$$\text{Upper Boundary of Class 1: } \frac{2.9+3.0}{2} = 2.95$$

$$\text{Midpoint of Class 1: } \frac{1.0+2.9}{2} = 1.95$$

Use the class width to find the other class boundaries and midpoints. To find the relative frequency, divide the frequency of each class by the number of data values, 18. The cumulative frequency is the rolling total of the class frequencies. The final frequency table with all of the values listed is shown below.

Memory Booster

Relative frequency is a ratio that relates a class to the whole.

Cumulative frequency is a running total of the number of data values.

Numbers of Miles Professors Drive to Work Each Day

Class	Frequency	Class Boundaries	Midpoint	Relative Frequency	Cumulative Frequency
1.0–2.9	3	0.95–2.95	1.95	$\frac{3}{18} = \frac{1}{6} = 0.1\overline{6} \approx 17\%$	3
3.0–4.9	3	2.95–4.95	3.95	$\frac{3}{18} = \frac{1}{6} = 0.1\overline{6} \approx 17\%$	6
5.0–6.9	4	4.95–6.95	5.95	$\frac{4}{18} = \frac{2}{9} = 0.\overline{2} \approx 22\%$	10
7.0–8.9	2	6.95–8.95	7.95	$\frac{2}{18} = \frac{1}{9} = 0.\overline{1} \approx 11\%$	12
9.0–10.9	4	8.95–10.95	9.95	$\frac{4}{18} = \frac{2}{9} = 0.\overline{2} \approx 22\%$	16
11.0–12.9	2	10.95–12.95	11.95	$\frac{2}{18} = \frac{1}{9} = 0.\overline{1} \approx 11\%$	18

Using the relative frequencies of each class, we can see that the data is somewhat evenly spread through the classes since no single class has more than 22% of the data in it. In other words, the driving distance for professors is not a consistent distance. The cumulative frequencies show that more than half of the data is in the first 3 classes. In fact, 10/18 of the professors surveyed travel less than 7 miles each day.

2.1 Section Exercises

Characteristics of Frequency Distributions

For Exercises 1–10, find the following for each frequency distribution.

a. Class width
b. Class boundaries for each class
c. Midpoint of each class
d. Relative frequency for each class
e. Cumulative frequency for each class

1.

Braking Times for Vehicles at 60 mph (in Minutes)

Class	Frequency
0.05–0.07	12
0.08–0.10	15
0.11–0.13	14
0.14–0.16	15
0.17–0.19	14

2.

Ages of Taste-Test Participants (in Years)	
Class	**Frequency**
15–19	7
20–24	8
25–29	10
30–34	2
35–39	3

3.

Age at Time of First Marriage (in Years)	
Class	**Frequency**
15–18	2
19–22	5
23–26	4
27–30	5
31–34	4

4.

Hourly Wage at First Job (in Dollars)	
Class	**Frequency**
7.50–8.49	12
8.50–9.49	50
9.50–10.49	48
10.50–11.49	45
11.50–12.49	34

5.

Cost of a 12 oz Soda (in Dollars)	
Class	**Frequency**
0.25–0.49	2
0.50–0.74	15
0.75–0.99	12
1.00–1.24	5
1.25–1.49	9

6.

Ages of Survey Participants (in Years)	
Class	**Frequency**
15–24	9
25–34	8
35–44	12
45–54	1
55–64	3

7.

Ages of First-Time Home Buyers (in Years)	
Class	**Frequency**
18–24	2
25–31	7
32–38	4
39–45	15
46–52	3

8.

Hourly Wages of Surveillance Operators (in Dollars)	
Class	**Frequency**
10.50–11.49	92
11.50–12.49	78
12.50–13.49	68
13.50–14.49	45
14.50–15.49	34

9.

Age at Time of First Car Purchase (in Years)	
Class	**Frequency**
16–19	12
20–23	8
24–27	15
28–31	12
32–35	9

10.

Grades on a Difficult Test	
Class	**Frequency**
A	2
B	5
C	7
D	13
F	10

Complete the frequency distribution that has been started for each set of data.

11. The following data describe the heights, in inches, of 30 volunteers for a bone density study.

72.8	71.2	70.3	73.4	72.6	74.1
70.9	71.6	72.1	74.6	75.0	72.0
69.1	69.5	72.6	72.4	73.6	75.1
71.8	71.6	71.9	70.9	70.2	69.3
72.1	72.3	72.5	73.4	74.0	75.0

Heights of Volunteers (in Inches)

Class	Frequency
69.0–69.9	3
70.0–70.9	
71.0–71.9	
72.0–72.9	
73.0–73.9	
74.0–74.9	
75.0–75.9	

12. The following data represent the number of exercises at the end of various sections in a traditional college algebra textbook.

145	137	138	112	137	100	78	127	97
70	143	133	150	124	115	110	45	141
119	92	84	94	105	71	95	117	104

Number of Section Exercises

Class	Frequency
40–59	
60–79	
80–99	
100–119	
120–139	
140–159	

13. At a state fair, one game involves guessing the number of marbles in a glass jar. The following data represent the guesses that people made during one hour at the state fair.

1234	1645	1469	1467	1549	1348	1671	1300	1200	1199
1621	1547	1501	1410	1487	1299	1500	1688	1301	1399

Number of Marbles in the Jar

Class	Frequency
1100–1199	
1200–	
1300–1399	4
	4
1500–1599	
1600–	4

14. The following data represent the amounts of pocket change, in dollars, in the pockets of a sample of business professionals in an office building.

