Lesson 6

Using and Interpreting a Mathematical Model

Goals

- Interpret a scatter plot and line of fit that model temperature and latitude, and explain (orally) limitations of the model.
- Use a mathematical model of bivariate data to make predictions (in writing).

Learning Target

I can make predictions based on a model.

Lesson Narrative

To complete this section, in this optional lesson students analyze their model and use it to make predictions and draw conclusions. Students validate their model by seeing how well it predicts the actual temperature for locations that were not included in the original data. They also look for and investigate outliers in the data. Finally, students interpret mathematical features of their model (slope and intercepts of the line) and discuss limitations of the model.

Student Learning Goal

Let's use a model to make some predictions.

Access for Students with Diverse Abilities

- Action and Expression (Activity 1)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 1)

Instructional Routines

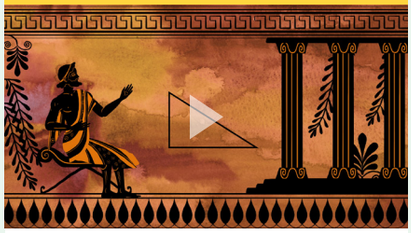
- MLR2: Collect and Display

Lesson Timeline

25 min	15 min
Activity 1	Activity 2

Inspire Math

Pythagoras video



Go Online
Before the lesson, show this video to **reinforce** the real-world connection.

ilclass.com/r/614226

Please log in to the site before using the QR code or URL.

Instructional Routines

MLR2: Collect and Display

ilclass.com/r/10690754
Please log in to the site before using the QR code or URL.

Access for Multilingual Learners (Activity 1, Launch)

MLR2: Collect and Display
This activity uses the *Collect and Display* math language routine to advance conversing and reading as students clarify, build on, or make connections to mathematical language.

Access for Students with Diverse Abilities (Activity 1, Student Task)

Action and Expression: Internalize Executive Functions.
To support development of organizational skills in problem-solving, chunk this task into more manageable parts. For example, present one question at a time and monitor students to ensure they are making progress throughout the activity.
Supports accessibility for: Organization, Attention

Activity 1
Using a Mathematical Model

25 min

Activity Narrative

In an earlier activity, students drew a line that best fit the latitude-temperature data and found the equation of this line. The line is a mathematical model of the situation. In this lesson, they use their model to make predictions about temperatures in cities that were not included in the original data set. If the class used their own data, adjust the information in this activity as needed. In the next activity, they also interpret the slope of the line and the intercepts in the context of this situation. This leads to a discussion of the limitations of the mathematical model they developed.

Launch

Keep students in the same groups of 3–4. If available, tell the students the latitude and average high temperature in September in their city.

Use *Collect and Display* to create a shared reference that captures students' developing mathematical language. Collect the language students use to determine if the new data fits the model. Display words and phrases such as "close to the line," "outlier," "above the line," and "lower than expected."

Student Task Statement

In an earlier activity, you found the equation of a line to represent the association between latitude and temperature. This is a *mathematical model*.

1. Use your model to predict the average high temperature in September for the following cities that were not included in the original data set:

   Answers may vary slightly depending on the equation of the line determined by eye.

   a. Detroit (Lat: 42.33 degrees north)

   −0.8742.33 + 111, or 74.2 degrees Fahrenheit

   b. Albuquerque (Lat: 35.09 degrees north)

   −0.8735.09 + 111, or 80.5 degrees Fahrenheit

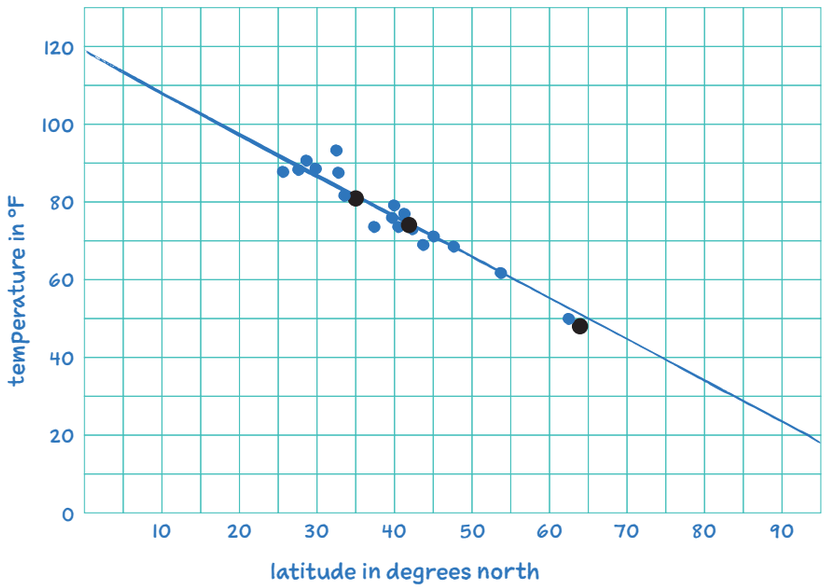
   c. Nome (Lat: 64.50 degrees north)

   −0.8764.50 + 111, or 54.9 degrees Fahrenheit

   d. Your own location (if available)

   Answers vary.

2. Draw points that represent the predicted temperatures for each city on the scatter plot.



3. The actual average high temperature in September in these cities were:

- Detroit: 74 degrees Fahrenheit
- Albuquerque: 82 degrees Fahrenheit
- Nome: 49 degrees Fahrenheit
- Your own location (if available):

How well does your model predict the temperature? Compare the predicted and actual temperatures.

Two of the predictions are very close to the actual data. The actual temperature for the third city, Nome, is farther from the prediction.

