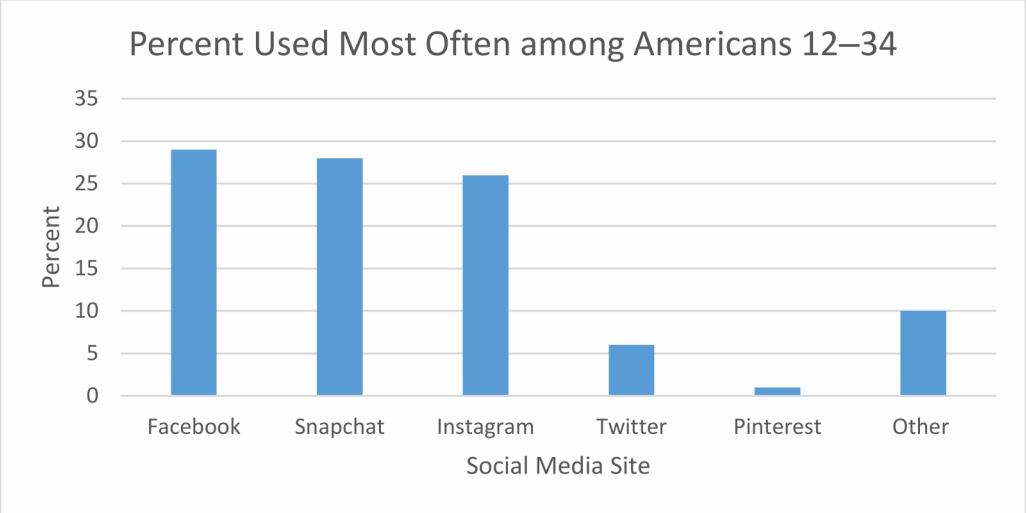
Chapter 1 – Picturing Distributions with Graphs

1.1 (a) The individuals are the car makes and models.
(b) For each individual, the variables recorded are vehicle class (categorical), transmission type (categorical), number of cylinders (usually treated as quantitative), city mpg (quantitative), highway mpg (quantitative), and annual fuel cost in dollars (quantitative).

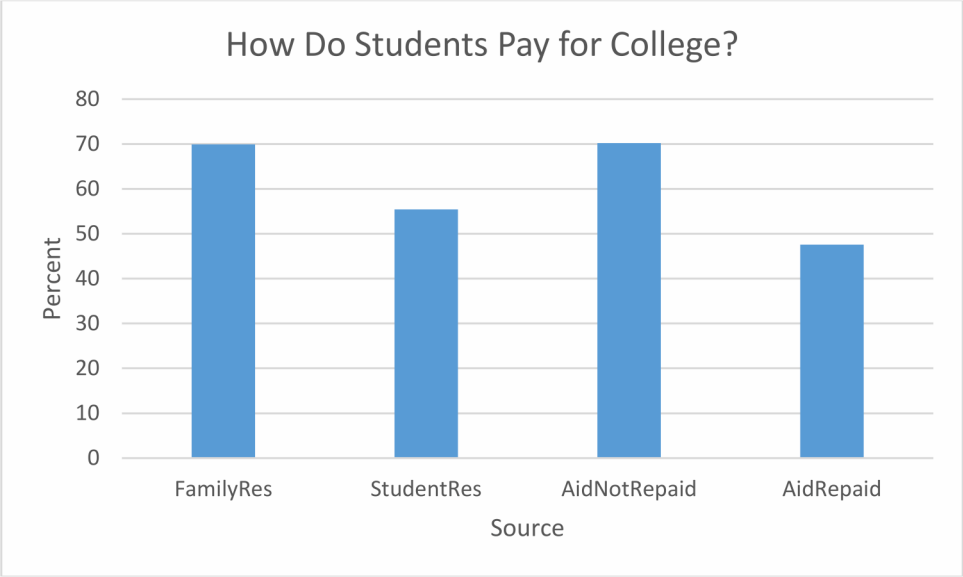
1.2 Answers will vary. Some possible categorical variables: whether or not the student plays sports; gender; whether or not the student smokes; and attitude about exercise. Some possible quantitative variables: weight (kilograms or pounds), height (centimeters or inches); resting heart rate (beats per minute); and body mass index (kg/m^2 or lb/ft^2).

1.3 (a) 90% use these top social media sites; 10% use other sites most often.
(b) A bar graph is provided.