0.23	0.52	0.76	0.79	0.8	0.21	0.13
1.05	1.24	1.15	1.10	0.98	0.28	0.64
1.34	0.38	0.31	0.42	0.41	0.24	1.42

Amount of Pocket Change (in Dollars)

Class	Frequency
–0.24	4
0.25–0.49	
0.50–	2
0.75–0.99	
–1.24	4
1.25–1.49	

Create a frequency distribution with the indicated number of classes for each set of data. Include the frequency, class boundaries, midpoint, relative frequency, and cumulative frequency of each class.

15. The following data represent the numbers of curl-ups completed in 60 seconds for a group of 16 eight-year-old children. Use six classes that have a class width of 5. Begin with a lower class limit of 15.

31	34	41	36	27	29	18	33
31	28	34	22	26	28	36	42

16. The following data represent times in minutes for completing a one mile run/walk from a group of 24 teenagers. Use six classes that have a class width of 2.00. Begin with a lower class limit of 6.00.

15.23	13.52	11.35	11.15	12.20	9.90	10.37	14.05
10.02	17.35	8.33	8.05	9.87	9.28	10.62	6.65
9.55	10.23	13.93	10.97	9.75	12.85	12.82	10.93

17. The following data represent the caloric intakes in one day for a group of 15 people between the ages of 20 and 39. Use five classes that have a class width of 400. Begin with a lower class limit of 1800.

2700	2200	2500	2800	2600
3000	2600	2200	3100	2800
1800	3500	2500	3000	2900

18. The following data represent the precipitation totals in inches for the month of September in 21 different towns in Alaska. Use six classes that have a class width of 3.50. Begin with a lower class limit of 0.00.

2.7	1.72	1.39	6.88	2.59	2.04	2.43
9.28	1.06	3.29	1.57	4.23	0.95	8.37
0.6	4.41	6.73	1.92	2.28	2.74	18.65

19. The following data represent the numbers of days absent from school in one school year for each of the 24 students in Ms. Jinn's fourth grade class. Use six classes that have a class width of 5 days. Begin with a lower class limit of 0.

17	8	12	3	0	5	13	12
25	10	6	8	11	0	1	4
19	21	22	9	16	9	3	2

20. The following data represent the weights in pounds of 24 collegiate offensive linemen in a particular state. Use six classes that have a class width of 25 pounds. Begin with a lower class limit of 175.

195	210	255	267	231	229	301	199
178	281	245	256	278	205	217	223
279	196	235	248	262	291	302	189

Use the given frequency distribution to answer the questions.

21.

Amounts of Weight (in Pounds) Lost Following a Low-Carbohydrate Diet

Weight Lost	Number of Women
1–5	4
6–10	8
11–15	11
16–20	3
21–25	0
26–30	1

a. How many participants were involved in the study?

b. How much weight did most participants lose?

c. What percentage of participants lost more than 15 pounds?

d. How long did the study last?

e. What is the lower class limit of the 4^{th} class?

f. What is the midpoint for the 1^{st} class?

g. If you were writing an article about this study, what would be your headline? Justify your response.

22.

Grams of Sugar per Serving in Children's Breakfast Cereal

Class	Frequency
10.00–11.99	21
12.00–13.99	19
14.00–15.99	11
16.00–17.99	18
18.00–19.99	18

a. How big was the original data set?

b. What percentage of the data fell in the 3^{rd} class?

c. Estimate the average value of the data in the highest class.

d. Based on this distribution, do you believe that children's breakfast cereal contains too much sugar? Justify your response.

23. The frequency distribution shows the ages of students volunteering at a local animal shelter.

Ages of Student Volunteers (in Years)

Class	Frequency
10–12	5
13–15	9
16–18	2
19–21	11
22–24	6

a. What is the relative frequency for the 4th class?

b. What is the cumulative frequency for ages 18 and under?

c. What is the upper class boundary for the 2nd class?

d. What is the class width?

e. What percentage of the student volunteers were between the ages 19 and 24?

f. How many students were surveyed?

g. What was the youngest age of the students surveyed?

24.

Distribution of Attitudes Toward College Success

Scale	Freshmen	Sophomores	Juniors	Seniors	Graduate Students
1.0–1.9	11	10	2	9	19
2.0–2.9	3	2	5	5	1
3.0–3.9	15	2	3	11	1
4.0–4.9	11	15	1	1	10
5.0–5.9	6	7	8	11	12
6.0–6.9	16	9	17	16	16
7.0–7.9	5	19	1	17	5
8.0–8.9	3	5	19	14	17
9.0–9.9	5	11	1	14	10
10.0–10.9	9	3	4	15	7

a. How many students were surveyed for the study?

b. What percentage of sophomores gave a response smaller than 5?

c. How many people gave a response in the 9th class?

d. What percentage of respondents were graduate students?

e. Does this table easily display patterns in the data? In what ways might this data be better displayed?

25. Below is an example of a frequency distribution produced by a statistical software package called SPSS. Use it to answer the following questions.

Statistics

Respondent's Ethnicity

N	Valid	936
	Missing	4

Respondent's Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	White	476	50.6	50.9	50.9
	Black or African American	74	7.9	7.9	58.8
	Asian	123	13.1	13.1	71.9
	Hispanic	198	21.1	21.2	93.1
	American Indian or Alaska Native	4	.4	.4	93.5
	Race and Ethnicity Unknown	61	6.5	6.5	100.0
	Total	936	99.6	100.0	
Missing	System	4	.4		
Total		940	100.0		

a. How many respondents gave their ethnicities?

b. What percentage of respondents were American Indian or Alaska Native?

c. What percentage of respondents who gave their ethnicities were White?

d. If you were to describe the racial diversity, or lack thereof, for this population, what would you say?