Lesson 5: Plotting the Weather

Goals

- Create a mathematical model of bivariate data using a scatter plot.
- Describe (in writing) associations in bivariate data shown in a table or scatter plot.

Lesson Narrative

In this second in a sequence of three lessons, students construct a mathematical model to investigate if there is an association between latitude and temperature.

- They make a scatter plot of latitude and average high temperature in September for cities across North America.
- They then use dried linguine pasta to find (that is, eyeball) a line that best approximates the data.
- They find an equation of the line. The data is given as part of the activities in the lesson plan. If appropriate, students could also collect their own data and use a different measure for temperature (for example, average yearly temperature, average September temperature, etc.).

Alignments

Addressing

- 8.SP.A: Investigate patterns of association in bivariate data.

Instructional Routines

- MLR8: Discussion Supports
- Notice and Wonder

Required Materials

Dried linguine pasta
We specified linguine since it is flatter and less likely to roll around than spaghetti.

> **Student Learning Goals**
>
> Let's construct a model.

5.1 California Rain

Optional: 5 minutes
This activity is a review of scatter plots and how to interpret information from a scatter plot.

Addressing

- 8.SP.A

Instructional Routines

- Notice and Wonder

Launch

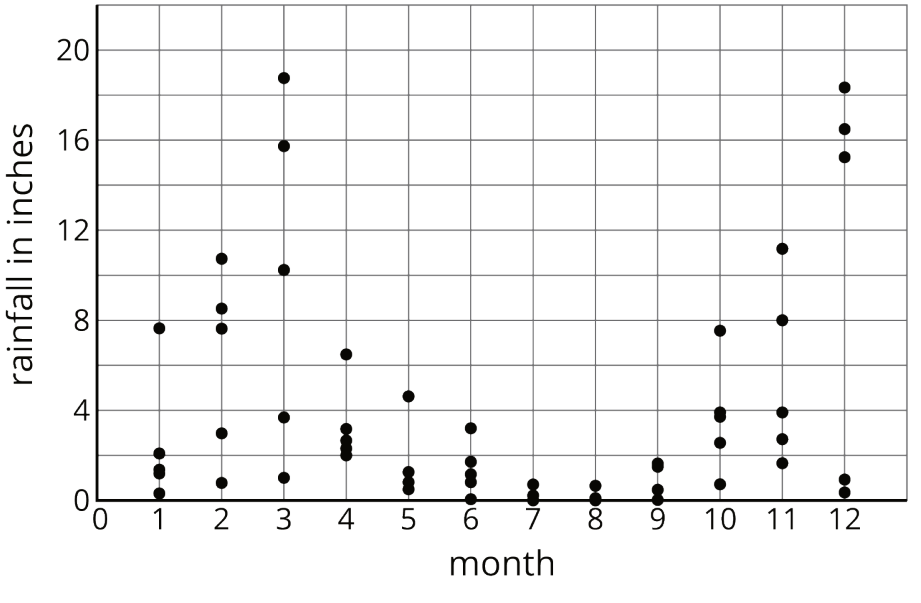
Keep students in same groups. Tell students that they will look at an image, and their job is to think of at least one thing they notice and at least one thing they wonder. Display the image for all to see. Ask students to give a signal when they have noticed or wondered about something. Give students 1 minute of quiet think time, and then 1 minute to discuss the things they notice with their group, followed by a whole-class discussion.

Access for Students with Disabilities

Action and Expression: Internalize Executive Functions. Provide students with a graphic organizer, such as a two-column table, to record what they notice and wonder prior to being expected to share these ideas with others.
Supports accessibility for: Language; Organization

Student Task Statement

What do you notice? What do you wonder?



Student Response

Things students may notice:

- There is hardly any rainfall in the summer.
- Most of the rainfall happens in December through March.
- The high rainfall totals happen in December and March, and they are about 19 inches for each month.
- In some months (for example, March) and in some years, it rains a lot, and in other years, it doesn't rain.

Things students may wonder:

- Why does it rain less in the summer than in the winter?
- Why are the dots so spread out in the colder months?

Activity Synthesis

Invite students to share the things they noticed and wondered. Record and display their responses for all to see. If possible, record the relevant reasoning on or near the image. After each response, ask the class if they agree or disagree and to explain alternative ways of thinking, referring back to the images each time.

Discuss what each point in the scatter plot represents. Ask students to describe general patterns visible in the plot. Ask, "Is there a pattern of association?" (Yes, it is not linear, but it is possible to say that there is more rain in the winter and less rain in the summer.)

5.2 Data Snooping

Optional: 10 minutes
The task statement provides data students can analyze for the remainder of this lesson. It gives the average high temperature in September at different cities across North America. This is only one possible choice for data to analyze. If appropriate, students can instead collect their own data and then continue using it. If so, then the instructions are the same just with the students' data.

