



# How to support your student as they learn about

## Describing Variability of Quantities

Mathematics is a connected set of ideas, and your student knows a lot. Encourage them to use the mathematics they already know when seeing new concepts in this module.

### Module Introduction

In this module your student will learn more about the field of statistics, which is the study of data. There are 2 topics in this module: *The Statistical Process* and *Numerical Summaries of Data*. Your student will use what they already know about representing data with graphs in this module.

### Academic Glossary

Each module will highlight an important term. Knowing and using these terms will help your student think, reason, and communicate their math ideas.

Term	Describe
<b>Definition</b>	<ul style="list-style-type: none"> <li>To represent or give an account of in words.</li> <li>Describing communicates mathematical ideas to others.</li> </ul>
<b>Questions to Ask Your Student</b>	<ul style="list-style-type: none"> <li>How should I organize my thoughts?</li> <li>Is my explanation logical?</li> <li>Did I consider the context of the situation?</li> <li>Does my reasoning make sense?</li> </ul>
<b>Related Phrases</b>	<ul style="list-style-type: none"> <li>Demonstrate</li> <li>Label</li> <li>Display</li> <li>Determine</li> <li>Define</li> <li>What are the advantages?</li> <li>What are the disadvantages?</li> <li>What is similar?</li> <li>What is different?</li> </ul>

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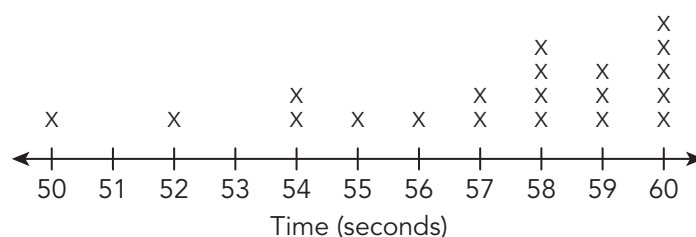
#### Pages 4–13

Topic Summaries

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Rock-Climbing Times (6th Grade)



**Describe** the shape of the dot plot, including its overall shape and any relevant, or closely connected, patterns.



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## Math Process Standards

Each module will focus on a process (or a pair of processes) that will help your student become a mathematical thinker. The “I can” statements listed below help your student to develop their mathematical learning and understanding.

*Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying a solution, and evaluating the problem-solving process and reasonableness of the solution.*

I can:

- explain what a problem “means” in my own words.
- create a plan and change it if necessary.
- ask useful questions in an attempt to understand the problem.
- explain my reasoning and defend my solution.
- reflect on whether my results make sense.

*Apply mathematics to problems arising in everyday life, society, and the workplace.*

I can:

- use the mathematics that I learn to solve real-world problems.
- interpret mathematical results in the contexts of a variety of problem situations.

Look for examples of these processes in the Topic Summaries.

## The Carnegie Learning Way

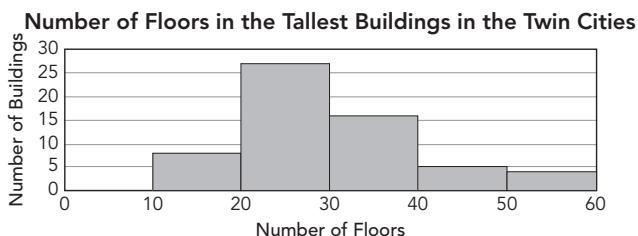
Problem Types You Will See: **Who’s Correct**

**When you see a Who’s Correct icon:**

- Take your time to read through the situation.
- Question the strategy or reason given.
- Determine if correct or not correct.

**Ask Yourself**

- Does the reasoning make sense?
- If the reasoning makes sense, what is the justification?
- If the reasoning does not make sense, what error was made?





Bella says, “There are 5 buildings represented in the histogram, since there are 5 bars.” Do you agree or disagree with Bella’s statement? If you do not agree with Bella, estimate how many buildings are represented in the histogram.



