

## 2.2: Display Data

### Stem-and-Leaf Graphs (Stemplots), Line Graphs, and Bar Graphs

One simple graph, the **stem-and-leaf graph** or **stemplot**, comes from the field of exploratory data analysis. It is a good choice when the data sets are small. To create the plot, divide each observation of data into a stem and a leaf. The leaf consists of a **final significant digit**. For example, 23 has stem two and leaf three. The number 432 has stem 43 and leaf two. Likewise, the number 5,432 has stem 543 and leaf two. The decimal 9.3 has stem nine and leaf three. Write the stems in a vertical line from smallest to largest. Draw a vertical line to the right of the stems. Then write the leaves in increasing order next to their corresponding stem.

#### ✓ Example 2.2.1

For Professor Dean's spring pre-calculus class, scores for the first exam were as follows (smallest to largest):  
33; 42; 49; 49; 53; 55; 55; 61; 63; 67; 68; 68; 69; 69; 72; 73; 74; 78; 80; 83; 88; 88; 88; 90; 92; 94; 94; 94; 94; 96; 100

Table 2.2.1

Stem	Leaf
3	3
4	2 9 9
5	3 5 5
6	1 3 7 8 8 9 9
7	2 3 4 8
8	0 3 8 8 8
9	0 2 4 4 4 4 6
10	0

#### Solution

The stemplot shows that most scores fell in the 60s, 70s, 80s, and 90s. Eight out of the 31 scores or approximately 26% ( $\frac{8}{31}$ ) were in the 90s or 100, a fairly high number of As.

#### 🔧 Try It 2.2.1

For the Park City basketball team, scores for the last 30 games were as follows (smallest to largest):  
32; 32; 33; 34; 38; 40; 42; 42; 43; 44; 46; 47; 47; 48; 48; 48; 49; 50; 50; 51; 52; 52; 52; 52; 53; 54; 56; 57; 57; 60; 61

Construct a stem plot for the data.


The stemplot is a quick way to graph data and gives an exact picture of the data. You want to look for an overall pattern and any outliers. An outlier is an observation of data that does not fit the rest of the data. It is sometimes called an **extreme value**. When you graph an outlier, it will appear not to fit the pattern of the graph. Some outliers are due to mistakes (for example, writing down 50 instead of 500) while others may indicate that something unusual is happening. It takes some background information to explain outliers, so we will cover them in more detail later.

#### ? Exercise 2.2.1

The data are the distances (in kilometers) from a home to local supermarkets. Create a stemplot using the data:  
1.1; 1.5; 2.3; 2.5; 2.7; 3.2; 3.3; 3.3; 3.5; 3.8; 4.0; 4.2; 4.5; 4.5; 4.7; 4.8; 5.5; 5.6; 6.5; 6.7; 12.3

### Problem

Do the data seem to have any concentration of values?

 **Note** The leaves are to the right of the decimal.

### Answer

The value 12.3 may be an outlier. Values appear to concentrate at three and four kilometers.

Table 2.2.2

Stem	Leaf
1	1 5
2	3 5 7
3	2 3 3 5 8
4	0 2 5 5 7 8
5	5 6
6	5 7
7	
8	
9	
10	
11	
12	



### Solution

The value 12.3 may be an outlier. Values appear to concentrate at three and four kilometers.

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

Stem	Leaf
12	3

Table 2.2

### Try It 2.2.2

The following data show the distances (in miles) from the homes of off-campus statistics students to the college. Create a stem plot using the data and identify any outliers:

0.5; 0.7; 1.1; 1.2; 1.2; 1.3; 1.3; 1.5; 1.5; 1.7; 1.7; 1.8; 1.9; 2.0; 2.2; 2.5; 2.6; 2.8; 2.8; 2.8; 3.5; 3.8; 4.4; 4.8; 4.9; 5.2; 5.5; 5.7; 5.8; 8.0

### ? Exercise 2.2.2

A **side-by-side stem-and-leaf plot** allows a comparison of the two data sets in two columns. In a side-by-side stem-and-leaf plot, two sets of leaves share the same stem. The leaves are to the left and the right of the stems. Table 2.2.4 and Table 2.2.5 show the ages of presidents at their inauguration and at their death. Construct a side-by-side stem-and-leaf plot using this data.