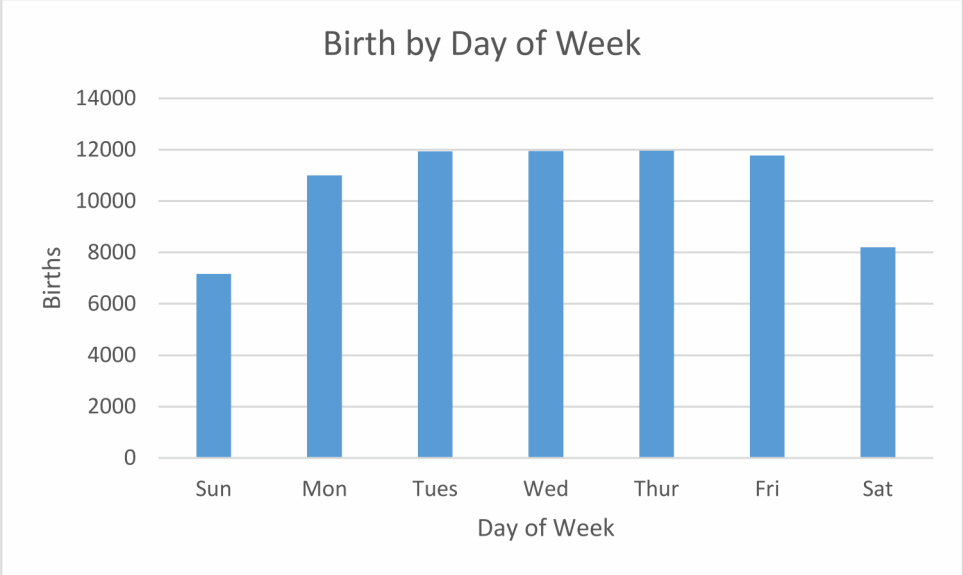


(c) If you include an "Other" category, then a pie chart is appropriate. This survey asked about the site used most often, so each individual is represented in only one category, and the categories make up the whole.
(d) Answers will vary. Some questions would be, "Through which social media site should a particular company market its product?" and "Through which social media site should a politician market his or her campaign to reach the target audience in this age group?"

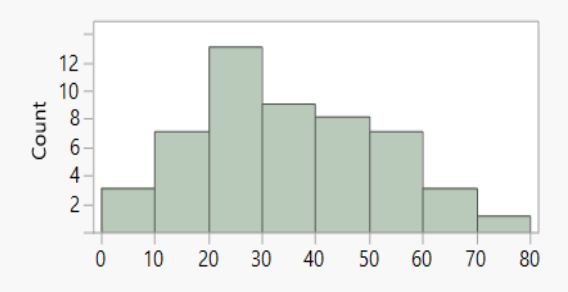
1.4 (a) Individuals fall into more than one of the categories.
(b) A bar graph is shown.



1.5 A pie chart can be made because the days are non-overlapping and make up the whole. Some births are scheduled (induced labor, for example), and probably, most are scheduled for weekdays.



1.6 Make this histogram by hand, as the instructions suggest.



1.7 Use the applet to answer these questions.

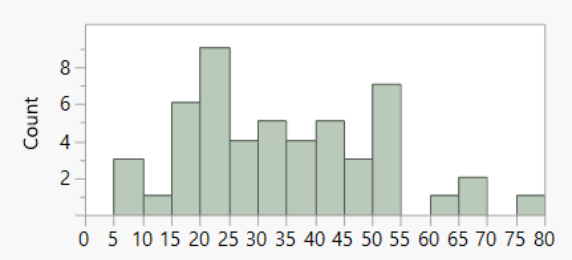
1.8 The distribution is slightly right-skewed. The center is between 30% and 40% (23 states have less than 30% minority residents, and another 10 states have between 30% and 40%). The statewide percents range from about 0% to about 80%. No states have an unusually large or small percent of minority residents.

1.9 (a) There are two clear peaks in the distribution. If we gave only one center, it would most likely be between these and would not be truly representative.
(b) Young boys might spend a lot of time outdoors playing; their time outside in places where they would encounter ticks might well be less in younger adulthood. With families and yard work, their time outside might increase.
(c) No, this is incorrect. Hiking in the woods at any age will make a person more likely to encounter the ticks that spread Lyme disease.
(d) The histograms have the same shapes, but females have a slightly lower incidence rate until age 75, after which females have a slightly higher rate. Possibly, females under age 75 spend less time outdoors in areas where they would encounter ticks.

1.10 (a) A stemplot is provided. With a single stem, the distribution appeared unimodal. After the stems are split, it appears bimodal.

```
0 | 889
1 | 1
1 | 556789
2 | 022333333
2 | 6778
3 | 01114
3 | 5799
4 | 01112
4 | 588
5 | 1112234
5 |
6 | 1
6 | 77
7 |
7 | 5
```

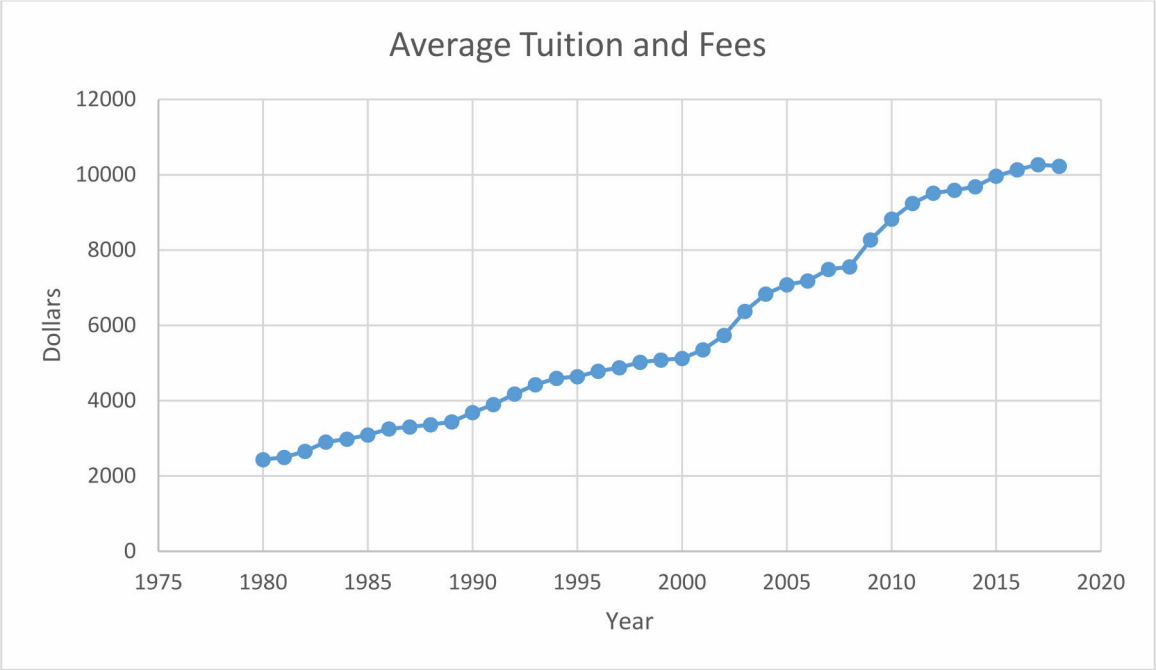
(b) The histogram with bins of width 5 will give the same pattern as the stemplot from part (a).



