

Shortest Distance Activity

In this activity, you will discover, through exploration that the shortest distance from a point on a line to the origin is a measure of a perpendicular line segment. You will investigate this minimization problem and support the analytical explanations with interactive explorations.

Shortest Distance Between a Line and the Origin

Part I Construction

1. Create a new Document and Insert a Graphs page. Press Ctrl G to hide the function entry line.

2. Construct a non-horizontal line. See Figure 1.

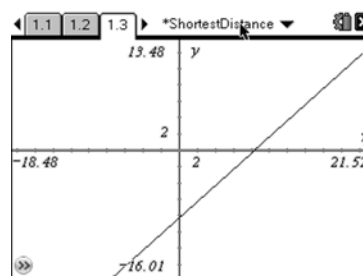


Figure 1

3. Place a point, A, on the line and a point, O, on the origin.

4. Construct the line segment \overline{AO} . See Figure 2.

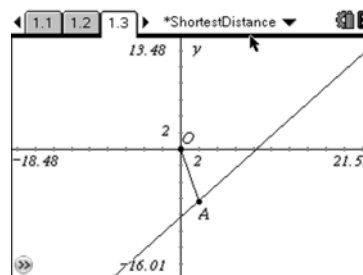


Figure 2

5. Use the Measurement tools to measure the angle between the line and the segment \overline{AO} . Next, measure the length of segment \overline{AO} . Label the measurements as in Figure 3. The point used to measure the angle on the line can be hidden.

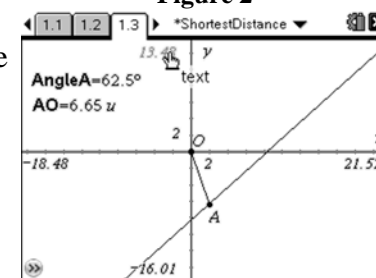


Figure 3

6. Grab Point A and move the point along the line. Notice how the angle measurement and the length of the segment change as the location of Point A moves along the line.

Part II Measuring Distances to the Origin from the Line

1. Insert a Lists & Spreadsheet page. Label the first column **ang** to represent the measurement of the angle. Click on the equation entry cell for column A and select Data/ Manual Data Capture. From the VAR list link the data capture to the measurement of Angle A.

Label the second column **mea** to represent the measurement of the segment. Click on the equation entry cell for column B and insert the Manual Data Capture command. From the VAR list link the data capture to the measurement of segment AO. See Figure 4.



Figure 4

2. Return to the Graphs page. Grab and move Point A to collect data into the spreadsheet. Pressing **Ctrl .** will transfer the data to the spreadsheet. Capture a number of data by moving point A along the line and pressing **Ctrl .** for each new location. See Figure 5.

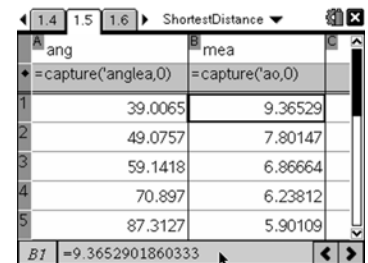


Figure 5

3. Insert a Graphs Page. Select Scatter Plot for the graph type. To define the data used for the scatterplot, choose **ang** for the x data, and choose **mea** for the y data. Select Zoom Data to plot the points in the window.

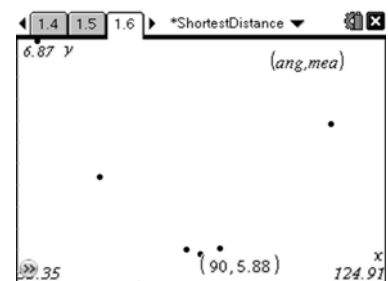


Figure 6

4. Insert a Calculator page and run a Quadratic regression.

5. Return to the Graph page. To graph the regression equation, select function for the type of graph, click in the entry line and select F1, then press enter. See Figure 7.

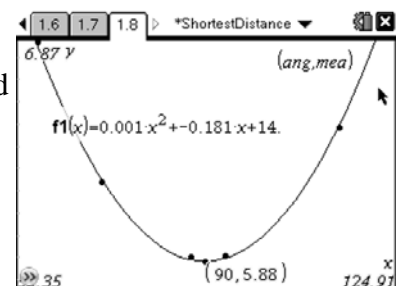


Figure 7

Part III Analyzing the Data to Determine the Shortest Distances to the Origin from the Line

1. Use the graph trace feature to locate the minimum value of the regression. This minimum value represents the shortest distance from the line to the origin.
2. Notice that when the shortest distance is measured, the angle between the line and the segment is 90 degrees, therefore, they are perpendicular.