Potential

Vision Within Every Instructor - Potential Within Every Student
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Contents

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[1] Handshakes, Nods, and Polygons

Two ways of introducing people who are gathered around a table are:

1. Have everyone stand up and move around shaking hands such that each person shakes the hand of each other person exactly once.

2. Each person shakes the hand of the person sitting on either side and nods in recognition to each of the other people sitting around the table.

Illustrate these two methods by drawing polygons of 4, 5,and 6 sides along with their diagonals. Let the vertices represent the individuals, sides represent handshakes, and diagonals represent nods.

Your task is to develop a model for the number of handshakes in the first method of introducing people and a model for the number of nods in the second method. Then determine the number of handshakes in the first method and the number of nods in the second method if there are 10 people in the group.

* Supported by the U.S. Military Academy.

Hint: (Handshakes) Form a two-column table with the first column labeled *Number of People* and the second column labeled *Number of Handshakes*. Form a scatter plot of the table data and then fit a curve to the scatter plot.

(Nods) Form a two-column table with the first column labeled *Number of People* and the second column labeled *Number of Nods*. Form a scatter plot of the table data and then fit a curve to the scatter plot.

[2] Locating the *Best* Water Line

A trickler hose attached to an outside hose faucet is going to be pulled in a straight line away from the house and turned on, in order to water four nearby bushes. Using an x-y coordinate system with the faucet at the origin (0,0), and measuring in meters, the four bushes are located at (1,1), (2,3), (3,2), and (5,3). Your basic task in this project is to locate the *best* line you can find to water all the bushes.

Begin by drawing (by hand) a scatter plot of the four bushes. Draw a line through the origin that gives the best *eye-ball* fit to the points on your scatter plot. Let m denote the unknown slope of your line. Because your line does not pass through each of the four points, there will be an error associated with each point. A point error is defined to be the vertical distance measured from the point to your line. There are several ways to measure the total error. Compute the total error for each of the following three methods noting

that each of your answers will be a function of m, the unknown slope of your line.

a. The actual error which is the sum of the four point errors.
b. The absolute error which is the sum of the absolute values of the four point errors.
c. The sum of the squares of the four point errors.

Note that methods b and c both avoid cancellation due to positive and negative errors.

Using your calculator or a computer, plot each of the functions. For each function, graphically determine the value of m that minimizes the function. Using these values of m, impose the graphs of the three functions on the scatter plot of the location of the four bushes.

Which method gives the *best* fit? Explain your reasoning.

Use the regression program built into your calculator to determine the line of best fit. Does it correspond with any of the results of the three methods? If so, which one.

[3] Gasoline Price Modeling Project

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For the past three years we have been teaching a course called Algebraic Reasoning designed to introduce students to the notion of functions, rates of change, and function families through student-centered activities and modeling. We teach this course in sections of 35 students and each term we ask the students to do a group project outside of class. For the last three terms we have given students a project involving collecting gasoline price data and comparing that data to historic data that we have collected. One of our goals for the project is that students see the importance of the "units" of the slope for a linear equation. When the students compare the data they gather daily with the historic data that is recorded monthly they find linear equations to fit the data, often not realizing that the slopes of the two equations are in different units. In the first case the slope represents the change in gasoline price per day, while in the second case the slope is the change in price per month. We have found that our students struggle with this idea when they try to compare the graphs they get for each function.

Slope and linear functions are part of the regular curriculum for the course, but to prepare students for doing this project we do an activity in class where students are given data, create scatter plots and estimate what they think should be the line of best fit. We then have them compare their guesses and go back and enter the data into their calculators to determine the "real" best-fit line.

This is the gasoline prices project in its current form.

THE PROJECT

The purpose of this project is to gather some data on gasoline prices in Corvallis, OR and to analyze and present that data in an understandable form. For this project, you will compare that data with historic data on the average gasoline prices in the United States from January 2007 to December 2008. You will work in groups of three or four to gather data, answer some questions and finally produce a paper and a ten-minute quality presentation that will be given during the last week of classes. Here is what you need to do.

Part I. Choose a gasoline station in the Corvallis area and, for the next four weeks, keep a daily record of the price of regular unleaded gasoline. (Be sure that you stick with the same gas station throughout the data gathering process.)

1. Plot the points that represent the data that you have gathered over the past weeks. Be sure to correctly label the horizontal and vertical axes.

2. Using your calculator or Excel, plot a "best-fit" line through the data. How do you know this is the "best" line? (This will be Line A.)

3. What is the slope of A? What does this slope represent? What is the equation of this line?

4. Use this equation to predict the cost of gasoline in Corvallis on December15, 2009.

5. According to your equation what should have been the price of regular gasoline on September 1, 2008. Was this actually the price of gas on that day? (Use the historic data at the end of this assignment.) If the two prices are not the same, why do you think this is so?