4. If you added the actual temperatures for these 4 cities to the scatter plot, would you move your line?

They would not cause a noticeable change to the line.

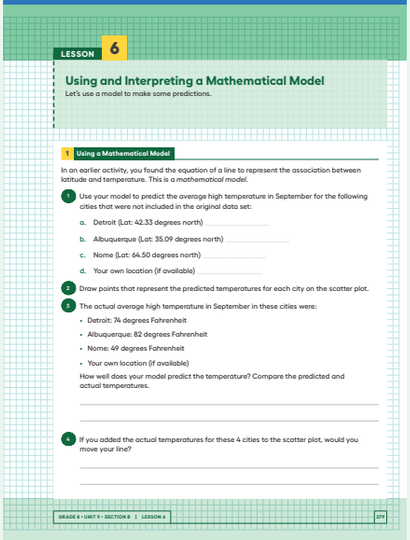
5. Are there any outliers in the data? What might be the explanation?

There are a few points that could be considered outliers in the data. They tend to happen on the higher and lower latitudes. This could mean that the model is less reliable for extreme latitudes. The point that could be an outlier in the middle of the data represents San Francisco. This might be because of the geography in the area.

Activity Synthesis

Direct students' attention to the reference created using *Collect and Display*. Ask students to share how well their model predicted the temperature for the cities and why their predictions were accurate (or not). In particular, invite students to comment on any outliers in their data and what might be causing them. Invite students to borrow language from the display as needed and update the reference to include additional phrases as they respond.

Student Workbook


LESSON 6

Using and Interpreting a Mathematical Model

Let's use a model to make some predictions.

1 Using a Mathematical Model

In an earlier activity, you found the equation of a line to represent the association between latitude and temperature. This is a *mathematical model*.

1. Use your model to predict the average high temperature in September for the following cities that were not included in the original data set:
   a. Detroit (Lat: 42.33 degrees north) _____
   b. Albuquerque (Lat: 35.09 degrees north) _____
   c. Nome (Lat: 64.50 degrees north) _____
   d. Your own location (if available) _____
2. Draw points that represent the predicted temperatures for each city on the scatter plot.
3. The actual average high temperature in September in these cities were:
   - Detroit: 74 degrees Fahrenheit
   - Albuquerque: 82 degrees Fahrenheit
   - Nome: 49 degrees Fahrenheit
   - Your own location (if available)

   How well does your model predict the temperature? Compare the predicted and actual temperatures.

4. If you added the actual temperatures for these 4 cities to the scatter plot, would you move your line?

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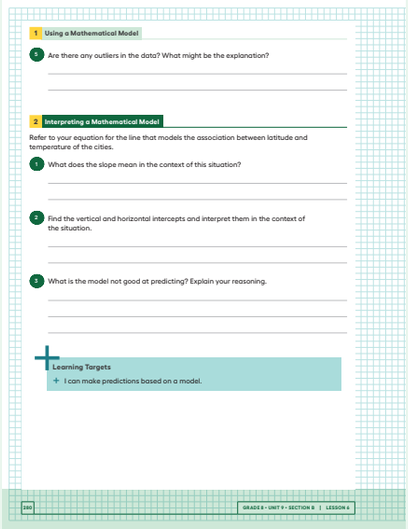
Student Workbook


1 Using a Mathematical Model

5. Are there any outliers in the data? What might be the explanation?

2 Interpreting a Mathematical Model

Refer to your equation for the line that models the association between latitude and temperature of the cities.

1. What does the slope mean in the context of this situation?
2. Find the vertical and horizontal intercepts and interpret them in the context of the situation.
3. What is the model not good at predicting? Explain your reasoning.

Learning Targets

+ I can make predictions based on a model.

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Building on Student Thinking

If students are using "units" to describe their slope, consider asking:

"Tell me more about what the slope means for your model."
"How could you use specific units to help you make the meaning more clear?"

Activity 2
Interpreting a Mathematical Model

15 min

Activity Narrative

In this activity, students interpret the slope and intercepts of the line they drew to fit the data in the context of the situation and discuss the limitations of the mathematical model.

This activity can be extended by having students investigate if temperature on other continents or across continents fits the same pattern that was found for North America.

Launch

Keep students in the same groups of 3–4.

Student Task Statement

Refer to your equation for the line that models the association between latitude and temperature of the cities.

1. What does the slope mean in the context of this situation?

   For every degree latitude moving north, the temperature decreases by 0.87 degrees Fahrenheit.

2. Find the vertical and horizontal intercepts and interpret them in the context of the situation.

   Vertical: The temperature at 0 degrees north (that is, on the equator) is 111 degrees Fahrenheit. Horizontal: A latitude where high temperature is 0 degrees Fahrenheit would have to be over 100 degrees north, which doesn't exist.

3. What is the model not good at predicting? Explain your reasoning.

   This model is not good at predicting temperatures for locations outside of North America because it is built from that limited data set. It is also not good at predicting temperatures for locations that are very close to or very far from the equator because we can see the data is not as close to the model at those extremes.

Activity Synthesis

Invite students to share their responses. Discuss the limitations and uses of the model. Consider asking the following questions:

- *"What are some limitations of the model?"*

  The data the model is made from are only from North America, so may not be good at predicting cities on other continents.

- *"Do limitations mean that the model is not good?"*

  No, it just means that we have to be aware of when we can use it and when we can't use it. Our model is pretty good for latitudes between 20 and 65 degrees north and for locations in North America.

- *"What questions do you have about predicting temperature?"*

  "How could you extend your investigation of predicting temperature?"