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Essential Question How can you use a histogram to characterize the basic shape of a distribution?

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1 **EXPLORATION:** Analyzing a Famous Symmetric Distribution

Work with a partner. A famous data set was collected in Scotland in the mid-1800s. It contains the chest sizes, measured in inches, of 5738 men in the Scottish Militia. Estimate the percent of the chest sizes that lie within (a) 1 standard deviation of the mean, (b) 2 standard deviations of the mean, and (c) 3 standard deviations of the mean. Explain your reasoning.

Scottish Militiamen

Mean = 40 in.
Standard deviation = 2 in.

Frequency vs. Chest size (inches)

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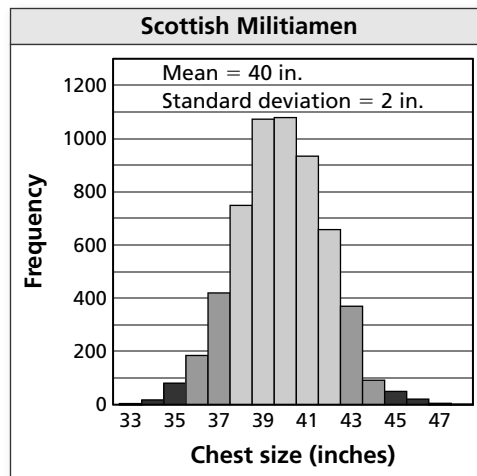
2 **EXPLORATION:** Comparing Two Symmetric Distributions

Work with a partner. The graphs show the distributions of the heights of 250 adult American males and 250 adult American females.
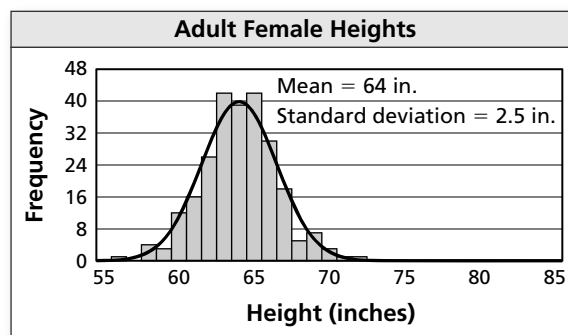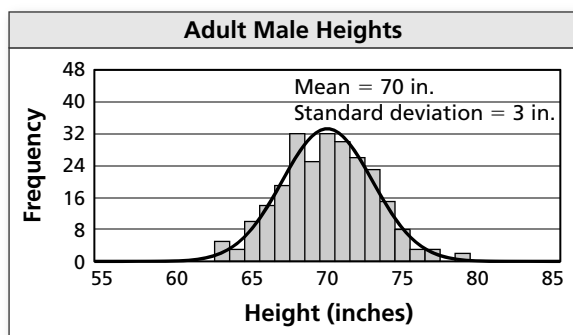
a. Which data set has a smaller standard deviation? Explain what this means in the context of the problem.

b. Estimate the percent of male heights between 67 inches and 73 inches.

Communicate Your Answer

3. How can you use a histogram to characterize the basic shape of a distribution?

4. All three distributions in Explorations 1 and 2 are roughly symmetric. The histograms are called "bell-shaped."

a. What are the characteristics of a symmetric distribution?

b. Why is a symmetric distribution called "bell-shaped?"

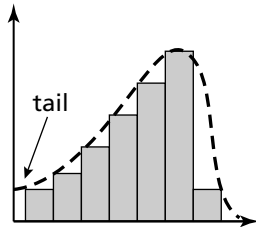**c.** Give two other real-life examples of symmetric distributions.

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Core Concepts

Symmetric and Skewed Distributions

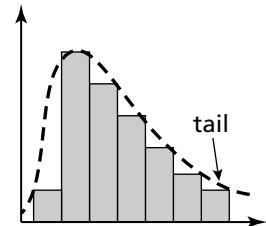| **Skewed left** | **Symmetric** | **Skewed right** |

- The "tail" of the graph extends to the left.
- Most of the data are on the right.