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## Module Overview

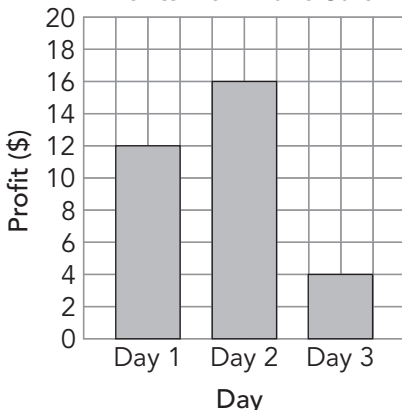
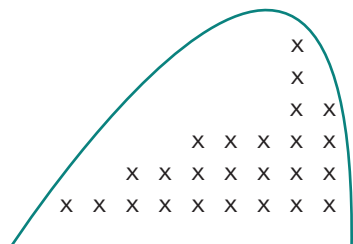

TOPIC 1	TOPIC 2
The Statistical Process	Numerical Summaries of Data
9 Days	10 Days
You student will learn about the statistical problem-solving process: formulate questions, collect data, analyze data, and interpret the results.	Your student will learn about measures of central tendency and measures of variability.
<p>Did You Know That?</p>  <p>A census is an official count or <b>survey</b> of a population, typically recording various details of individuals.</p> <p>The data collected by the census tells us who we are and where we are going as a nation, and helps our communities determine where to build everything from schools to supermarkets, and from homes to hospitals.</p>	<p>Did You Know That?</p>  <p>Colleges use data from schools each year to determine admission. One of the key factors that matter most is a student's grade point average.</p> <p>Your student's grade point average (GPA) is the sum of all their course grades throughout high school divided by the total number of credits.</p>



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## Topic 1: The Statistical Process

Key Terms																						
<ul style="list-style-type: none"><li>• statistical question</li><li>• data</li><li>• variability</li><li>• statistical process</li><li>• categorical data</li><li>• quantitative data</li><li>• population</li><li>• sample</li><li>• survey</li></ul>	<ul style="list-style-type: none"><li>• observational study</li><li>• experiment</li><li>• bar graph</li><li>• frequency</li><li>• frequency table</li><li>• mode</li><li>• relative frequency table</li><li>• dot plot</li><li>• distribution</li></ul>	<ul style="list-style-type: none"><li>• symmetric</li><li>• skewed right</li><li>• skewed left</li><li>• clusters</li><li>• gaps</li><li>• peaks</li><li>• outliers</li><li>• stem-and-leaf plot</li><li>• histogram</li></ul>																				
<p>A <b>bar graph</b> displays <b>categorical data</b> using either horizontal or vertical bars on a graph. The height or length of each bar indicates the value for that category.</p> <p><b>Profits from Bake Sale</b></p>  <table><thead><tr><th>Day</th><th>Profit (\$)</th></tr></thead><tbody><tr><td>Day 1</td><td>12</td></tr><tr><td>Day 2</td><td>16</td></tr><tr><td>Day 3</td><td>4</td></tr></tbody></table>	Day	Profit (\$)	Day 1	12	Day 2	16	Day 3	4	<p>A <b>frequency table</b> is table used to organize data according to how many times a data value occurs.</p> <table><thead><tr><th colspan="2">Number of Roller Coasters at Major Theme Parks</th></tr><tr><th>Number of Roller Coasters</th><th>Frequency (f)</th></tr></thead><tbody><tr><td>7–9</td><td>6</td></tr><tr><td>10–12</td><td>4</td></tr><tr><td>13–15</td><td>7</td></tr><tr><td>16–18</td><td>2</td></tr></tbody></table>	Number of Roller Coasters at Major Theme Parks		Number of Roller Coasters	Frequency (f)	7–9	6	10–12	4	13–15	7	16–18	2	<p>In a <b>skewed left</b> distribution of data the peak of the data is to the right side of the graph. There are only a few data points to the left side of the graph.</p> 
Day	Profit (\$)																					
Day 1	12																					
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Day 3	4																					
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<div> Follow the link to access the Mathematics Glossary: <a href="https://www.carnegielearning.com/texas-help/students-caregivers/">https://www.carnegielearning.com/texas-help/students-caregivers/</a></div>																						

In this topic, students are introduced to the statistical problem-solving process: create questions, collect data, analyze data, and interpret the results.



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## Statistical Questions

A **statistical question** is a question that has an answer based on data that vary.

### Statistical Question

- What clubs do my classmates belong to?
- How many members do the clubs at my school have?

These examples are statistical questions because the answers will vary. Every student does not belong to the same clubs, and every club does not have the same number of members.

### Not a Statistical Question

- What clubs am I in?
- How many students are in the chess club?

These examples are not statistical questions because each has only one answer; there is no variability in the answers to the questions.

## Data Collection

The second step of the **statistical process** is to collect the data to answer the statistical question. Two types of data that can be collected are *categorical data* and *quantitative data*.

**Categorical data**, or *qualitative data*, are data for which each piece of data fits into exactly one of several different groups or categories.