1.11 Here is a stemplot for health expenditure per capita (in PPP). Data are rounded to units of hundreds. For example, Argentina's 1390 becomes 14. Stems are thousands and are split, as prescribed. This distribution is right-skewed, with a single high outlier (United States). There seem to be two clusters of countries. The center of this distribution is around 26 ($2600 spent per capita). The distribution varies from 0|1 (about $100 spent per capita) to 9|5 (about $9500 spent per capita).

```
0 | 1224
0 | 689
1 | 0113444
1 | 7
2 | 4
2 | 6
3 | 124
3 |
4 | 14
4 | 5568
5 | 11334
5 |
6 | 2
6 |
7 |
7 | 6
8 |
8 |
9 |
9 | 5
```

1.12 (a) A time plot of average tuition and fees is given.



(b) The average spent on tuition and fees has steadily climbed during the 38-year period, with the sharpest absolute increases between 2008 and 2012.
(c) The average spent on tuition and fees decreased slightly from 2017 to 2018 (as shown in this plot), and there have been periods of very small increases (1995–2000 and 2012–2014, for example). There are two periods of very rapid increases: 2000–2005 and 2008–2012.
(d) It would be better to use percent increases rather than dollar increases. A 10% increase in average tuition and fees in 1980 should correspond to a 10% increase in average tuition and fees in 2005, but the absolute dollar increases in these cases are very different.

1.13 (a) the students.

1.14 (c) a bar graph but not a pie chart. Individuals could belong to more than one category.

1.15 (b) Square footage and average monthly gas bill are both quantitative variables.

1.16 (b) categorical variable. Zip codes are equivalent to town (or zone) names or identifications, and you can't do arithmetic meaningfully with them.

1.17 (b) 90% to 92%.

1.18 (b) 2, 3, 4, 5, 6, 7, 8, 9.

1.19 (b) 73.5%. There are 50 observations, so the center would be between the 25th and 26th observations, namely 73 and 74.

1.20 (a) skewed to the left.

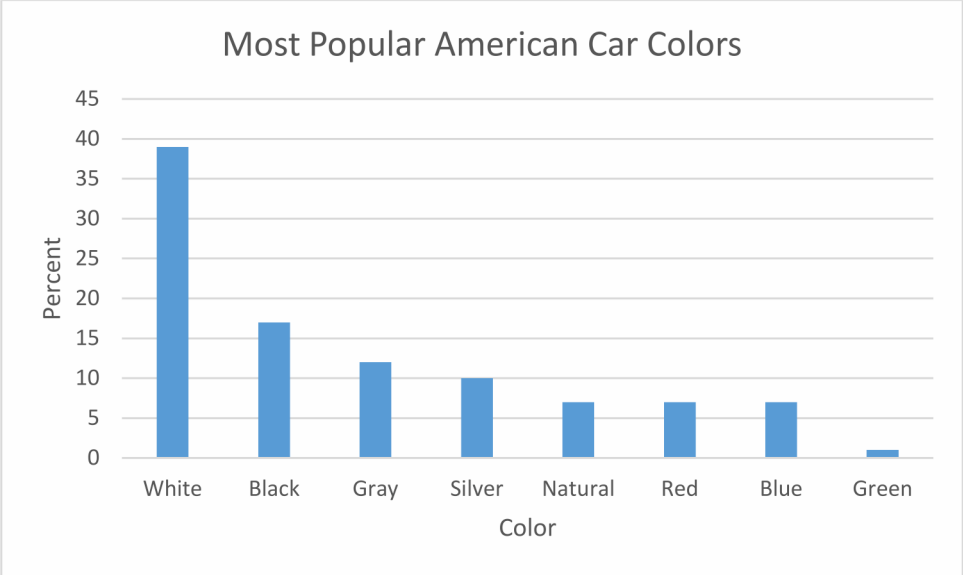
1.21 (c) 33% enrolled. The stems are rounded to whole percents; you cannot make finer judgments.

1.22 (c) skewed to the right.