- The data on the right of the distribution are approximately a mirror image of the data on the left of the distribution.

- The "tail" of the graph extends to the right.
- Most of the data are on the left.

Notes:
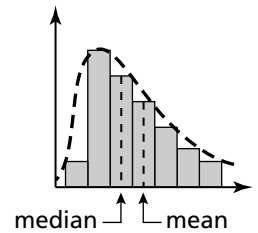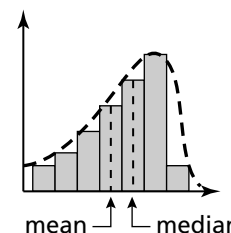
Choosing Appropriate Measures

When a data distribution is symmetric,

- use the mean to describe the center and
- use the standard deviation to describe the variation.
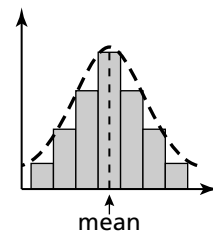
When a data distribution is skewed,

- use the median to describe the center and
- use the five-number summary to describe the variation.

Notes:

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Worked-Out Examples

Example #1

ANALYZING DATA   The table shows the last 24 ATM withdrawals at a bank.

a. Display the data in a histogram using seven intervals beginning with 26–50.

b. Which measures of center and variation best represent the data? Explain.

c. The bank charges a fee for any ATM withdrawal less than $150. How would you interpret the data?

ATM Withdrawals (dollars)		
120	100	70
60	40	80
150	80	50
120	60	175
30	50	50
60	200	30
100	150	110
70	40	100

a.

ATM Withdrawals (dollars)	Frequency
26–50	7
51–75	5
76–100	5
101–125	3
126–150	2
151–175	1
176–200	1
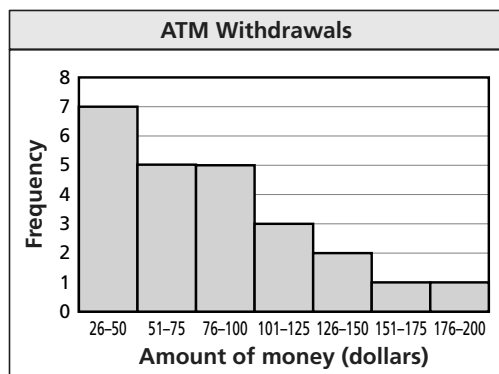
b. Most of the data are on the left and the tail of the graph extends to the right. So, the distribution is skewed right, which means that the median and five-number summary best represent the data.

c. Most of the data values are on the left side of the graph, which represent withdrawals of less than $150. So, most people were charged a fee for their withdrawals.

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Example #2

ANALYZING DATA Measuring an IQ is an inexact science. However, IQ scores have been around for years in an attempt to measure human intelligence. The table shows some of the greatest known IQ scores.

a. Display the data in a histogram using five intervals beginning with 151–166.
b. Which measures of center and variation best represent the data? Explain.
c. The distribution of IQ scores for the human population is symmetric. What happens to the shape of the distribution in part (a) as you include more and more IQ scores from the human population in the data set?

IQ Scores		
170	190	180
160	180	210
154	170	180
195	230	160
170	186	180
225	190	170

a.

IQ Scores	Frequency
151–166	3
167–182	8
183–198	4
199–214	1
215–230	2
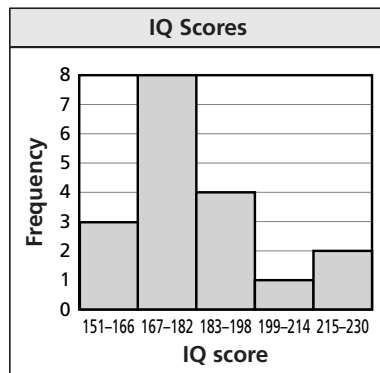
b. Most of the data are on the left and the tail of the graph extends to the right. So, the distribution is skewed right, which means that the median and five-number summary best represent the data.

c. As you include more and more IQ scores in the data set, the shape of the distribution will become more symmetric.