**Quantitative data**, or *numerical data*, are data for which each piece of data can be placed on a numerical scale and compared.

### Statistical Question:

What is the most popular favorite color in the school?

### Sample Answers

Colors: blue, green, red, etc.

### Statistical Question:

How many siblings do 6th graders have?

### Sample Answers

Numbers: 0, 5, 3, 7, etc.



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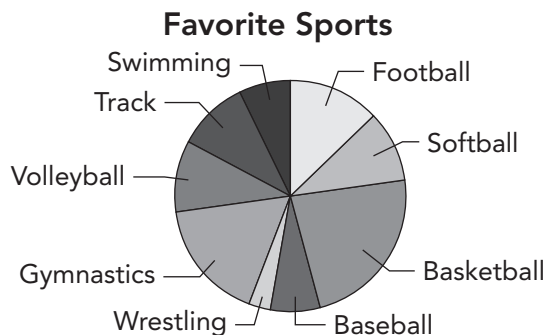


### Analyzing the Data

Analyzing the collected data is Part 3 of the statistical process. Your student will use different graphs to analyze and interpret data.

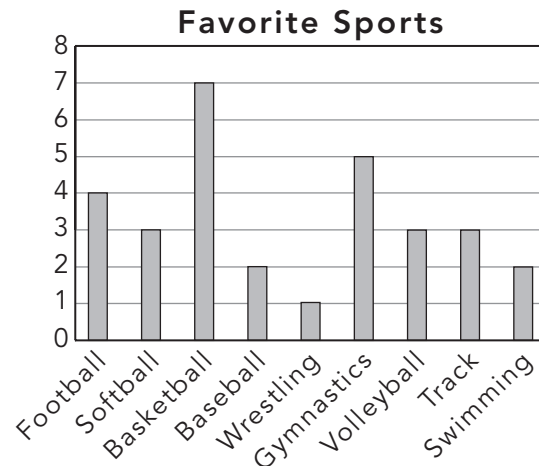
In this example, 30 students were surveyed on their favorite sport. The data is displayed in two different ways.

Circle Graph



This graph shows the percentage who preferred each sport.

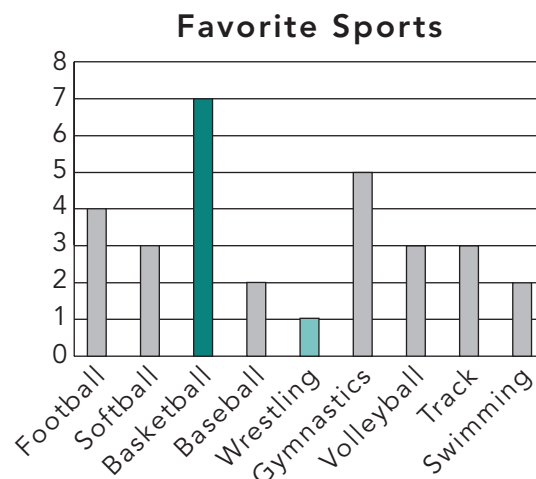
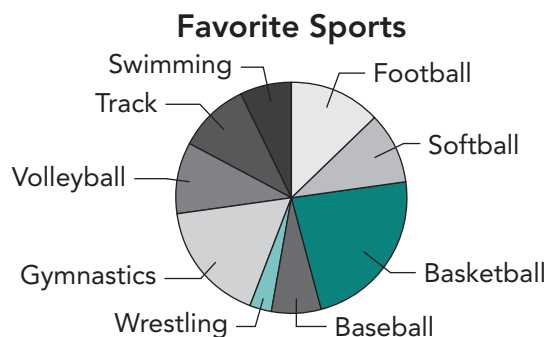
Bar Graph



This graph shows the number of students who preferred each sport.

### Interpret the Results

Interpreting the data, or drawing conclusions, is the final step of the statistical process. By looking at both graphs you can conclude that basketball is the most popular sport among the **population** surveyed and that wrestling is the least popular sport.

