Unit 8, Lesson 4

Dot Plots

Goals

- Describe (orally and in writing) a distribution represented by a dot plot, including informal observations about its center and spread.
- Interpret a dot plot to answer (in writing) statistical questions about a data set and to identify (orally) what values are "typical" for the distribution.

Learning Targets

- I can describe the center and spread of data from a dot plot.

Lesson Narrative

In this lesson, students continue to choose appropriate representations (MP5) to display categorical and numerical data, reason abstractly and quantitatively (MP2) by interpreting the displays in context, and study and comment on features of data distributions that they show. Here they begin to use the everyday meaning of the word "typical" to describe a characteristic of a group. They are also introduced to the idea of using center and spread to describe distributions generally. Planted here are seeds for the idea that values near the center of the distribution can be considered "typical" in some sense. These concepts are explored informally at this stage but will be formalized over time, as students gain more experience in describing distributions and more exposure to different kinds of distributions.

Standards

Building On	**6.SP.1**
Addressing	**6.SP.2, 6.SP.4, 6.SP.5.a, 6.SP.B**
Building Toward	**6.SP.3, 6.SP.5.c**

Instructional Routines

- Math Talk
- MLR8: Discussion Supports

Student Facing Learning Goals

Let's investigate what dot plots and bar graphs can tell us.

4.1 Math Talk: What Percent?

Warm-up

5 min

Activity Narrative

This *Math Talk* focuses on calculating percentages from parts of a whole. It encourages students to think about percentages and to rely on what they know about division to mentally solve problems. The understanding elicited here will be helpful later in the lesson when students describe how common a value is in a data set as a percentage.

To calculate percentages mentally, students need to look for and make use of structure (MP7). In describing their strategies, students need to be precise in their word choice and use of language (MP6).

Standards

Addressing **6.SP.4**

Instructional Routines

- Math Talk
- MLR8: Discussion Supports

Launch

Tell students to close their books or devices (or to keep them closed). Reveal one problem at a time. For each problem:

- Give students quiet think time and ask them to give a signal when they have an answer and a strategy.
- Invite students to share their strategies and record and display their responses for all to see.
- Use the questions in the activity synthesis to involve more students in the conversation before moving to the next problem.

Keep all previous problems and work displayed throughout the talk.

Student Task Statement

Find each value as a percentage.

- 18 out of 50
- 7 out of 20
- 6 out of 60
- 12 out of 30

Student Response

- 36%. Sample reasoning: By doubling both values, 18 out of 50 is the same percentage as 36 out of 100, which is 36%.
- 35%. Sample reasoning: By multiplying both values by 5, 7 out of 20 is the same as 35 out of 100, which is 35%.
- 10%. Sample reasoning: By dividing both values by 6, 6 out of 60 is the same percentage as 1 out of 10. Then, multiplying those by 10, it is the same percentage as 10 out of 100, or 10%.
- 40%. Sample reasoning: By dividing both values by 3, 12 out of 30 is the same percentage as 4 out of 10. Then, multiplying those by 10, it is the same percentage as 40 out of 100, or 40%.

Activity Synthesis

To involve more students in the conversation, consider asking:

- "Who can restate _____'s reasoning in a different way?"
- "Did anyone use the same strategy but would explain it differently?"
- "Did anyone solve the problem in a different way?"
- "Does anyone want to add on to _____'s strategy?"
- "Do you agree or disagree? Why?"
- "What connections to previous problems do you see?"

When examining displays of data, it can help to consider frequencies as percentages to determine how often certain values, or ranges of values, appear in the data set.

Access for English Language Learners

MLR8 Discussion Supports. Display sentence frames to support students when they explain their strategy. For example, "First, I _____ because . . . ." or "I noticed _____ so I . . . ." Some students may benefit from the opportunity to rehearse what they will say with a partner before they share with the whole class.
Advances: Speaking, Representing

4.2 Computer Upgrades

10 min

Activity Narrative

In this activity, students use a list of data to complete a frequency table and draw a dot plot. The drawing of the dot plot should be fairly straightforward. The emphasis here is on using a graphical representation to study and comment on the data distribution, and to reinforce how it allows us to make observations that are difficult to make by looking at lists and tables.