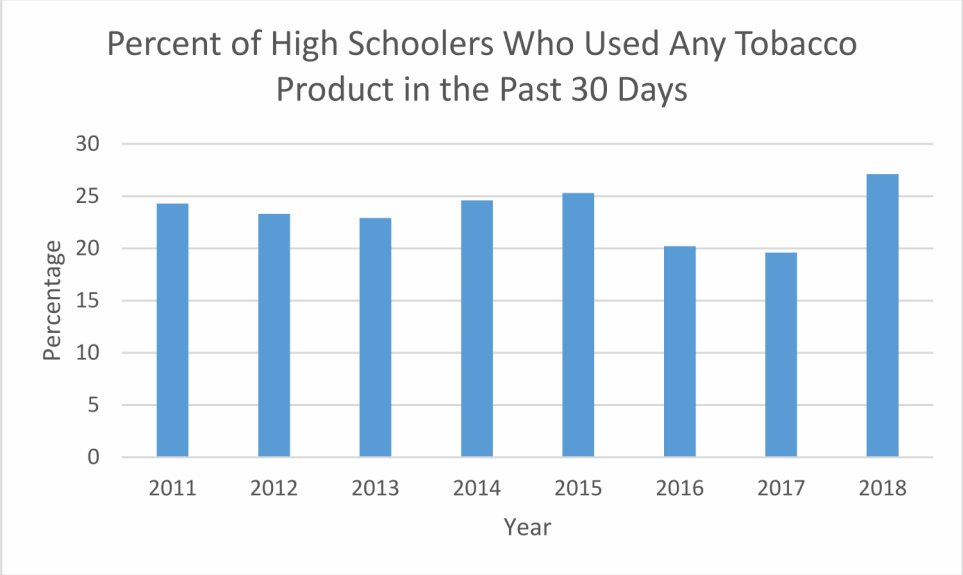
1.23 (a) Individuals are students who have finished medical school.
(b) Five, in addition to "Name." "Age" (in years) and "USMLE" (in score points) are quantitative. The others are categorical.

1.24 The categorical variables are freezer type and Energy Star compliant (yes/no). The quantitative variables are annual energy consumption (kw), width (in.), depth (in.), height (in.), freezer capacity (ft^3), and refrigerator capacity (ft^3). The individuals are the refrigerator makes and models.

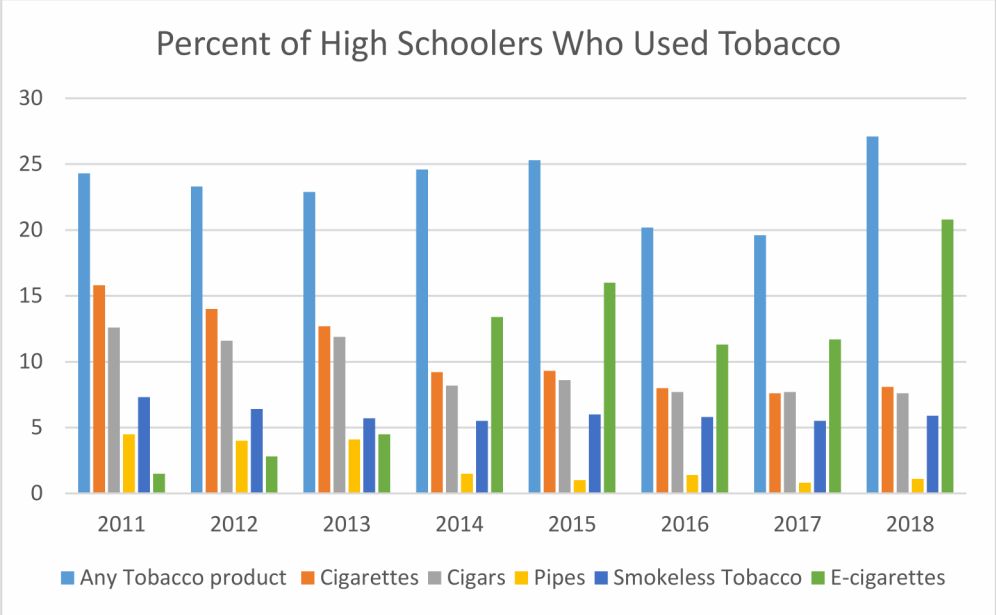
1.25 "Green" should account for 1%. A bar graph would be an appropriate display. If you included the "Green" category, a pie chart could also be made.



1.26 (a) A bar graph for the percent who used any tobacco product is given. The percent stayed relatively constant between 2011 and 2015, with a slight decrease from 2011 to 2013. Then there was a sharp decrease for 2016 and 2017, followed by an even larger increase from 2017 to 2018.