Table 2.2.4: Age of US Presidents when inaugurated

President	Age	President	Age	President	Age
Washington	57	Lincoln	52	Hoover	54
J. Adams	61	A. Johnson	56	F. Roosevelt	51
Jefferson	57	Grant	46	Truman	60
Madison	57	Hayes	54	Eisenhower	62
Monroe	58	Garfield	49	Kennedy	43
J. Q. Adams	57	Arthur	51	L. Johnson	55
Jackson	61	Cleveland	47	Nixon	56
Van Buren	54	B. Harrison	55	Ford	61
W. H. Harrison	68	Cleveland	55	Carter	52
Tyler	51	McKinley	54	Reagan	69
Polk	49	T. Roosevelt	42	G.H.W. Bush	64
Taylor	64	Taft	51	Clinton	47
Fillmore	50	Wilson	56	G. W. Bush	54
Pierce	48	Harding	55	Obama	47
Buchanan	65	Coolidge	51		

Table 2.2.4: Age of US Presidents at death

President	Age	President	Age	President	Age
Washington	67	Lincoln	56	Hoover	90
J. Adams	90	A. Johnson	66	F. Roosevelt	63
Jefferson	83	Grant	63	Truman	88
Madison	85	Hayes	70	Eisenhower	78

President	Age	President	Age	President	Age
Monroe	73	Garfield	49	Kennedy	46
J. Q. Adams	80	Arthur	56	L. Johnson	64
Jackson	78	Cleveland	71	Nixon	81
Van Buren	79	B. Harrison	67	Ford	93
W. H. Harrison	68	Cleveland	71	Reagan	93
Tyler	71	McKinley	58		
Polk	53	T. Roosevelt	60		
Taylor	65	Taft	72		
Fillmore	74	Wilson	67		
Pierce	64	Harding	57		
Buchanan	77	Coolidge	60		

## Answer

Table 2.2.5:

Ages at Inauguration		Ages at Death
9 9 8 7 7 7 6 3 2	4	6 9
8 7 7 7 7 6 6 6 5 5 5 5 4 4 4 4 2 2 1 1 1 1 1 0	5	3 6 6 7 7 8
9 8 5 4 4 2 1 1 1 0	6	0 0 3 3 4 4 5 6 7 7 7 8
	7	0 1 1 1 2 3 4 7 8 8 9
	8	0 1 3 5 8
	9	0 0 3 3



## Solution

Ages at Inauguration		Ages at Death
9 9 8 7 7 7 6 3 2	4	6 9
8 7 7 7 7 6 6 6 5 5 5 5 4 4 4 4 2 2 1 1 1 1 1 0	5	3 6 6 7 7 8
9 8 5 4 4 2 1 1 1 0	6	0 0 3 3 4 4 5 6 7 7 7 8
	7	0 1 1 1 2 3 4 7 8 8 9
	8	0 1 3 5 8
	9	0 0 3 3

Table 2.5

### Try It 2.2.3

The table shows the number of wins and losses the Atlanta Hawks have had in 42 seasons. Create a side-by-side stem and-leaf plot of these wins and losses.