Part II. Look at the historic gasoline price data provided on the last page. This data represents the average gasoline prices for the U.S. from January 2007 through December 2008.

6. On a separate graph plot the points that represent the data from January 2007 through December 2008. (Again, be sure to properly label your axes.)

7. Using your calculator or Excel find the "best-fit" line for this data (Line B).

8. What is the equation of the line? What is the slope of the line? Interpret the meaning of this slope.

9. Find a third "best-fit" line (Line C) just for the points from August 2007 through January 2008. What are the equation and slope of this line?

10. Are the three equations the same? If not, why do you think they are different?

11. Compare the equations and slopes for all three lines – A, B, and C. What does your information tell you about the rate of change in gasoline prices in these three different time periods? Pay attention to the units!

12. Which equation do you think would be a better predictor for gasoline prices in 2010? Explain.

Part III. Suppose your group has the opportunity to bid for operating a school bus service for Ashbrook School in Corvallis. The school has provided four buses and will pay for maintenance on those buses. Your job is to design the bus routes, buy gas for the four buses and drive the buses. You must maintain four routes; each with four stops reasonably placed so that you can pick up all the students and drive your routes twice each day – morning and afternoon.

13. Map out your bus routes in detail (actually drawing them on a map would be good), list bus stops for each route and determine how many miles your buses will need to travel each day. Assume that you have no students who are more than 3 miles from the school.

14. Assuming that the buses get about 8 miles per gallon (they have to stop and wait for kids a lot) and that they run on regular unleaded gasoline. Determine how many gallons of gasoline you will need for the next 12 weeks and the price that you think you will have to pay for that gasoline. Create a budget based upon your estimations and justify or explain how you determined the mileage and the gasoline price(s). This should be included in your report.

Part IV. Write a report containing three sections.

- The first section should address the questions and issues in Parts 1 and 2. Use these questions as a guide; do not simply answer the questions and decide you are finished! This section should contain appropriate graphs and tables.

• The second section should address the questions in Part 3 and should contain your bid for the school bus service.

• The third section should contain a log of your work as a group. This should include all meeting times, locations and how long you met; a list of who did what part of the report and how much time they spent; and anything else you want to record about your process during this project.

Average Price of Gasoline

Year 2007		**Year 2008**	
Jan	$2.274	Jan	$3.047
Feb	$2.285	Feb	$3.033
Mar	$2.592	Mar	$3.258
Apr	$2.860	Apr	$3.441
May	$3.130	May	$3.764
Jun	$3.052	Jun	$4.065
Jul	$2.961	Jul	$4.090
Aug	$2.782	Aug	$3.786
Sep	$2.789	Sep	$3.698
Oct	$2.793	Oct	$3.155
Nov	$3.069	Nov	$2.151
Dec	$3.020	Dec	$1.669

[4] Query

Laying out a patio on a Habitat for Humanity house led to the following situation. As the patio was to extend 8 feet from the back wall of the house, the question was: How to determine a point whose perpendicular distance from a straight wall is 8 feet? Someone suggested laying out a 3-4-5 right-triangle to get a perpendicular line and then measuring eight feet along that line. Someone else suggested it would be simpler to just double each of the lengths to obtain a 6-8-10 triangle. Letting the six foot length be measured along the back wall, the desired point would be where the eight and ten foot sides meet. However a question arose: Is this 6-8-10 triangle also a right triangle? Would tripling the lengths of the sides still give a right-triangle? More generally, would multiplying the lengths of a 3-4-5 triangle by any positive number result in a right-triangle? Explain. (Would it matter if the positive multiplier was a fraction?)

[5] Notices

1. The sixth edition of *Contemporary College Algebra: Data, Functions, Modeling* by Don Small is now available. Contact Kathy Kilburg (563-584-6322, Kathyj_Kilburg@mcgraw-hill.com) for an examination copy.

2. http://usmasvdzdeanext/departments/math/HBCU/ is a resource website for the seventeen HBCUs in the U.S. Military Academy's program to assist HBCUs in refocusing their college algebra courses, as well as for anyone else interested in refocusing college algebra.

3. MAA PREP Workshop: REFOCUSING AND REMODELING COLLEGE ALGEBRA, will be held June 1-5, 2009 at the University of Wisconsin-River Falls. Facilitators are: Don Small, Erick Hofacker, Kathy Ernie. To register or learn more, visit www.maa.org/PREP.

4. Past issues of the *Vision - Potential* Newsletter are available on our website: www//ContemporaryCollegeAlgebra.org.

5. Deadline for contributions to the September Newsletter is September 1, 2009. Opinion articles, suggestions for writing assignments, small group in-class activities, small group out-of-class projects, Queries, announcements, etc. are welcomed.

6. To subscribe to this Newsletter, contact Don Small via e-mail at donsmall@usma.edu.