10.3 **Practice (continued)**

Practice A

1. The table shows the average annual snowfall (in inches) of 26 cities.

   a. Display the data in a histogram using six intervals beginning with 15–28.

Average Annual Snowfall (inches)		
22	68	33
15	28	31
20	18	30
15	54	16
44	43	17
95	41	30
29	23	47
37	26	54
16	30	

   b. Which measures of center and variation best represent the data? Explain.

   c. A weather station lists the top 20 snowiest major cities. The city in 20th place had 51 inches of snow. How would you interpret the data?

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2. The double histogram shows the distributions of monthly precipitation for two towns over a 50-month period. Compare the distributions using their shapes and appropriate measures of center and variation.

Monthly Precipation
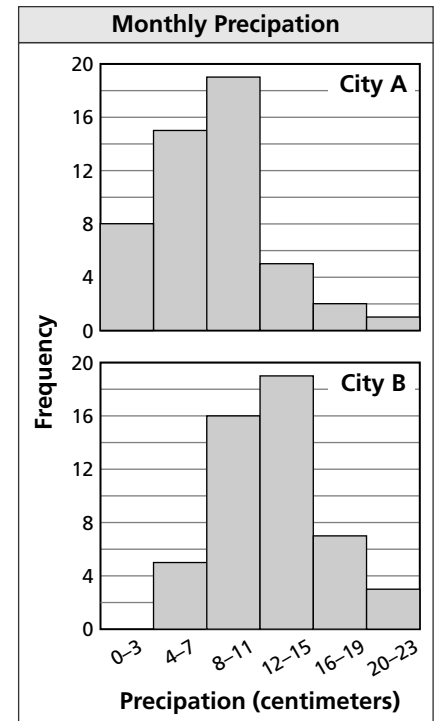
3. The table shows the results of a survey that asked high school students how many hours a week they listen to music.

a. Make a double box-and-whisker plot that represents the data. Describe the shape of each distribution.

	Females	Males
Survey size	50	58
Minimum	16	18
Maximum	40	52
1st Quartile	24	30
Median	28	38
3rd Quartile	32	46
Mean	28	30
Standard deviation	6	12

b. Compare the number of hours of music listened to by females to the number of hours of music listened to by males.

c. About how many females surveyed would you expect to listen to music between 22 and 34 hours per week?

d. If you survey 100 more females, about how many would you expect to listen to music between 16 and 40 hours per week?

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Practice B

1. The frequency table shows the results of a survey that asked people how many parking tickets they received during the last five years. Display the data in a histogram. Describe the shape of the distribution.

Number of parking tickets	0–1	2–3	4–5	6–7	8–9	10–11
Frequency	18	23	20	14	4	1

In Exercises 2 and 3, describe the shape of the distribution of the data. Explain your reasoning.

2.
```
Stem | Leaf
   1 | 2 3 4 5 6 7 8 9
   2 | 0 1 2 3 4 5 6 7 8 9
   3 | 0 1 2 3 4 5 6
   4 | 0 1 7 8 9
   5 | 2 3
   6 | 4
   7 | 5
```
       Key: 2|1 = 21

3.
```
Stem | Leaf
   3 | 8
   4 | 4 5 5
   5 | 0 2 4 4 5
   6 | 2 3 4 5 5 8 9
   7 | 2 4 6 6 7
   8 | 1 3 3
   9 | 4
```
       Key: 4|5 = 45

4. The table shows the results of a survey that asked sophomores and juniors how many school events they attended last month.

   a. Make a double box-and-whisker plot that represents the data. Describe the shape of each distribution.

   b. Compare the number of school events attended by sophomores to the number of school events attended by juniors.

   c. About how many of the juniors surveyed would you expect to attend between 7 and 11 school events?

	Sophomores	Juniors
Survey size	55	52
Minimum	0	2
Maximum	9	15
1st Quartile	3	7
Median	6	12
3rd Quartile	8	14
Mean	9	11
Standard Deviation	2.4	4.3