As students work, identify those who describe distributions not only in terms of individual categories or values (like "four people did not order any upgrades") but also characterize them in broader terms (like "almost all customers in the data set ordered two or fewer upgrades"). Invite them to share during the discussion following the activity.

Standards

Addressing	**6.SP.4, 6.SP.B**
Building Toward	**6.SP.5.c**

Launch

Keep students in groups of 2. Give students 4–5 minutes of quiet work time and 1–2 minutes to share their responses with a partner.

Access for Students with Disabilities

Engagement: Develop Effort and Persistence. Chunk this task into more manageable parts. Have students complete the table, then proceed to answer the other problems. Check in with students to provide feedback and encouragement after each chunk.
Supports accessibility for: Attention, Social-Emotional Functioning

Student Task Statement

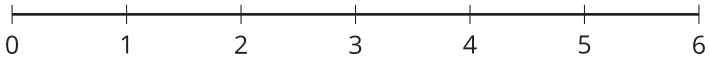
A computer shop offers upgrades to computers such as better graphic cards, additional memory, a larger monitor, or a wireless mouse. Fifteen customers are asked, "How many upgrades did you add to your computer?" Here are their responses:

1 2 1 3 0 1 1 2 0 3 0 0 1 2 2

1. Complete the table.

number of upgrades	frequency (number)
0	4
1	5
2	
3	

2. Use the frequency table to make a dot plot. Label your drawing clearly.



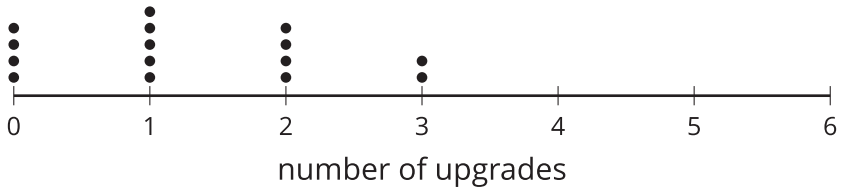
3. Use your dot plot to study the distribution for the number of upgrades. What do you notice about the number of upgrades that this group of customers ordered? Write 2–3 sentences summarizing your observations.

Student Response

1.

number of upgrades	frequency (number)
0	4
1	5
2	4
3	2

2.



3. Sample response: Most customers ordered 0, 1, or 2 upgrades. Nobody ordered 4 or more upgrades. The most common number of upgrades was 1.

Are You Ready for More?

Think of a statistical question that can be answered with the data about the number of upgrades ordered, as displayed on the dot plot. Then answer your question.

Extension Student Response

Sample responses:

- What is the largest number of upgrades ordered by the fifteen customers? (3)
- What percentage of the customers in the data set ordered 3 upgrades? (About 13%)

Activity Synthesis

Display a completed dot plot for all to see. Solicit as many observations or comments about the distribution as time permits. The goal of this discussion is to allow students to hear as many ways to describe distributions as possible. Be sure to select previously identified students to make observations that succinctly capture the distributions.

4.3 Homework Time

20 min

Activity Narrative

In this activity, students begin to think about how to characterize a distribution as a whole, in terms of its *center* and *spread*. Students learn that we can give a general description of a distribution by identifying a location that could be the center of the data, and by noting how alike or different the data points are.

Note that at this point *center* and *spread* can only be identified and described informally, via visual observation and intuitive reasoning about how data points are distributed. The lack of precise ways to identify center and spread helps to cultivate the need for more formal measures later.

In this activity, students evaluate and critique another's reasoning (MP3).

