How much rain? Linear equations

from the Esri GeoInquiries™ collection for Mathematics

MATH

Target audience – Algebra 1 learners **Time required – 15 minutes**

Activity	Measure the distance between two rain gauges to estimate how much precipitation an intervening town receives by deriving a linear function.
Math Standards	**CCSS: Math.Content.8.EE.B.6**. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*. **CCSS: Math.Content.8.EE.C.7**. Solve linear equations in one variable.
Learning Outcome	• Students will use a linear model to interpolate an intermediate value in a real-world situation.

Map URL: http://esriurl.com/MathGeoInquiry4

Engage

How much rain has fallen so far in 2017?

- ➔ Click the URL above to launch the map.
- ➔ Read aloud: "In early 2017, the amount of rainfall was recorded at different gauges along Sleeping Bear Creek. Notice two rain gauges labeled South and Cimarron River."
- ➔ Click each marker to find the total rainfall in inches that each gauge received in early 2017. *[20.77 and 32.84]*
- – You will notice a gauge labeled E 210 Rd between the other two rain gauges.
- ➔ Make a guess as to the amount of rain the E 210 Rd gauge received. *[Note the responses on the board or in individual student notes.]*
- **?** How might you use the rainfall from the two known gauges to calculate a better estimate of the unknown rainfall at E 210 Rd? *[Create a model.]*

Explore

What is the equation of the line?

- ➔ Read aloud: "We will use a linear relationship as a model for estimating the rainfall at E 210 Rd and then compare that estimate to the actual rainfall."
- ➔ From the Measure tool, select Measure and choose Kilometers.
- ➔ Measure the distance between the South gauge and the Cimarron gauge. What is the distance? *[~24.6 km]*
- ➔ Measure the distance from the South gauge to the gauge near E 210 Rd. What is the distance? *[~8.2 km]*
- ➔ Using distance as the independent variable and rainfall as the dependent variable, calculate the slope between South and Cimarron River. $\left[\frac{32.84-20.77}{24.6-0}\right] = .49065$
- ➔ Use this slope to derive the equation of the line. $\left[\begin{array}{c} y = .49065x + 20.77 \\ rainfall = .49065\ distance + 20.77 \end{array}\right]$
- ➔ Use the distance from the South gauge to Cimarron River to estimate the rainfall at E 210 Rd, rounding to the nearest tenth. *[y = .49065 (8.2) + 20.77 = 24.8 in.]*

more ▶

Explain

How does the model compare with reality?

? How does the estimate using the linear model compare to your original guess at E 210 Rd; which do you think is more accurate (closest to the actual rainfall) and why? *[The model should be more accurate, generally. However, some students may make a more accurate guess.]*

→ Click Details and then the Show Contents of Map button.

→ Check the Actual Rainfall layer check box to turn on the layer.

? How did the estimate using the linear model compare to the actual rainfall? *[It should have been very close.]*

Elaborate

Can a line be used to estimate rainfall beyond the data?

→ Using the actual rainfall amounts for both the South and E 210 Rd gauges and using the distance between them, find the equation of the line that models rainfall between the two gauges.

→ Use that equation to estimate the rainfall at the Cimarron River gauge.

? How well does the linear model predict rainfall, not between, but beyond the gauges? *[It becomes less accurate beyond the gauges.]*

Evaluate

Does the linear model work for all gauges?

→ Turn on the Six Gauges layer, and note rainfall amounts at other gauges.

→ Pick one other gauge and use the model that you previously derived to predict the rainfall at the gauge that you just picked.

? Does your model adequately predict the rainfall at that gauge? *[Answers will depend on the chosen gauge and student accuracy.]*

TURN A MAP LAYER ON AND OFF

- Make sure that the Details pane is selected, and click Show Map Contents.
- To show individual map layers, select the check boxes next to the layer names.
- Hint: If a map layer name is light gray, zoom in or out on the map until the layer name is black. The layer can now be turned on.

USE THE MEASURE TOOL

- Click Measure, select the Distance button, and from the drop-down list, choose a unit of measurement.
- On the map, click once to start the measurement, click again to change direction, and double-click to stop measuring.
- Hint: Position the area of interest on the map so that it is not obscured by the Measure window.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at http://www.esri.com/schools.

THEN TRY THIS...

• Load a layer of rain gauges for an area.

• Using an ArcGIS Online organizational account's Analysis tools, select Analyze Patterns and then Interpolate Points.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these high school texts.

- *Geometry by Holt, Rinehart & Winston — Chapter 3*
- *Geometry by Moise & Downs — Chapter 13*
- *Geometry by Houghton Mifflin — Chapter 13*

Version Q1 2018. Send feedback: http://esriurl.com/GeoInquiryFeedback