Addressing

- 8.SP.A

Launch

Students in same groups of 3–4.

Access for Students with Disabilities

Engagement: Develop Effort and Persistence. Encourage and support opportunities for peer interactions. Prior to the whole-class discussion, invite students to share their work with a partner. Display sentence frames to support student conversation such as: "First, I _____ because . . .", "I noticed _____ so I . . .", "There is/is not an association because . . .", or "I agree/disagree because . . ."
Supports accessibility for: Language; Social-emotional skills

Student Task Statement

The table shows the average high temperature in September for cities with different latitudes. Examine the data in the table.

city	latitude (degrees North)	temperature (degrees Fahrenheit)
Atlanta, GA	33.38	82
Portland, ME	43.38	69
Boston, MA	42.22	73
Dallas, TX	32.51	88
Denver, CO	39.46	77
Edmonton, AB	53.34	62
Fairbanks, AK	64.48	55
Juneau, AK	58.22	56
Kansas City, MO	39.16	78
Lincoln, NE	40.51	77
Miami, FL	25.45	88
Minneapolis, MN	44.53	71
New York City, NY	40.38	75
Orlando, FL	28.26	90
Philadelphia, PA	39.53	78
San Antonio, TX	29.32	89
San Francisco, CA	37.37	74
Seattle, WA	47.36	69
Tampa, FL	27.57	89
Tucson, AZ	32.13	93
Yellowknife, NT	62.27	50

1. What information does each row contain?

2. What is the range for each variable?

3. Do you see an association between the two variables? If so, describe the association.

Student Response

1. Each row lists a city, its latitude, and its average high temperature in September.
2. For latitude, the minimum value is 25.45 degrees north in Miami, FL, and the maximum is 64.48 degrees north in Fairbanks, AK. For temperature, the low is 50 degrees Fahrenheit for Yellowknife, NT, in Canada, and the maximum is 93 degrees Fahrenheit for Tucson, AZ.
3. It looks like locations with smaller latitudes have higher temperatures, and locations with higher latitudes have lower temperatures.

Activity Synthesis

Make sure students understand the information listed in the table. Invite students to share their responses to the last question, then move on to the next activity.

5.3 Temperature vs. Latitude

Optional: 15 minutes
In this activity, students use the data from the previous activity and draw a scatter plot and a line that fits the data. The given data show a clear linear association, so it is appropriate to model the data with a line. Students can use a piece of dried linguine pasta or some other rigid, slim, long object (for example, wooden skewer) to eyeball the line that best fits the data. (The line of best fit has a variance of $R^2 = 0.94$.) Even though different answers will have slightly different slopes and intercepts, they will be close to each other.

Addressing

- 8.SP.A

Instructional Routines

- MLR8: Discussion Supports

Launch

Students in same groups of 3–4. Provide access to pieces of dried linguine pasta.

Access for Students with Disabilities

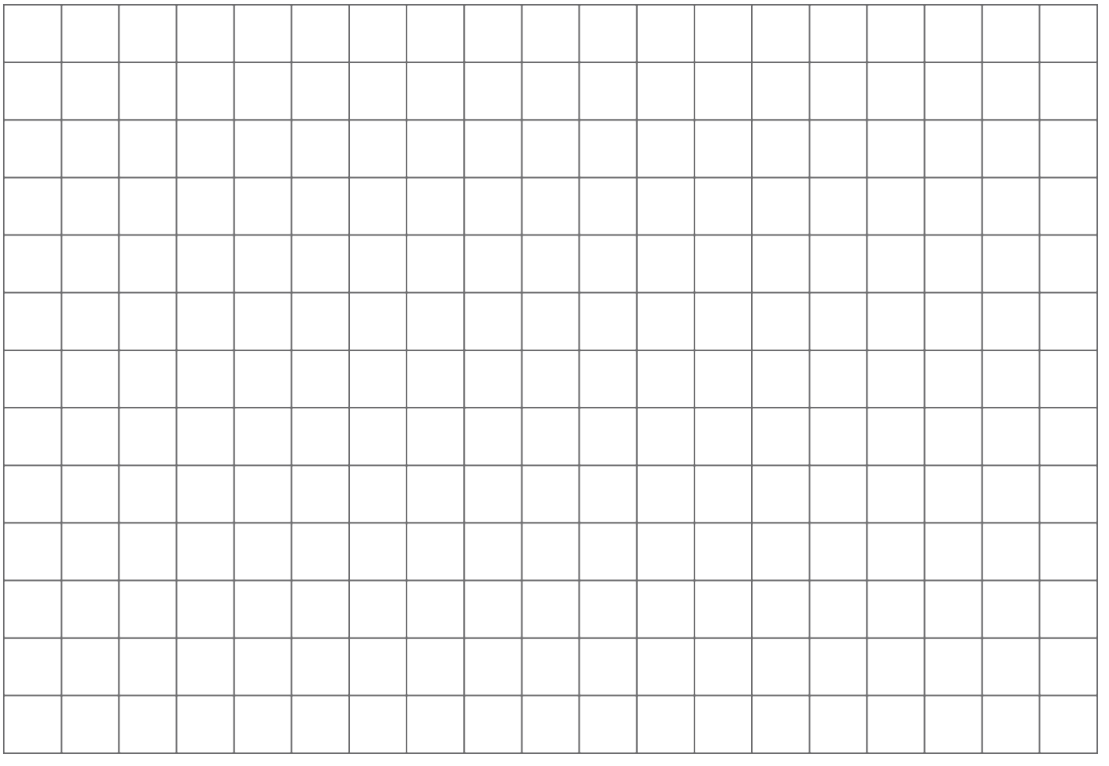
Representation: Internalize Comprehension. Provide a range of examples and counterexamples for a best fit line. Consider displaying charts and examples from previous lessons to aide in memory recall.
Supports accessibility for: Conceptual processing