Standards

Building On	**6.SP.1**
Addressing	**6.SP.2, 6.SP.B**
Building Toward	**6.SP.3**

Instructional Routines

- MLR8: Discussion Supports

Launch

Keep students in groups of 2. Ask students to read the question in the stem, “How many hours do you generally spend on homework each week?” Then, ask students to explain why this is a statistical question. This is a statistical question because it can be answered by collecting data, and we can expect variability in the data.

Give them 6–7 minutes of quiet time to work on the first three questions, and then 4–5 minutes to share their responses with their partner and to complete the last questions together. Be sure to leave at least 5 minutes for a whole-class discussion.

Access for Students with Disabilities

Action and Expression: Provide Access for Physical Action. Provide access to tools and assistive technologies, such as a calculator, to compute percentages.

Supports accessibility for: Visual-Spatial Processing, Conceptual Processing, Organization

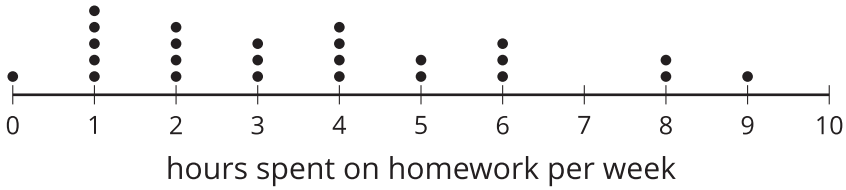
Access for English Language Learners

MLR8 Discussion Supports. Encourage students to begin partner discussions by reading their written responses aloud. If time allows, invite students to revise or add to their responses based on the conversation that follows. *Advances: Conversing, Speaking*

Student Task Statement

Twenty-five sixth-grade students answered the question: "How many hours do you generally spend on homework each week?"

This dot plot shows the number of hours per week that these 25 students reported spending on homework.



Use the dot plot to answer the following questions. For each, show or explain your reasoning.

1. What percentage of the students reported spending 1 hour on homework each week?
2. What percentage of the students reported spending 4 or fewer hours on homework each week?
3. Would 6 hours per week be a good description of the number of hours this group of students spends on homework per week? What about 1 hour per week? Explain your reasoning.
4. What value would you consider the center of the distribution of data? (Not necessarily the center of the number line shown.) Explain your reasoning.
5. Would the value you chose for the center be a good description of the number of hours spent on homework for these students?

Student Response

1. 20%. 5 of the students reported spending 1 hour on homework each week. 5 out of 25 is 20%.
2. 68%. 17 students reported spending 4 or fewer hours on homework each week. 17 out of 25 is 68%.
3. Sample response: 6 hours would not be a good value for a typical number of hours. Only 3 students in the group reported spending this much time per week doing homework. Most of the group spent a lot less. One hour would also not be a good estimate. Even though 5 students spent this much time on homework, nearly all other students spent much more.
4. Sample response: The center might be around 3 or 3.5. The data range from 0 to 9, but they are not evenly distributed, with more values in the lower end of the range.
5. Sample response: It would be a good description of these data. Many students spend about this much time on homework and about as many students spend more time as students who spend less.

Building on Student Thinking

Students may not recall how to find a percentage. Remind them that a percentage can be found if we know the size of a part and that of a whole. If needed, prompt them to determine the size of the entire data set.

Activity Synthesis

Ask a couple of students to share their thinking on what number of hours would be a good description of homework time for this group of students and why. Then, select a couple of other students to discuss how alike or different the lengths of homework time are.

Explain that sometimes it helps to describe a set of data generally, or to characterize it as a whole. Ask students to share what they found to be the center of the distribution and whether that was a good description of the set as a whole.