Table 2.2.6: Atlanta Hawks wins and losses in 42 seasons

Losses	Wins	Season	Losses	Wins	Season
34	48	1	41	41	22
34	48	2	39	43	23
46	36	3	44	38	24
46	36	4	39	43	25
36	46	5	25	57	26
47	35	6	40	42	27
51	31	7	36	46	28
53	29	8	26	56	29
51	31	9	32	50	30
41	41	10	19	31	31
36	46	11	54	28	32
32	50	12	57	25	33
51	31	13	49	33	34
40	42	14	47	35	35
39	43	15	54	28	36
42	40	16	69	13	37
48	34	17	56	26	38
32	50	18	52	30	39
25	57	19	45	37	40
32	50	20	35	47	41
30	52	21	29	53	42

Table 2.6

Another type of graph that is useful for specific data values is a **line graph**. In the particular line graph shown in Exercise 2.2.3, the **x-axis** (horizontal axis) consists of **data values** and the **y-axis** (vertical axis) consists of **frequency points**. The frequency points are connected using line segments.

### ✓ Example 2.2.2

In a survey, 40 parents were asked how many times per week a teenager must be reminded to do their chores. The results are shown in Table 2.2.7 and in Figure 2.2.1

Table 2.2.7

Number of times teenager is reminded	Frequency
0	2

Number of times teenager is reminded	Frequency
1	5
2	8
3	14
4	7
5	4

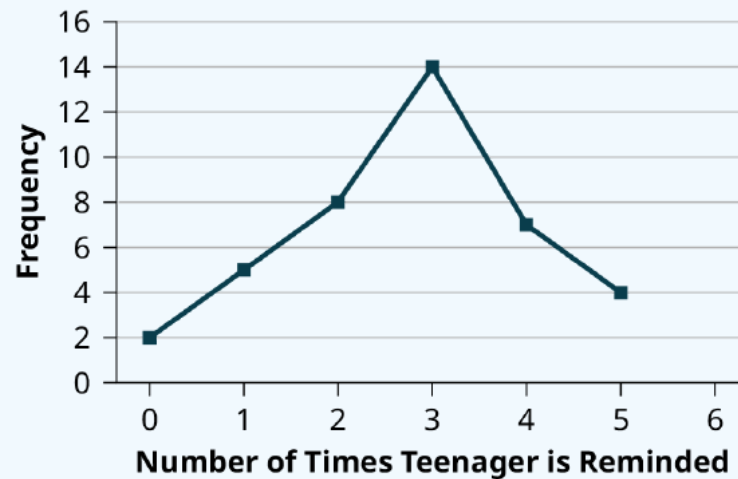


Figure 2.2.1

#### Try It 2.2.4

In a survey, 40 people were asked how many times per year they had their car in the shop for repairs. The results are shown in Table 2.2.8. Construct a line graph.

Table 2.2.8

Number of times in shop	Frequency
0	7
1	10
2	14
3	9

**Bar graphs** consist of bars that are separated from each other. The bars can be rectangles or they can be rectangular boxes (used in three-dimensional plots), and they can be vertical or horizontal. The **bar graph** shown in [Example 2.5](#) has age groups represented on the **x-axis** and proportions on the **y-axis**.

#### Exercise 2.2.3

The percentage of U.S.-based TikTok users by age is shown in Table 2.2.9. Construct a bar graph using this data.