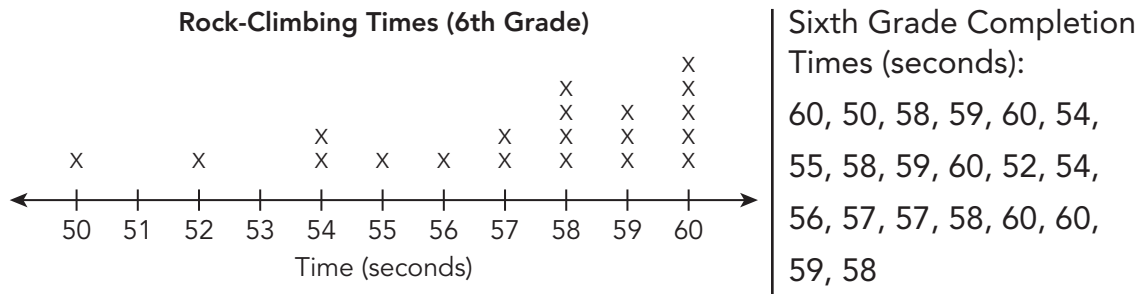


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## Graphs, Graphs, and More Graphs

A **dot plot** is a data display that shows discrete data on a number line with dots, Xs, or other symbols. Dot plots help organize and display a small number of data points.



A **stem-and-leaf plot** is a table used to represent ordered data. Once the data is ordered, the 'stem' on the left displays the first digit or digits. The 'leaf' is on the right and displays the last digit.

Total Medals Won by Countries 2016 Summer Olympics		Total Medals Won by Countries 2016 Summer Olympics:
0	5 5 5 6 6 6 7 7 7 8 8 8 8 8 9 9	5, 5, 5, 6, 6, 6, 7, 7, 7, 8, 8, 8, 8,
1	0 0 0 1 1 1 1 1 3 3 5 5 7 8 8 8 9 9	8, 9, 9, 10, 10, 10, 11, 11, 11, 11,
2	2 8 9	11, 13, 13, 15, 15, 17, 18, 18, 18,
3		19, 19, 22, 28, 29, 41, 42, 42, 56,
4	1 2 2	67, 70, 121.
5	6	
6	7	
7	0	
8		
9		
10		
11		
12	1	

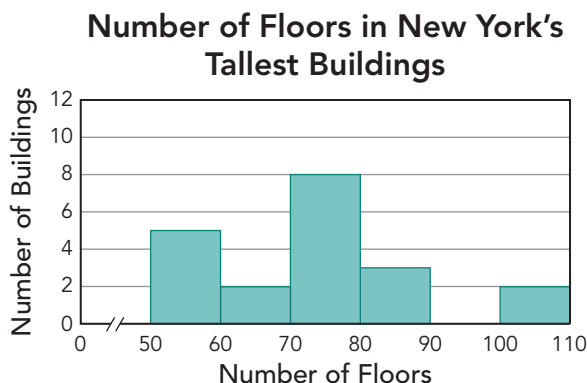
**Key:** 4|1 = 41 medals won



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A **histogram** is a graph that displays quantitative or numerical data using vertical bars. The width of a bar represents an interval of data and is called a bin. The height of the bar indicates the **frequency**, or the number of data values included in any given bin.



Number of floors	Frequency (f)
50-60	5
60-70	2
70-80	8
80-90	3
90-100	0
100-110	2

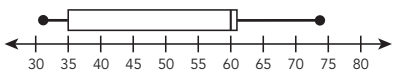
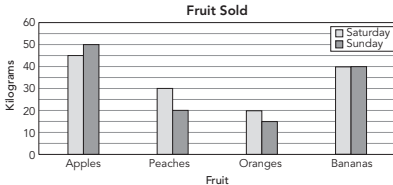
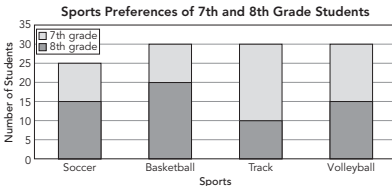



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## Topic 2: Numerical Summaries of Data