Another way to characterize a data set is by describing its *spread*, or the variability in the data points. The wider the spread (the more dispersed the data points are on a dot plot), the more variable or different they are. The narrower the spread (the more clustered together), the more alike they are. Ask students:

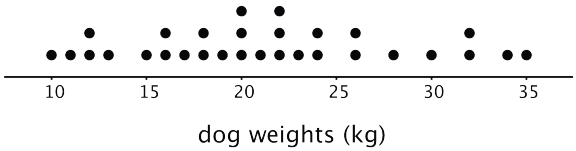
- "Do you agree with this statement? 'In general, these students spend roughly the same number of hours doing homework.'" (I disagree. Most of the data spreads out from 0 to 9 hours. There is a student who does not do homework at all, and there are several who spend 8–9 hours per week.)
- "Based on the dot plot, how would you describe the spread of the students' homework time? Are the amounts of time they spend on homework alike or different?" (Students spend anywhere from 0 to 9 hours on homework, but most students spend 1–6 hours. The difference between 1 hour of homework and 6 hours of homework seems like a lot based on how much time there is after school, so the amounts of time seem different.)

Lesson Synthesis

The purpose of the discussion is to solidify student understanding of typical values for a distribution.

Ask students:

- "What does the term 'typical' mean? When someone wants to find out a typical height of sixth-graders, what is the information of interest?" (A typical value is one that represents a lot of the data with one number. Often it is the most frequent value or a value near the bulk of the data. To find the typical height of sixth-graders, we need to collect heights from many sixth-graders and look at what is common in the distribution.)
- "How do you tell what is typical from a dot plot such as this one? How might we describe the characteristics of this data set on dog weights?" (Look for a place on the dot plot where most of the data are in the distribution. For these dog weights, a typical weight might be around 20 kilograms.)



4.4 Family Size

Cool-down

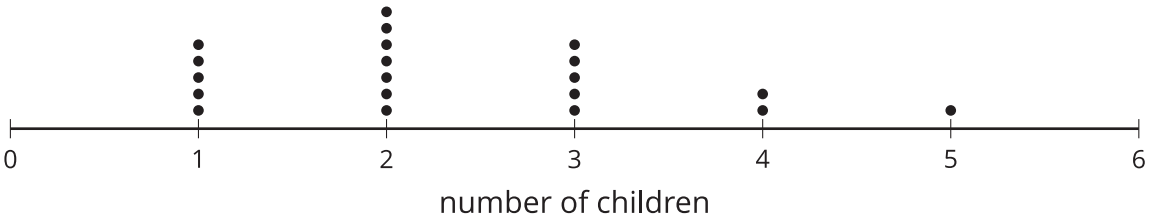
5 min

Standards

Addressing	**6.SP.5.a, 6.SP.B**
Building Toward	**6.SP.5.c**

Student Task Statement

A group of students was asked, "How many children are in your family?" The responses are displayed in the dot plot.



1. How many students responded to the question?
2. What percentage of the students have more than one child in the family?
3. Write a sentence that describes the distribution of the data shown on the dot plot. Use a description of the center and spread in your description.

Student Response

1. There are 20 dots and each corresponds to one student in the group.
2. 75%. 15 out of 20 students answered that there are 2 or more children in the family.
3. Sample response: A typical number of children for this group of families is around 2 because the center is around 2.5 or so, but some families had many more children than others. The distribution is not very spread out with most families having 1–3 children and only a few of them having more.

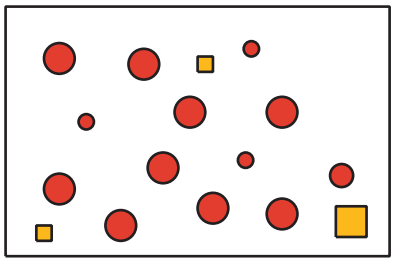
Responding to Student Thinking

More Chances
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

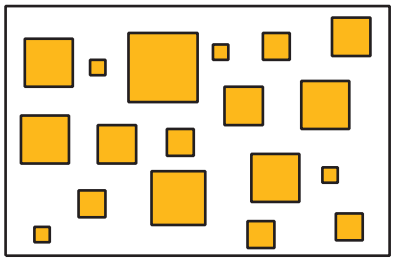
Lesson 4 Summary

We often collect and analyze data because we are interested in learning what is "typical," or what is common and can be expected in a group.