Table 2.2.9

Age groups	Proportion (%) of TikTok users
10–19	32.5%
20–29	29.5%

Age groups	Proportion (%) of TikTok users
30–39	16.4%
40–49	13.9%
50+	7.1%

Answer

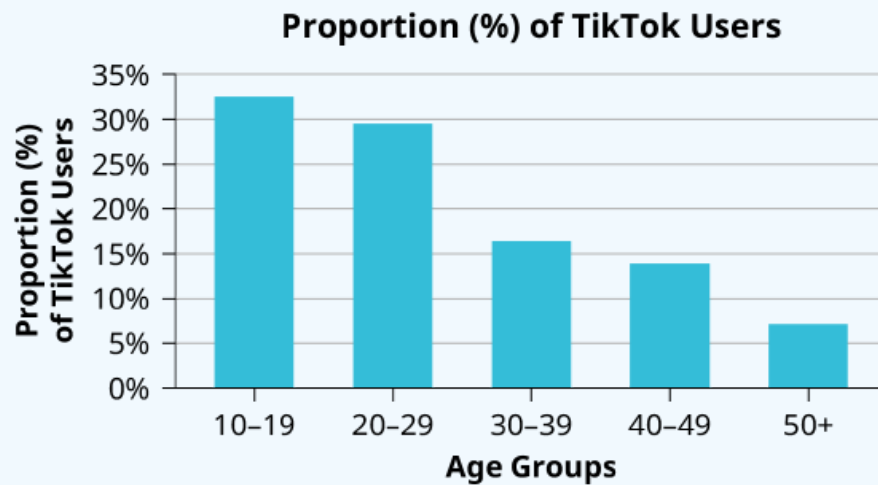


Figure 2.2.2

### Solution

Bar graph of age groups against percentage of TikTok users. The percentage ranges from 0 to 35 in increments of 5. Bar of age group 10 to 19 has height of 32 percent, 20 to 29 has height of 29 percent, 30 to 39 has height of 16 percent, 40 to 49 has height of 14 percent, 50 plus has height of 7 percent.

Figure 2.3

### Try It 2.2.5

The population in Park City is made up of children, working-age adults, and retirees. Table 2.2.10 shows the three age groups, the number of people in the town from each age group, and the proportion (%) of people in each age group. Construct a bar graph showing the proportions.

Age groups	Number of people	Proportion of population
Children	67,059	19%
Working-age adults	152,198	43%
Retirees	131,662	38%

Table 2.10

### ? Exercise 2.2.1

The columns in Table 2.2.11 show the projected data for the year 2030 for the number and percentages of high school graduates by geographic region in the United States. Create a bar graph for this data with the geographic region (qualitative data) on the x-axis and the percentage of high school data (quantitative data) on the y-axis.

Table 2.2.11

Region	Number of Graduates	Percentage of Graduates
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Region	Number of Graduates	Percentage of Graduates
Northeast	517,720	16.1%
Midwest	695,170	21.6%
South	1,253,540	39.0%
West	749,400	23.3%

**Answer**

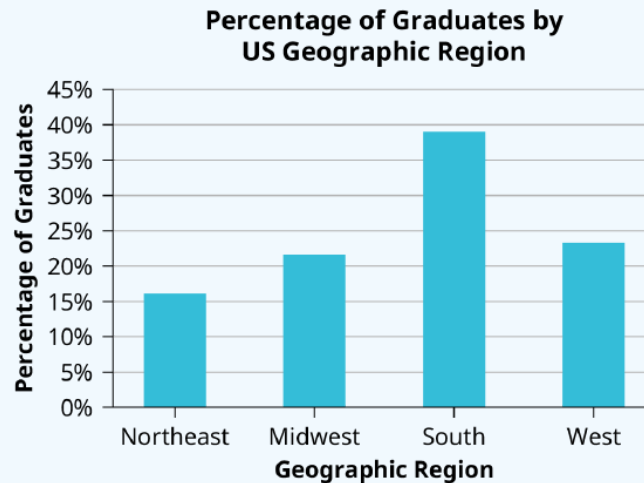


Figure 2.2.3:

### Solution

Bar graph of geographic region against percentage of graduates. Percent of graduates ranges from 0 to 45 in increments of 5. Bar of northeast has height of 16 percent, midwest has height of 22 percent, south has height of 39 percent, west has height of 23 percent.

Figure 2.4

### Try It 2.2.1

Park city is broken down into six voting districts. The table shows the percent of the total registered voter population that lives in each district as well as the percent total of the entire population that lives in each district. Construct a bar graph that shows the registered voter population by district.

Table 2.2.12

District	Registered voter population	Overall city population
1	15.5%	19.4%
2	12.2%	15.6%
3	9.8%	9.0%
4	17.4%	18.5%
5	22.8%	20.7%
6	22.3%	16.8%

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