

Least squares fit line

Objectives

Students will:

- Estimate the least squares fit line for a set of data.
- Understand error involved in least squares fit lines.
- Solve application problems using least squares fit lines.

Prerequisite Knowledge

Students are able to:

- Find equations of lines.
- Solve equations for a given variable.

Resources

- This lesson assumes that your classroom has enough computers for all your students, either working individually or in small groups. If your classroom has only one computer, from which you can lecture, see the [lecture version](#) of this lesson.
- Rulers, pencil, and paper
- Access to <http://www.explorelearning.com/>
- Copies of the [worksheet](#) for each student (optional)

Lesson Preparation

Before conducting this lesson, be sure to read through it thoroughly, and familiarize yourself with the [Least squares fit line](#) activity at [ExploreLearning.com](#). You may want to bookmark the activity page for your students. If you like, make copies of the [worksheet](#) for each student.

Lesson

Motivation:

Before the lesson, print copies of the [Mona Lisa](#) for each student. Students are to measure the length and width of the triangle on the portrait. The students should then divide the length of the rectangle by the width of the rectangle. Answers should be close to **1.618**.... Explain to students that this ratio is called the

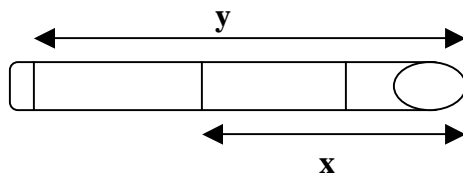
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“Golden Ratio.” The Golden Ratio occurs in a variety of places including plants, animals, architecture, and music. The Greeks believed that “Golden Rectangles” were the most pleasing to the eye. (You may want to use the Internet to obtain examples of the Golden Ratio.)

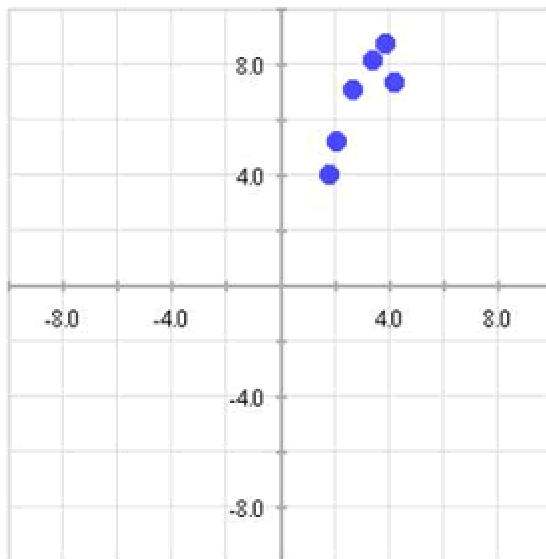
Let’s explore the relationship between the Golden Ratio and the index finger. Have each student measure:

1. The distance from the tip of their index finger to the base of the finger (y).
2. The distance from the tip of their index finger to the middle of the second knuckle (x).

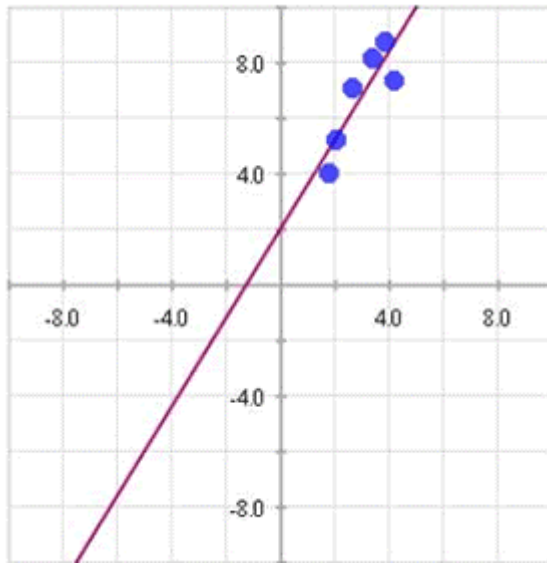
Use the wrinkle marks on the palm side of the hand as endpoints.



Students should then display everyone’s data on their own scatter diagram.



Have students make observations of the scatter diagram. Students should observe that generally when x increases, y increases. Ask students to plot a line that gets as close as possible to as many data points as possible.



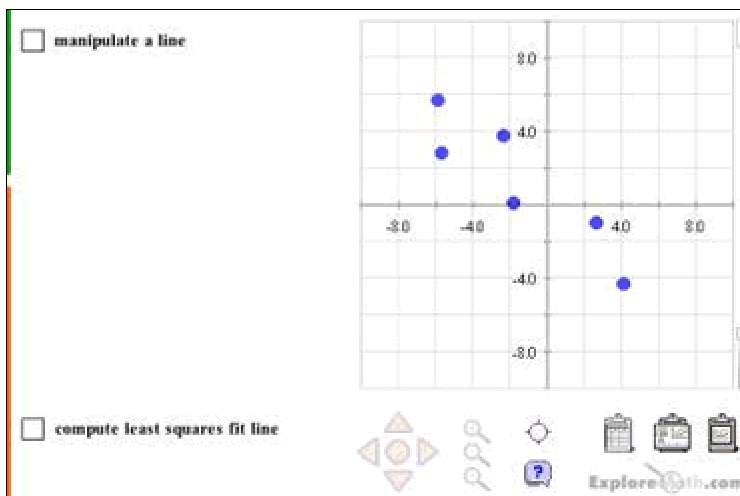
Explain to students that this line approximates the line of best fit.