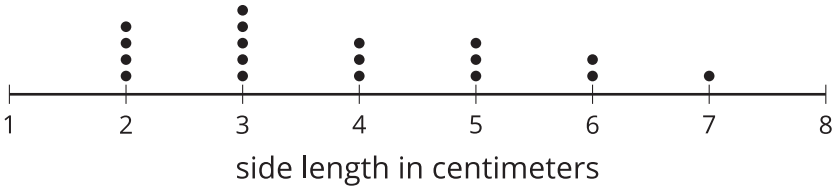
Sometimes it is easy to tell what a typical member of the group is. For example, we can say that a typical shape in this set is a large circle.



Just looking at the members of a group doesn't always tell us what is typical, however. For example, if we are interested in the side length typical of squares in this set, it isn't easy to do so just by studying the set visually.



In a situation like this, it is helpful to gather the side lengths of the squares in the set and look at their distribution, as shown in this dot plot.



We can see that squares with 3 centimeter sides are the most common and many others are about the same size. That means we could say that side lengths of about 3 centimeters are typical of squares in this set.

Lesson 4 Practice Problems

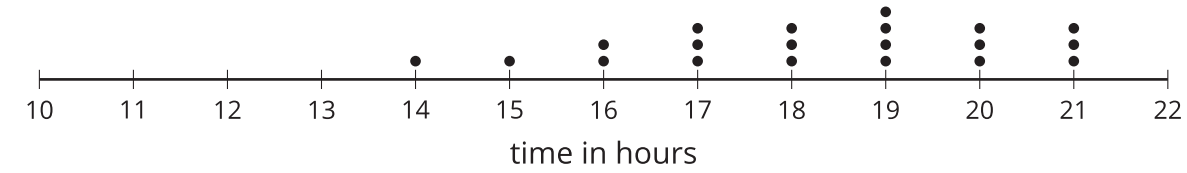
1 Student Task Statement

Clare recorded the amounts of time spent doing homework, in hours per week, by students in sixth, eighth, and tenth grades. She made a dot plot of the data for each grade and provided the following summary.

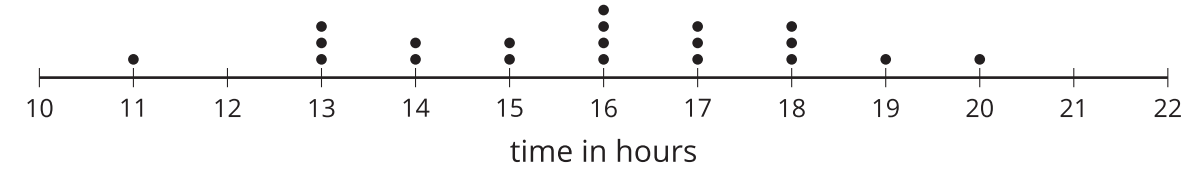
- Students in sixth grade tend to spend less time on homework than students in eighth and tenth grades.
- The homework times for the tenth-grade students are more alike than the homework times for the eighth-grade students.

Use Clare's summary to match each dot plot to the correct grade (sixth, eighth, or tenth).

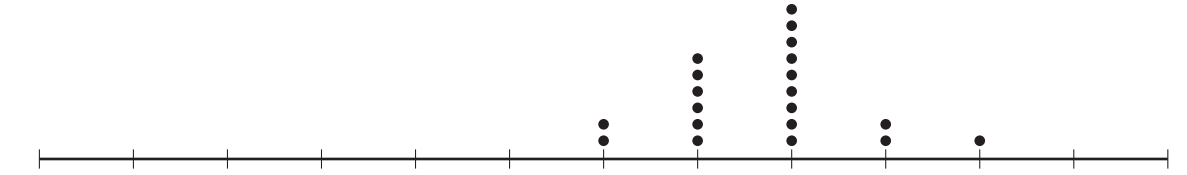
A



B



C



Solution

A is the dot plot for eighth grade.

