

# 10.4 Interpret Stem-and-Leaf Plots and Histograms



**Before**

You found measures of central tendency and dispersion.

**Now**

You will make stem-and-leaf plots and histograms.

**Why?**

So you can analyze historical data, as in Ex. 20.

## Key Vocabulary

- stem-and-leaf plot
- frequency
- frequency table
- histogram

A **stem-and-leaf plot** is a data display that organizes data based on their digits. Each value is separated into a *stem* (the leading digit(s)) and a *leaf* (the last digit). A stem-and-leaf plot has a key that tells you how to read the data. A stem-and-leaf plot shows how the data are distributed.

## EXAMPLE 1 Make a stem-and-leaf plot



**CC.9-12.S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots).\*

**BASEBALL** The number of home runs hit by the 20 baseball players with the best single-season batting averages in Major League Baseball since 1900 are listed below. Make a stem-and-leaf plot of the data.

14, 25, 8, 8, 7, 7, 19, 37, 39, 18, 42, 23, 4, 32, 14, 21, 3, 12, 19, 41

### Solution

**STEP 1** Separate the data into stems and leaves.

**STEP 2** Write the leaves in increasing order.

Home Runs	
Stem	Leaves
0	8 8 7 7 4 3
1	4 9 8 4 2 9
2	5 3 1
3	7 9 2
4	2 1

Key: 1 | 4 = 14 home runs

Home Runs	
Stem	Leaves
0	3 4 7 7 8 8
1	2 4 4 8 9 9
2	1 3 5
3	2 7 9
4	1 2

Key: 1 | 4 = 14 home runs

### INTERPRET INTERVALS

Each stem in a stem-and-leaf plot defines an interval. For instance, the stem 2 represents the interval 20–29. The data values in this interval are 21, 23, and 25.



### GUIDED PRACTICE for Example 1

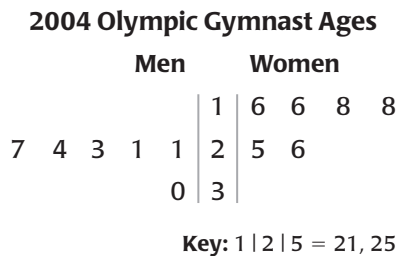
1. **U.S. HISTORY** The years in which each of the first 20 states were admitted to the Union are listed below. Make a stem-and-leaf plot of the years.

1788, 1787, 1788, 1816, 1792, 1812, 1788, 1788, 1817, 1788, 1787, 1788, 1789, 1803, 1787, 1790, 1788, 1796, 1791, 1788

2. **REASONING** In Example 1, describe the distribution of the data on the intervals represented by the stems. Are the data clustered together in a noticeable way? *Explain.*

## EXAMPLE 2 Interpret a stem-and-leaf plot

**GYMNASTICS** The back-to-back stem-and-leaf plot shows the ages of members of the U.S men’s and women’s 2004 Olympic gymnastics teams. Compare the ages of the gymnasts on the two teams.



### Solution

Consider the distribution of the data. The interval for 10–19 years old contains more than half of the female gymnasts. The interval for 20–29 years old contains more than half of the male gymnasts. The clustering of the data shows that the men’s team was generally older than the women’s team.

**FREQUENCY** The **frequency** of an interval is the number of data values in that interval. A stem-and-leaf plot shows the frequencies of intervals determined by the stems. A **frequency table** is also used to group data values into equal intervals, with no gaps between intervals and no intervals overlapping.

A **histogram** is a bar graph that displays data from a frequency table. Each bar represents an interval. Because intervals have equal size, the bars have equal width. A bar’s length indicates the frequency. There is no space between bars.

## EXAMPLE 3 Make a histogram

**SANDWICH PRICES** The prices (in dollars) of sandwiches at a restaurant are listed below. Make a histogram of the data.

4.00, 4.00, 4.25, 4.50, 4.75, 4.25, 5.95, 5.50, 5.50, 5.75

### Solution

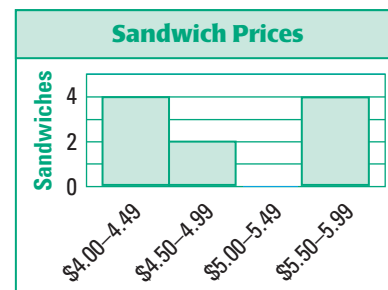
#### CHOOSE AN INTERVAL SIZE

To choose the interval size for a frequency table, divide the range of the data by the number of intervals you want the table to have. Use the quotient as an approximate interval size.