Tell students they are now going to explore lines of best fit. They will also come up with the equation of the least squares fit line for their data. Finally they will see the relationship between the Golden Ratio and index fingers.

Line of best fit

Students should go to the [“Least squares fit line”](https://www.explorelearning.com) activity at [ExploreLearning.com](https://www.explorelearning.com).

Have students drag the point onto the plane similar to the graph below.

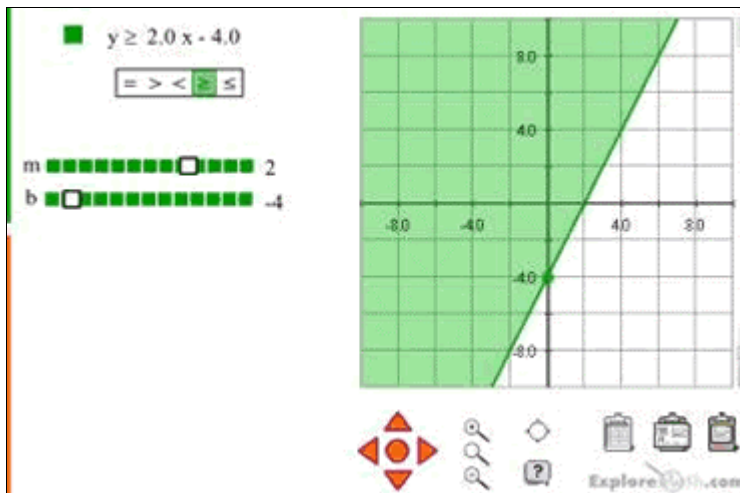


Ask students the sign of the slope of the line of best fit for this set of data. Have students select the “manipulate a line” box. Students can drag and rotate the green line. Have students position the green line so it approximates the line of best fit.

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Students should now select the “show error squares” box. Ask students to make conjectures about how the total error is calculated. Students should see from the graph that the vertical distance from the line to the data point is squared. The sum of these squares is the total error.

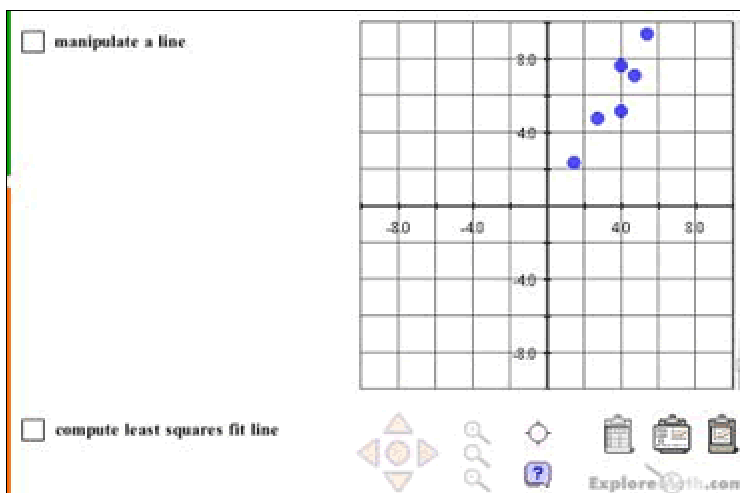
Now have students select the least squares fit line. The least squares fit line appears on the graph.



Have students compare the red and green lines. Students should then click the “green to red” box to show the total error for the red line. Have students compare the total error of their original green line to the total error of the red line. Ask students why the line of best fit is sometimes called the least squares fit line. Have students make conjectures about the least squares fit line for a set of data points.

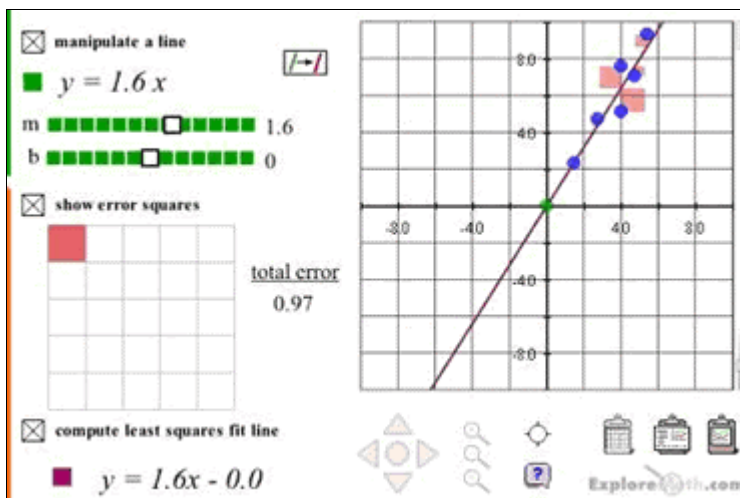
Finger data analysis

Randomly pick six students. Plot their data on the computer by dragging the blue points to the proper coordinates. The data may look like the graph below.



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Now have students manipulate the green line to fit the data and select the “show error squares” box as well as the “compute least squares fit line” box.



Students can now select the green to red box to see the total error of the least squares fit line.

Have students take note of the slope of the red line. This slope should be close to the Golden Ratio. As Leonardo da Vinci observed, the human body is basically proportional, and a good many of the proportions involve the Golden Ratio.

Have students estimate the length of someone’s index finger if the length to their second knuckle is 7cm.

Conclusion

The least squares fit line models the data that is basically linear in nature. The total error of squares is calculated by summing up the square of the vertical distances from each data point to the least squares fit line.