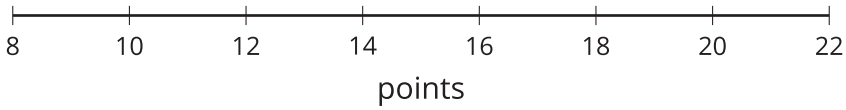
B is the dot plot for sixth grade.

C is the dot plot for tenth grade.

2 Student Task Statement

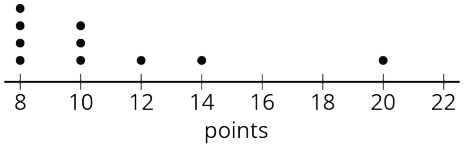
Mai played 10 basketball games. She recorded the number of points she scored and made a dot plot. Mai said that she scored between 8 and 14 points in most of the 10 games, but one game was exceptional. During that game she scored more than double her typical score of 9 points. Use the number

line to make a dot plot that fits the description Mai gave.



Solution

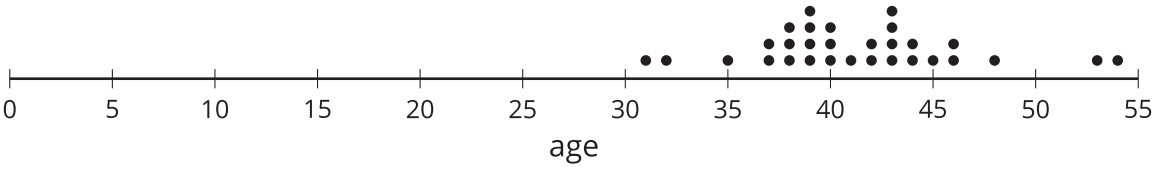
Sample response:



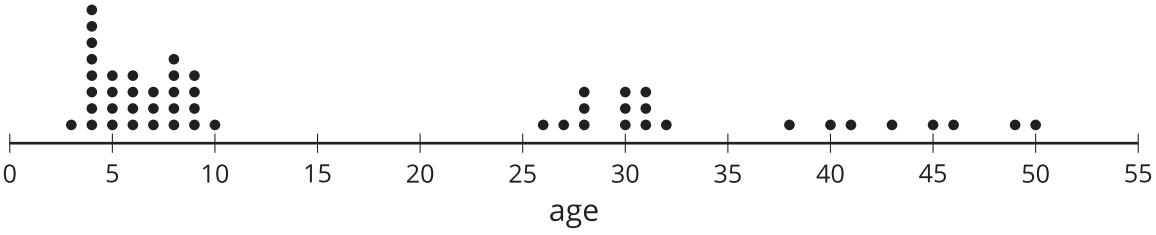
3 Student Task Statement

A movie theater is showing three different movies. The dot plots represent the ages of the people who were at the Saturday afternoon showing of each of these movies.

movie A



movie B



movie C

a. One of these movies was an animated movie rated G for general audiences. Do you think it was movie A, B, or C? Explain your reasoning.

b. Which movie has a distribution with a center around 30 years?

c. What is a typical age for the people who were at Movie A?

Solution

a. Movie B. There are many people with ages between about 4 and 10, and then ages that are between 25 and 50. This movie was attended by kids and the adults that were with the kids, so it is probably the G-rated movie.

b. Movie C.

c. A typical age would be around 40 years.

4 from Unit 5, Lesson 13

Student Task Statement

Find the value of each expression.

a. $3.727 + 1.384$

b. $3.727 - 1.384$

c. $5.01 \cdot 4.8$

d. $5.01 \div 4.8$

Solution

a. 5.111

b. 2.343

c. 24.048

d. 1.04375