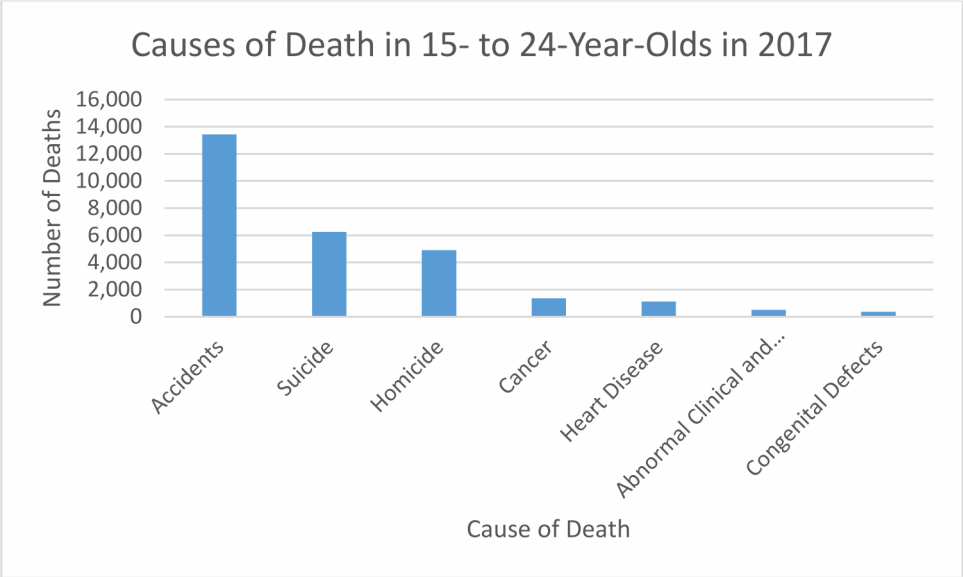


(b) See the bar chart given.



(c) The plot in part (b) shows that the recent increase in tobacco usage is due to a drastic increase in the use of e-cigarettes. Usage of other forms of tobacco has decreased since 2011.

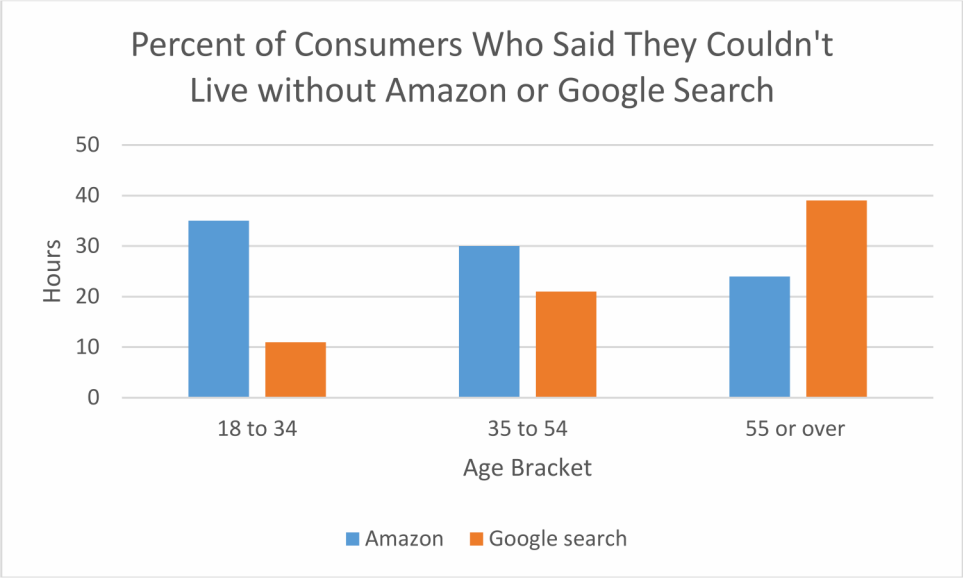
1.27 (a) A bar graph is given.



(b) To make a pie chart, you would need to know the total number of deaths in this age group or (equivalently) the number of deaths due to other causes.

1.28 About 20% had debt between $20,000 and $49,999. Less than 10% had debt above $150,000, but it is hard to tell from the plot.

1.29 (a) A bar graph is provided.



(b) For the 18 to 34 age group, the percent who claim not to be able to live without Amazon is triple that of those who couldn't live without Google Search, and for the 35 to 54 age group the percent who could not live without Amazon was higher, but only by 10%. For the "55 or over" age group, having Google Search was more critical.
(c) A pie chart is not appropriate because these data do not represent all parts of a whole.

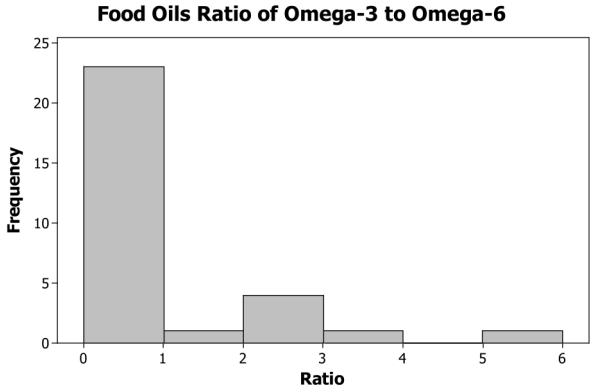
1.30 This distribution is right-skewed, with the center around two servings and a variability of zero to eight servings. There are no outliers. About 12% (9 out of 74) consumed six or more servings, and about 35% (26 out of 74) ate fewer than two servings (zero or one serving).

1.31 (a) Ignoring the four lower outliers, the distribution is roughly symmetric, is centered at a score of 111, and has a range of 86 to 136.
(b) 62 of the 78 scores are more than 100. This is 79.5%.

