

Lining Up Data

Mathematics

Secondary Grades 9–12

Purpose

In this activity, students:

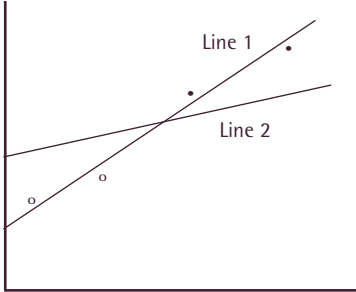
- ▶ Examine the concept of functions (including graphs, domain, and range of interest) using real-world data
- ▶ Make models of data and predictions based on that data
- ▶ Discuss and defend their conclusions with other students
- ▶ Use a variety of resources to gather information
- ▶ Show that math can be used to synthesize data

Description

Students make predictions based on such real-world data as phone bills, postage rates, and airline schedules. Students use graphing calculators to plot data and draw lines that fit the data they have graphed. They then use these lines to make predictions that extrapolate or interpolate the data. Students conduct research to find other appropriate data sets, develop questions, and answer questions developed by other students.

Activities

	MATH STANDARDS	NETS PERFORMANCE INDICATORS GRADES 9–12
1 Find appropriate introductory linear data sets and ask students to interpret (e.g., a long distance phone bill with several calls to the same number—record the length of the calls in minutes and the charge for each call). See the Web sites listed in Tools and Resources for possible data sets as well as local examples that students will find relevant.	MATH 5	
2 Use the selected data set to demonstrate how data and graphing are connected. Students plot data on graphing calculators and choose appropriate “window ranges” to display the data. (In the example, the length of the call is plotted along the x-axis and the cost along the y-axis.)	MATH 10	5, 8
3 With the students, develop a mathematical model to fit the data, writing it in functional form. (Graphically, the data looks like a straight line, with every minute “costing” a certain amount of money. The connection between the algebraic and graphical representation of straight lines may be elicited here.)	MATH 2, 6	9
4 Students calculate the parameters of the model using the data, and display the model graphically along with the data. (Students will derive ideas such as “Since 5 minutes costs \$2, each minute costs \$0.40.” Students learn to identify the meaning of their parameters, as in “slope is the cost/minute,” or “the y-intercept is the connect charge.”) TI-GraphLink can be used to copy the graphs from the calculator screen to a computer or printer.	MATH 1	5, 9

	MATH STANDARDS	NETS PERFORMANCE INDICATORS GRADES 9–12
<p>5 Students judge the model's "line of best fit" and adjust the model as necessary. By looking at their graphs, students can see how closely their model line comes to the data points. In addition, during the adjustments of their costs per minute and connection charges, students can come to understand the different effect of each parameter on the graph. (An extension of this discussion uses The Geometer's Sketchpad or Capri Geometry to show graphically the meaning of "least squares error.")</p> <p>6 Students compare their fit with the fits of other students, discuss and defend their models and parameters, and develop a measure for the "goodness of fit." (Students will compare graphs and generally work toward deciding which graph is a better model of the data.)</p> <p>For example, in the graph below, Line 1 is considered to be a better model of the data than Line 2.</p> 	<p>MATH 6</p> <p>MATH 8</p>	<p>8</p> <p>8, 10</p>
<p>7 Group students for an independent project that focuses on data sets and lines of best fit. Have students find other data sets from other sources such as the library, CD-ROMs, and the Internet. Using the data sets, follow the same procedure as in the previous activities. Have students develop questions based on these data sets, and then exchange both data sets and questions with other students. (Roughly linear data sets can be found in almost every newspaper; see Tools and Resources.)</p>	MATH 5, 9, 10	7, 10

Tools and Resources

SOFTWARE:

- ▶ TI-GraphLink (freeware available from www.ti.com/calc/; cable must be purchased separately), The Geometer's Sketchpad (Key Curriculum Press) or Capri Geometry (Texas Instruments)

HARDWARE:

- ▶ Graphing calculators

WEB SITES:

- ▶ Sites offered through the Texas Instruments Web site:
 A Paraphrase of the Airline Schedules Investigation:
www.ti.com/calc/docs/act/murdock04.htm
 Let Technology Help You "Experience Math"—Data Collection:
www.ti.com/calc/docs/act/stan3.htm
 Bring Mathematics to Life—Pass the Book:
www.ti.com/calc/docs/act/panke1.htm
 Bring Mathematics to Life—Spring Lab:
www.ti.com/calc/docs/act/panke2.htm

BOOK:

- ▶ Murdock, J., Kamischke, E., & Kamischke, E. (1997). *Advanced algebra through data exploration*. Emeryville, CA: Key Curriculum Press.

OTHER:

- ▶ Other good (and roughly linear) data sets are house prices per square foot (taken from local real estate ads); minutes played versus goals scored (for hockey players); postage rates versus weight (taken from the USPS or shipping companies); height versus shoe size (this has a lot of scatter if you use adolescents); years of math education and average salary (fortunately, the slope is positive!); and flight time versus mileage data for airlines.

Assessment

At a minimum, evaluate students on their ability to:

- ▶ Plot data correctly
- ▶ Calculate lines of fit and to explain the significance of the parameters in their equation
- ▶ Explain and defend their choice of fit to other students

Develop a rubric with students for scoring the independent projects that aligns with the learning activity objectives. Students should be aware of and understand the scoring rubric at the beginning of the project. As the project progresses, students can help refine the various levels of the rubric.

Credits

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Comments

Barney Ricca has used this activity with eighth and ninth graders who are just beginning algebra or physical science. A first data set that works well is a phone bill from a calling card (e.g., someone calling home from a conference). Having an entry for a single minute is helpful, because some students think that whatever the charge is for the first minute is the charge for every minute, and good discussion can ensue from that idea. Generally, this activity is used without ever mentioning "slope" or "intercept." Wait until students are proficient at their calculations and interpretations before introducing the vocabulary.

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