Key Terms																																
<ul style="list-style-type: none"> <li>• measure of center</li> <li>• mode</li> <li>• median</li> <li>• balance point</li> <li>• mean</li> <li>• measure of variation</li> <li>• range</li> </ul>	<ul style="list-style-type: none"> <li>• quartile</li> <li>• interquartile range (IQR)</li> <li>• box-and-whisker plot</li> <li>• categorical data</li> <li>• quantitative data</li> <li>• discrete data</li> <li>• continuous data</li> </ul>	<ul style="list-style-type: none"> <li>• bar graph</li> <li>• frequency</li> <li>• double bar graph</li> <li>• key</li> <li>• stacked bar graph</li> <li>• percent bar graph</li> </ul>																														
<p>A <b>box-and-whisker plot</b>, or just box plot, is a graph that displays the five-number summary of a data set: the <b>median</b>, the upper and lower <b>quartiles</b> (Q1 and Q3), and the minimum and maximum values.</p>  <p>Data: 32, 35, 35, 53, 55, 60, 60, 61, 61, 74, 74</p> <p>Minimum = 32 Q1 = 35 Median = 60 Q3 = 61 Maximum = 74</p>	<p>A <b>double bar graph</b> is used when each category contains two different data sets. The bars may be vertical or horizontal.</p>  <table border="1"> <caption>Fruit Sold (Kilograms)</caption> <thead> <tr> <th>Fruit</th> <th>Saturday</th> <th>Sunday</th> </tr> </thead> <tbody> <tr> <td>Apples</td> <td>45</td> <td>50</td> </tr> <tr> <td>Peaches</td> <td>30</td> <td>20</td> </tr> <tr> <td>Oranges</td> <td>20</td> <td>15</td> </tr> <tr> <td>Bananas</td> <td>40</td> <td>40</td> </tr> </tbody> </table>	Fruit	Saturday	Sunday	Apples	45	50	Peaches	30	20	Oranges	20	15	Bananas	40	40	<p>A <b>stacked bar graph</b> is a graph that stacks the frequencies of two different groups for a given category on top of one another so that you can compare the parts to the whole.</p>  <table border="1"> <caption>Sports Preferences of 7th and 8th Grade Students</caption> <thead> <tr> <th>Sports</th> <th>7th grade</th> <th>8th grade</th> </tr> </thead> <tbody> <tr> <td>Soccer</td> <td>15</td> <td>10</td> </tr> <tr> <td>Basketball</td> <td>20</td> <td>10</td> </tr> <tr> <td>Track</td> <td>10</td> <td>20</td> </tr> <tr> <td>Volleyball</td> <td>15</td> <td>15</td> </tr> </tbody> </table>	Sports	7th grade	8th grade	Soccer	15	10	Basketball	20	10	Track	10	20	Volleyball	15	15
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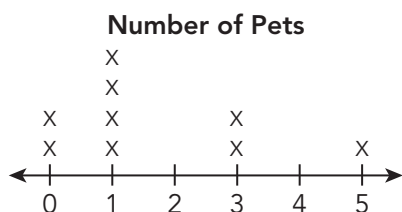


## Measures of Center

In this topic, students learn about measures of center which tell you how the data values are clustered, or where the “center” of a graph of the data is located. There are three measures that describe how a data set is centered: the *mean*, the *median*, and the *mode*.

### Mean

The **mean** is the arithmetic average of the numbers in a data set. It is based on leveling off or creating fair shares. In the example below there is a varying number of pets in the data set. The average number of pets is  $1\frac{2}{3}$  pets.



$$\begin{aligned}\text{Mean} &= \frac{0 + 0 + 1 + 1 + 1 + 1 + 3 + 3 + 5}{9} \\ &= \frac{15}{9} = 1\frac{2}{3} \text{ pets}\end{aligned}$$

Nine people were surveyed. There are two people that have no pets, four people that have 1 pet, two people that have 3 pets, and one person that has 5 pets.

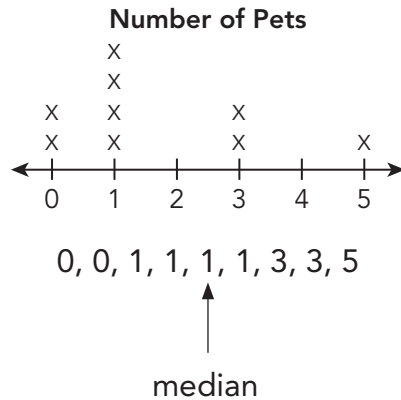


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### Median

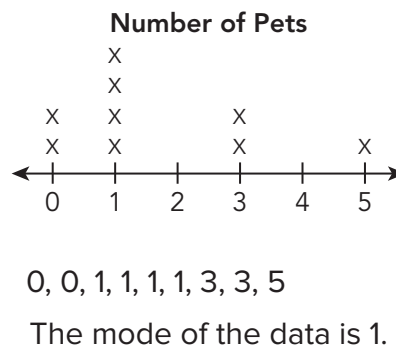
The **median** is the middle number in a data set when the values are placed in order from least to greatest or greatest to least. When a data set has an odd number of data values, you can determine which number is exactly in the middle of the data set. If there is an even number of data values, the median is calculated by adding the two middle numbers and dividing by 2.



The median number of pets is one pet.

### Mode

The **mode** is the data value or values that occur most frequently in a data set. A data set can have more than one mode.