**STEP 1** Choose intervals of equal size that cover all of the data values. Organize the data using a frequency table.

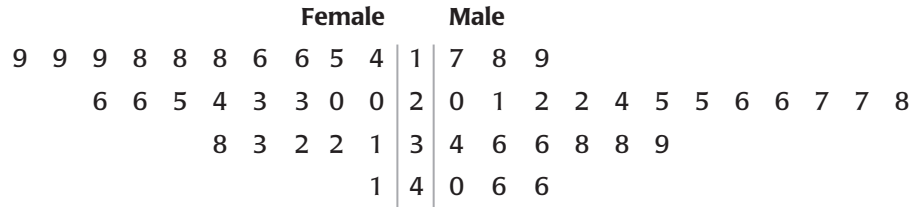
Prices	Sandwiches
\$4.00–4.49	
\$4.50–4.99	
\$5.00–5.49	
\$5.50–5.99	

**STEP 2** Draw the bars of the histogram using the intervals from the frequency table.



**✓** **GUIDED PRACTICE** for Examples 2 and 3

3. **TELEVISION** The back-to-back stem-and-leaf plot shows the percents of students in 24 countries who report watching television for 4 or more hours each day. Compare the data for female and male students.



Key: 4 | 1 | 7 = 14%, 17%

4. **PRECIPITATION** The average number of days each month with precipitation of 0.01 inch or more in Buffalo, New York, are 20, 17, 16, 14, 13, 11, 10, 10, 11, 12, 16, and 19. Make a histogram of the data.

## 10.4 EXERCISES

### HOMEWORK KEY

- = See **WORKED-OUT SOLUTIONS**  
Exs. 3 and 19
- ★ = **STANDARDIZED TEST PRACTICE**  
Exs. 2, 8, 9, 15, and 20

### SKILL PRACTICE

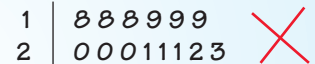
- VOCABULARY** Copy and complete: The number of data values in an interval is the   ?   of that interval.
- ★ **WRITING** Explain how a histogram differs from a bar graph.

**EXAMPLE 1**  
for Exs. 3–7

#### STEM-AND-LEAF PLOTS Make a stem-and-leaf plot of the data.

- 17, 31, 42, 33, 38, 20, 24, 30, 39, 38, 35, 20, 55
- 2, 8, 17, 7, 14, 20, 32, 5, 33, 6, 6, 8, 11, 9
- 121, 124, 133, 111, 109, 182, 105, 127, 156, 179, 142
- 1.23, 1.05, 1.11, 1.29, 1.31, 1.19, 1.45, 1.22, 1.19, 1.35

- ERROR ANALYSIS** Describe and correct the error in making a stem-and-leaf plot of the following data: 18, 19, 18, 19, 20, 20, 21, 22, 18, 19, 20, 21, 23, 21.



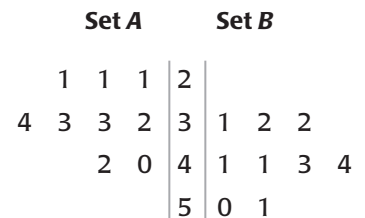
#### STEM-AND-LEAF PLOT In Exercises 8 and 9, consider the back-to-back stem-and-leaf plot that shows data sets A and B.

- ★ **MULTIPLE CHOICE** What is the median of data set A?

- (A) 21                      (B) 32  
(C) 33                      (D) 34

- ★ **MULTIPLE CHOICE** What is the range of data set B?

- (A) 18                      (B) 19  
(C) 20                      (D) 21

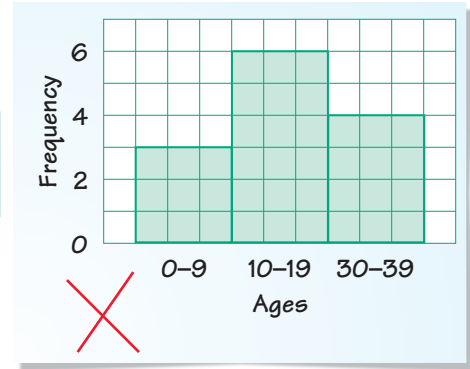


Key: 2 | 3 | 1 = 32, 31

**EXAMPLE 3**  
for Exs. 10–14

10. **ERROR ANALYSIS** Describe and correct the error in creating a histogram using the frequency table below.

Ages	0–9	10–19	20–29	30–39
Frequency				

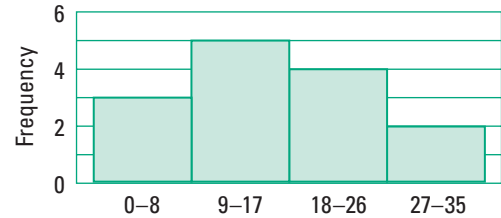


**HISTOGRAMS** Make a histogram of the data.

11. 55, 82, 94, 75, 61, 69, 77, 98, 81, 83, 75, 90, 51  
 12. 12, 0, 22, 31, 14, 7, 7, 45, 31, 28, 21, 25, 25, 18  
 13. 0.01, 0.13, 0.09, 1.10, 1.33, 0.99, 0.50, 0.95, 1.05, 1.50, 0.75, 1.01  
 14. 111, 109, 224, 657, 284, 120, 119, 415, 180, 105, 208, 108  
 15. **★ WRITING** Explain why a histogram can show the distribution of the data below better than a stem-and-leaf plot.

15, 21, 18, 10, 12, 11, 17, 18, 16, 12, 20, 12, 17, 16

16. **CHALLENGE** Create a stem-and-leaf plot that has the same distribution of data as the histogram shown. Explain the steps you took to create the stem-and-leaf plot.