1.32 (a) The distribution is slightly left-skewed (some might call it almost symmetric).
(b) The center is somewhere between 10% and 20%.
(c) The smallest value is somewhere between –50% and –40%, and the largest value is between 50% and 60%.
(d) There are about 25 negative returns, although your estimate could differ. This corresponds to about 31%.

1.33 (1.) "Are you female or male?" is Histogram (c). There are two outcomes possible, and the difference in frequencies is likely to be smaller than the right-handed/left-handed difference in part (2).
(2.) "Are you right-handed or left-handed?" is Histogram (b), because there are more right-handed people than left-handed people, and the difference is probably larger than the sex difference in part (1).
(3.) "What is your height in inches?" is Histogram (d). Height distribution is likely to be symmetric.
(4.) "How many minutes do you study on a typical weeknight?" is Histogram (a). The variable takes on more than two values, and time spent studying may well be a right-skewed distribution, with most students spending less time studying, but some students studying a lot.

1.34 (a) A histogram is provided.



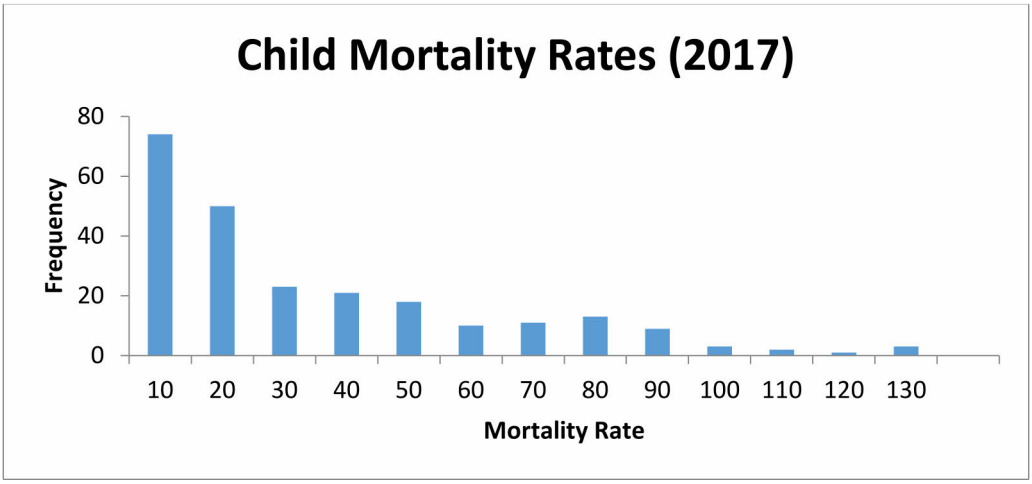
(b) This is an extremely right-skewed distribution. Ratios greater than 1 correspond to an oil with more omega-3 than omega-6. This accounts for 7 of the 30 oils, or 23.3%. Most food oils aren't this healthful.
(c) Of the 7 more healthful food oils, 5 come from types of fish. Furthermore, all the fish oils in the list have ratios higher than 1. Clearly, fish oils provide a more healthful ratio of omega-3 to omega-6 acids.

1.35 (a) States vary in population, so you would expect more nurses in California than in Wyoming, for example. Nurses per 100,000 provides a better measure of the number of nurses available to serve a state's population.
(b) A stemplot is provided. Round the data to the nearest ten, and use the stems for hundreds and the leaves for tens. The distribution is slightly right-skewed, with a center around 900 and a range from 585 to 1483 nurses per 100,000. The observation with 1483 nurses is an outlier. This corresponds to Washington DC; many people live in states surrounding DC but commute to DC for health care.

5	9
6	11347889
7	246
8	001133556668
9	001113455578
10	0122234599
11	06
12	6
13	0
14	8

(c) Splitting the stems would be useful, because it would better allow you to see the variability among the large number of states with between 800 and 1100 nurses per 100,000.

1.36 (a) Because the countries have varying populations, comparing them by deaths per 1000 children is easier than comparing them by total number of children.
(b) The histogram is provided. The distribution is right-skewed, with a center around 20 deaths per 1000 children. The range is from just above 0 to 130. The three countries with death rates between 120 and 130, namely Central African Republic, Chad, and Somalia, might be considered outliers.



1.37 The stemplot (after rounding to the nearest integer) is shown. The shape of the distribution is roughly symmetric (it might be called left-skewed if we ignore the high outlier); with this scaling, 246 seems to be a high outlier. The center is about 172 (the 12th observation). The data range from about 92 to about 246.

9	257
10	3
11	0
12	3
13	
14	6
15	9
16	68
17	022399
18	22
19	2
20	1244
21	
22	
23	
24	6