Anticipated Misconceptions

If a student is stuck on making the scale on the graph, remind them to look at the range from the previous problem.

Student Task Statement

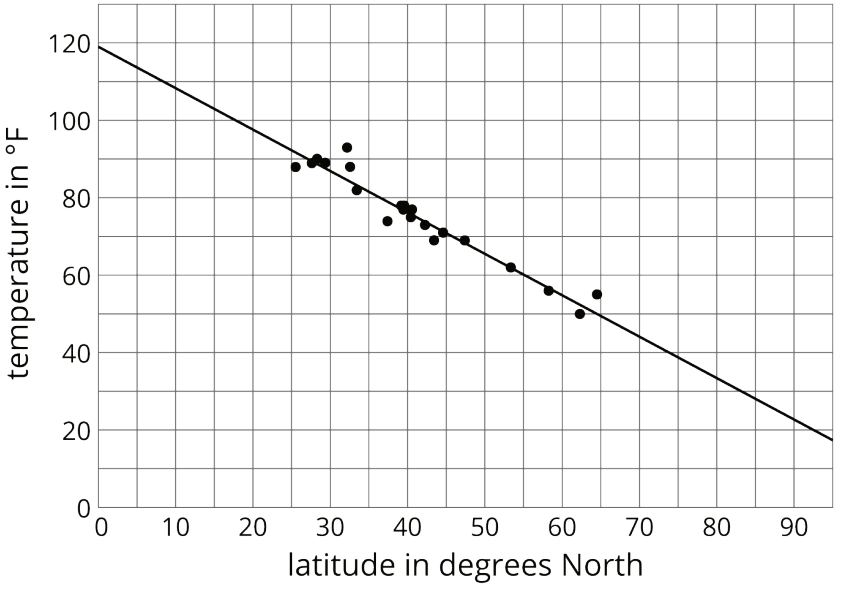
1. Make a scatter plot of the data.



2. Describe any patterns of association that you notice.

3. Draw a line that fits the data. Write an equation for this line.

Student Response

1. 

2. There seems to be a negative association. A line fits the data quite well.

3. The line is shown above. The line's equation is $y = -1.07x + 119$, where x is latitude and y is temperature. This equation was computed with software. A line obtained by eye should have a slope of approximately -1, and a y-intercept of approximately 120 degrees F.

Activity Synthesis

At the start of the discussion, make sure students agree that there seems to be a negative association that looks like a line would fit the data nicely before moving on.

Invite several groups to share the equations they came up with and how they found them. They will likely have slightly different slopes and intercepts. Ask students to explain where those differences come from. (Not everyone chose the same points to guide the trendline they drew for the data.) The differences should be small and the different models give more or less the same information. In the next activity, students will be using the model (equation and graph) to make predictions.

Access for English Language Learners

Representing, Conversing: MLR8 Discussion Supports. After students complete their scatter plots from the data, they should meet with a small group of 3–4 students to share and compare. While each student shares, circulate and encourage students to look for commonalities and to discuss their differences in displays. Tell students to generate an agreed on response for the equation and the visual display of the line even though they may have differences. Tell students that one member will share out, but they won't know who, so they all need to be prepared to share and explain. During the whole-class discussion, amplify use of mathematical language such as "slope", "intercept", "equation", "graph", and "negative association". Use this to help students develop their explanations of associations and differences that they see in how the data is interpreted.
Design Principle(s): Cultivate conversation; Maximize meta-awareness