**PROBLEM SOLVING**

**EXAMPLE 1**  
for Ex. 17

17. **HEIGHTS** The heights (in inches) of players on a boys' basketball team are as follows: 80, 76, 81, 69, 81, 78, 74, 68, 78, 74, 81, 72, 69, 81, 70. Make a stem-and-leaf plot of the heights.

**EXAMPLE 3**  
for Exs. 18–19

18. **SURVEY** A survey asked people how many 8 ounce glasses of water they drink in one day. The results are below. Make a histogram of the data.

3, 0, 9, 1, 4, 2, 11, 5, 3, 6, 0, 5, 7, 8, 5, 2, 9, 6, 10, 2, 4

19. **MEMORY** A survey asked people how many phone numbers they have memorized. The results are shown in the table.

Phone numbers	1–5	6–10	11–15	16–20	21–25
Frequency	88	85	50	28	14

- a. Make a histogram of the data.  
 b. What is the probability that a person surveyed, chosen at random, has 11–25 phone numbers memorized?

**EXAMPLE 2**  
for Ex. 20

20. **★ EXTENDED RESPONSE** The back-to-back stem-and-leaf plot shows the numbers of days the House of Representatives and the Senate spent in session each year from 1996 to 2004.

- What was the median number of days the House of Representatives spent in session? the Senate?
- What is the range of the number of days the House of Representatives spent in session? the Senate?
- Compare* the data for the House of Representatives and the Senate. What does the distribution of the data tell you?

		Days in Session			
House	Senate				
9	0	11			
3	2	12			
7	5	3	2	13	2 3
		2	14	1	3 9
		15			3
		16	2		
		17			3

**Key:** 2 | 14 | 1 = 142, 141

21. **MAYFLOWER** The known ages (in years) of adult male passengers on the *Mayflower* at the time of its departure are listed below.

21, 34, 29, 38, 30, 54, 39, 20, 35, 64, 37, 45, 21, 25,  
55, 45, 40, 38, 38, 21, 21, 20, 34, 38, 50, 41, 48, 18,  
32, 21, 32, 49, 30, 42, 30, 25, 38, 25, 20

- Make a stem-and-leaf plot of the ages.
- Find the median age and range of the ages.
- According to one source, the age of passenger Thomas English was unknown at the time of the *Mayflower's* departure. What is the probability that he was 18–29 years old? *Explain* your reasoning.



**Replica of the *Mayflower***

22. **CHALLENGE** The first two rows of a *cumulative frequency table* for the data in Exercise 21 are shown. The *cumulative frequency* for a given interval is the sum of the current frequency and all preceding frequencies. A histogram constructed from a cumulative frequency table is called a *cumulative frequency histogram*. Copy and complete the table. Then make a cumulative frequency histogram for the data.

Ages	Frequency	Cumulative frequency
15–24	9	9
25–34	11	9 + 11 = 20
?	?	?



Use appropriate tools strategically.

# Draw Histograms

**QUESTION** How can you use a graphing calculator to make a histogram?

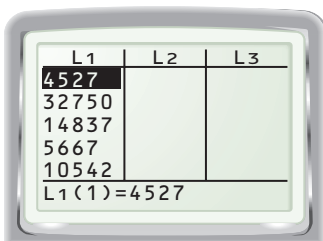
**EXAMPLE** Make a histogram

**POPULATION** The populations (in thousands) of metropolitan areas in the states with the greatest metropolitan populations in the United States in 2000 are listed below. Make a histogram of the data.

4527 32,750 14,837 5667 10,542 4390 4911 6101 8169 3795 8414  
17,473 5437 9214 10,392 3862 17,692 5528 4899 3640

**STEP 1** Enter the data

Go to the STAT menu and choose Edit. Enter the data into List 1.



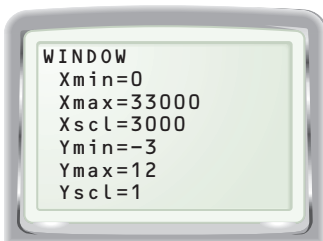
**STEP 2** Select histogram

Go to the STAT PLOT screen. Select Plot 1. Use the settings shown below.



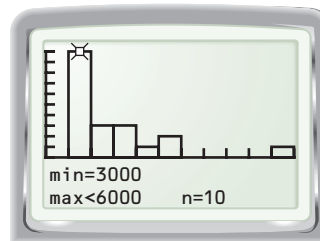
**STEP 3** Set the viewing window

Go to the WINDOW screen. Use the settings shown below.



**STEP 4** Graph

Press **GRAPH**. Use the trace feature to move from bar to bar.



**DRAW CONCLUSIONS**

- Describe the distribution of the population data in the example above.
- BOWLING** Use a graphing calculator to make a histogram of the following bowling scores: 200, 210, 105, 300, 180, 175, 162, 110, 140, 300, 152, 165, 175, 115, 250, 270, 145, 182, 164, 122, 141, 135, 189, 170, 151, 158.