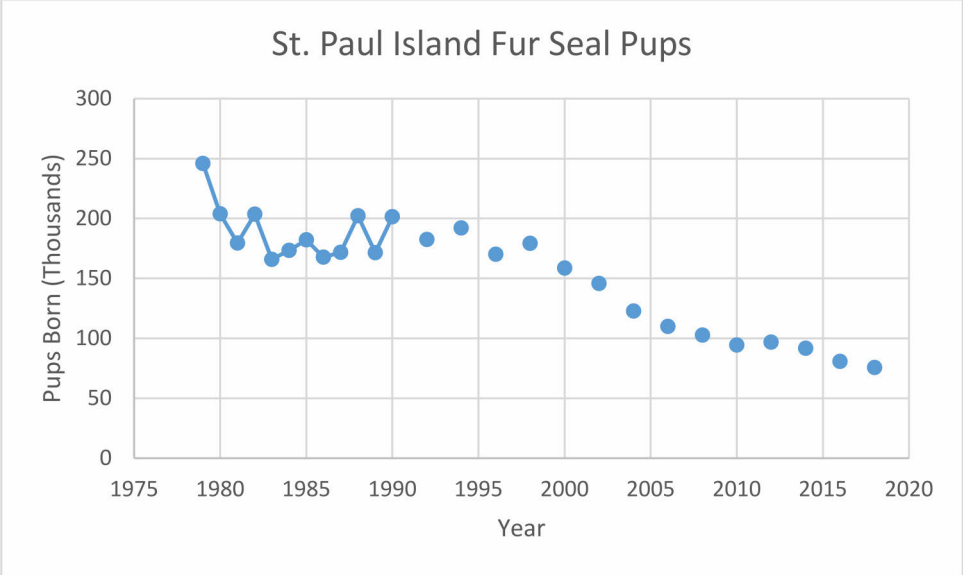
1.38 (a) A negative value means that the virtual operation took longer after the four-week program than it took before the program.

(b) The stemplot is provided.

Treatment		Control
	-0	8
122	-0	13
	0	23344
888776	0	5567789999
43332	1	1
9	1	5
4421	2	3
8	2	
3	3	

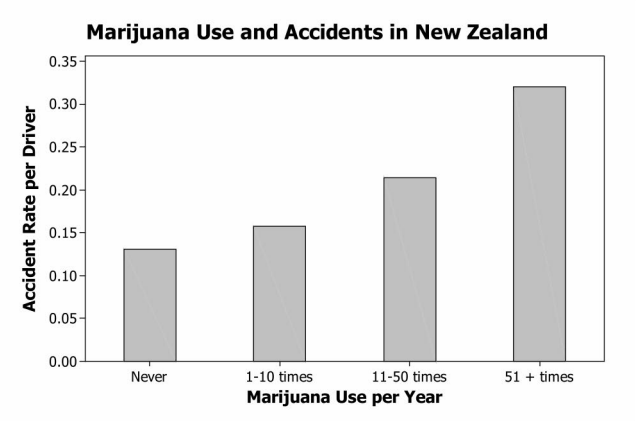
(c) The center for the treatment group is about 130 seconds; for the control group, the center is about 60 seconds. It appears that the treatment group had larger differences and so had greater improvement.

1.39 A time plot of fur seal pups. The decline in population is not seen in the stemplot made in Exercise 1.37.

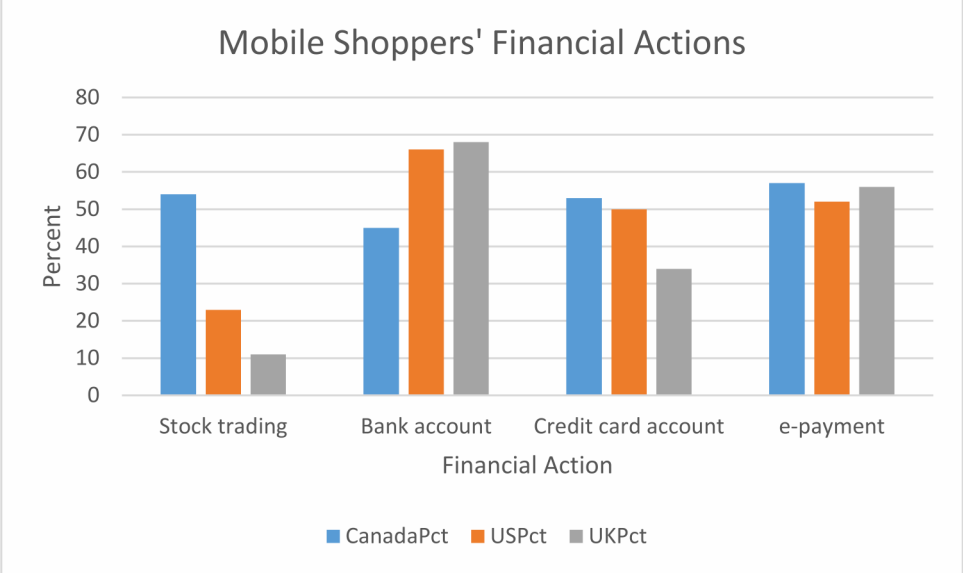


1.40 (a) Rates are appropriate (rather than numbers of accidents) because the group sizes are different. Even if marijuana did not increase with the rate of accidents, you would still have more accidents (by count) in the largest groups.

(b) The rates were computed as accidents / (number of drivers) in each group; a bar graph is given. Although we cannot conclude that marijuana use causes accidents, it is certainly associated with a greater accident rate. Perhaps the "risk-taking" aspect mentioned might also be an explanation.



1.41 (a) A bar graph is provided. Three separate bar graphs could also have been produced.



(b) The biggest difference among the financial actions used by mobile shoppers, by country, regards stock trading.
(c) A pie chart cannot be used because the percents do not represent parts of a whole.

1.42 (a) Here are stem and split-stem plots. In both cases, stems denote the tens place.