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**MATH PROCESS STANDARDS**

How do the activities in *Numerical Summaries of Data* promote student expertise in the math process standards?

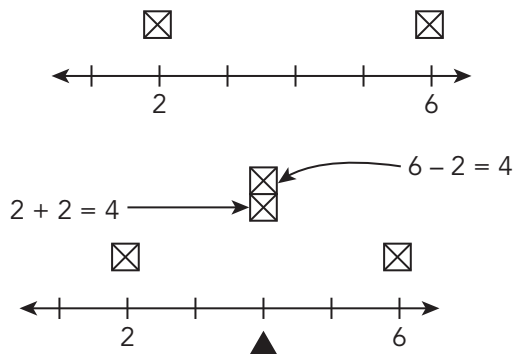
**NOTE:** This is an example of the math process standard:

*Use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying a solution, and evaluating the problem-solving process and reasonableness of the solution.*

- I can explain what a problem “means” in my own words.

Have your student refer to page 2 for more “I can” statements.

Consider the data set: 2, 6.

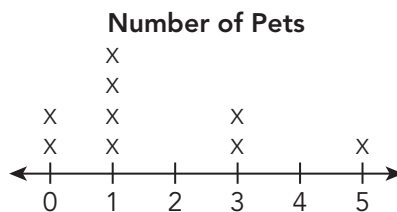


The value 2 was moved to the right from 2 to 4. To maintain balance, 6 was moved 2 to the left from 6 to 4. The **balance point** is 4.

Explain the meaning of the balance point shown in the model above.

**Measures of Variation**

A **measure of variation** describes the spread of data values. One measure of variation is the range. The **range** is the difference between the greatest and least values of a data set.



0, 0, 1, 1, 1, 1, 3, 3, 5

$$5 - 0 = 5$$

The range of the data is 5.



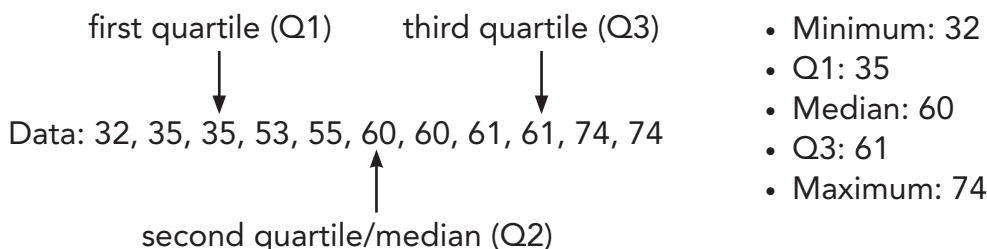
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Your student will learn that a data set can be split into four parts called quartiles to describe the spread of the data values.

To summarize and describe the spread of the data values, you can use the five-number summary. The five-number summary includes these five values from a data set:

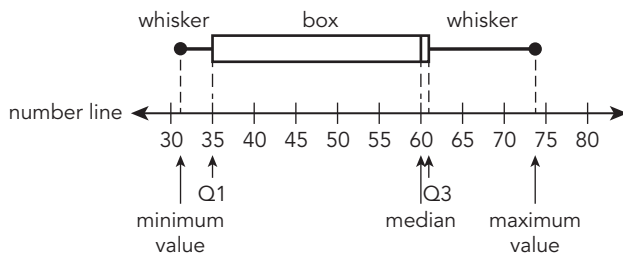
- Minimum: the lowest value in the data set
- Q1: the first quartile
- Median: the middle value in the data set
- Q3: the third quartile
- Maximum: the highest value in a data set



The **interquartile range (IQR)**, is the difference between the third quartile, Q3, and the first quartile, Q1. The IQR indicates the range of the middle 50 percent of the data.

$$\begin{aligned}\text{IQR} &= Q3 - Q1 \\ \text{IQR} &= 61 - 35 \\ \text{IQR} &= 26\end{aligned}$$

The five-number summary of a data set: the median, the upper and lower quartiles (Q1 and Q3), and the minimum and maximum values can be displayed on a **box-and-whisker plot**, or *box plot*.



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Discuss important dates throughout this module such as assessments, assignments, or class events with your student. Use the table to record these dates and reference them as your student progresses through the module.

Important Dates	
Date	Reason

Using the link below, visit the Texas Math Solution Support Center for students and caregivers to access additional resources such as:

- Mathematics Glossaries
- Videos
- Topic Materials
- A Letter to Families and Caregivers



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