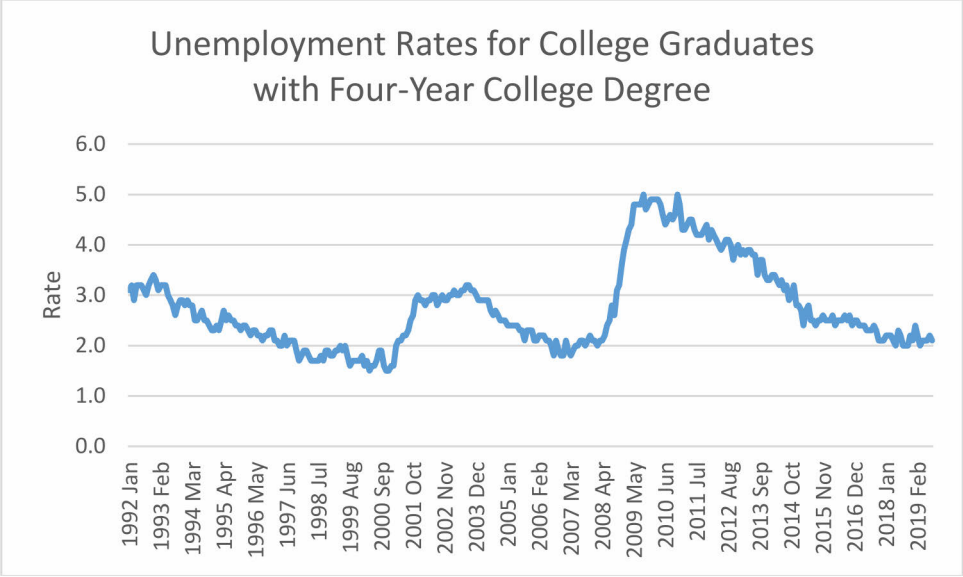
```
4 | 9
5 | 36668889
6 | 1123556777889
7 | 00
```

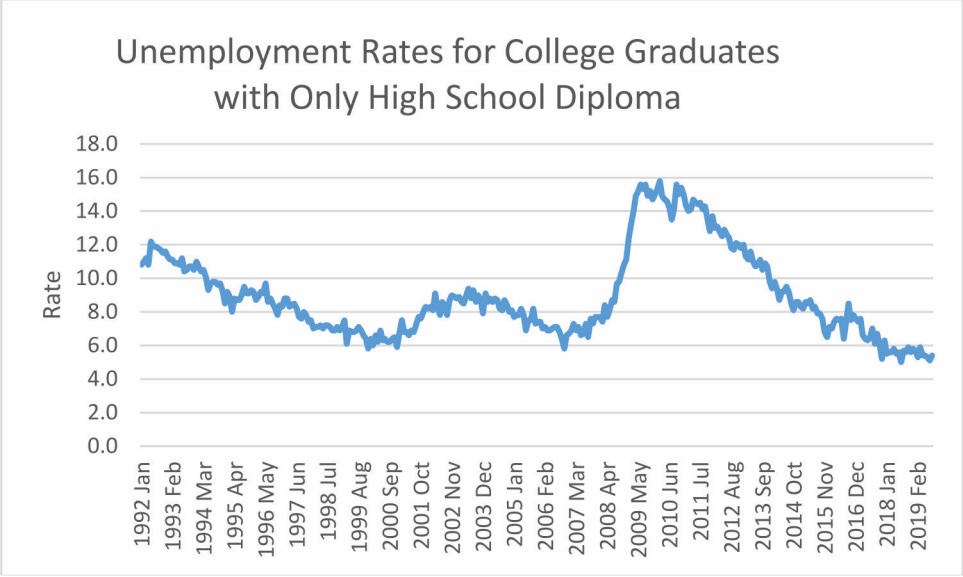
```
4 | 9
5 | 3
5 | 6668889
6 | 1123
6 | 556777889
7 | 00
```

(b) The center of this distribution is around 62 correct identifications; the data vary from 49 to 70. The distribution is somewhat left-skewed. There are no outliers.
(c) It would appear that a person's voice does help identify the taller person. If subjects were just guessing, we would expect the distribution to center about 50, but the center here is much higher. In fact, only one person correctly identified the taller person less than 50 times, and that person got 49 correct.

1.43 (a) Graph (a) appears to show the greatest increase. Vertical scaling can impact the perception of the data.
(b) In 2000, tuition was about $5000, and by 2018 it had risen to about $10,000; this is an increase of approximately $5000. Both plots describe the same data.

1.44 (a) The time plots are provided. The patterns are similar, but the changes in unemployment rate are much less drastic for college graduates than for high school graduates.





(b) The financial crisis of 2008 is reflected in the plot by a sharp increase in unemployment rates in 2008 and 2009. Since 2009, unemployment rates steadily decreased through 2019, almost back to the levels seen before the financial crisis.
(c) A slight increase in unemployment rates can be seen beginning in 2001.

1.45 (a) It seems as though winter quarters are typically associated with lower housing starts.

(b) & **(c)** Over the long run housing starts have risen, except for crisis years, which are shown by the sharp decrease between 2006 and 2008.
(d) Since 2011, housing starts appear to be increasing from year to year again.

1.46 Use the *One-Variable Statistical Calculator* applet on the text website to investigate this problem.