## Chapter 2: Graphical Summaries of Data

### Section 2.1 Exercises

**Exercises 1 – 4 are the Check Your Understanding exercises located within the section. Their answers are found on pages 48 and 49.**

**Understanding the Concepts**

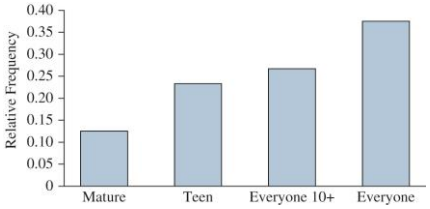
**5.** frequency
**6.** relative frequency
**7.** pareto chart
**8.** pie chart
**9.** False. In a frequency distribution, the sum of all frequencies equals the total number of observations.
**10.** True
**11.** True
**12.** False. In bar graphs and Pareto charts, the heights of the bars represent the frequencies or relative frequencies.

**Practicing the Skills**

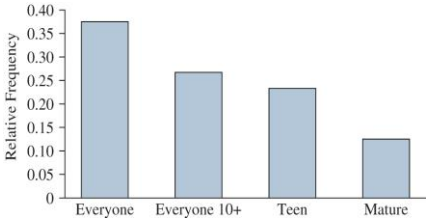
**13.** **(A)** Meat, poultry, fish, and eggs
**(B)** False ($450 < $550)
**(C)** True ($1300 > $1000)

**14.** **(A)** Type O
**(B)** False ($\frac{70}{150} = 46.7\%$)
**(C)** True

**15.** **(A)**

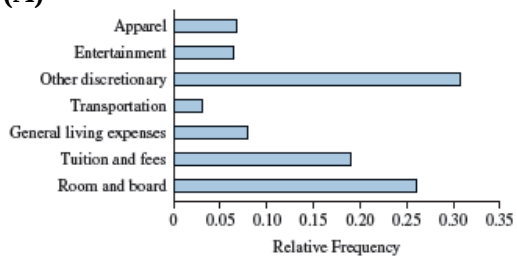



**(B)**

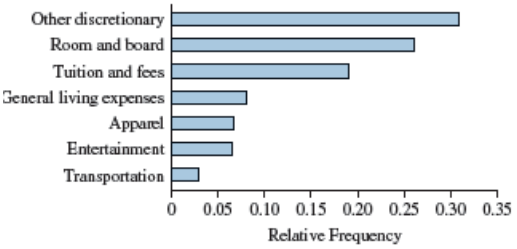



**(C)** Everyone (E)
**(D)** False
**(E)** True (12.5% < 20%)

**16.** **(A)**




**(B)**

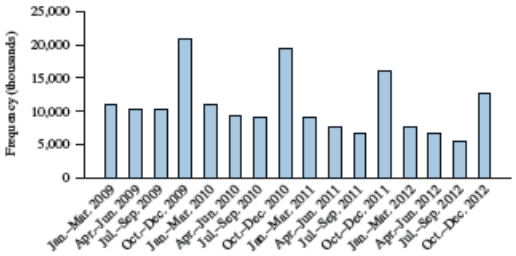



**(C)** Other discretionary
**(D)** 8% + 26% + 3% = 37%

**17.** **(A)** Families and individuals, Businesses, Governments
**(B)** Produced at home
**(C)** No, Produced at home is.
**(D)** Yes

**18.** **(A)** The game
**(B)** True
**(C)** False (men < women)
**(D)** True (both are about 0.65)

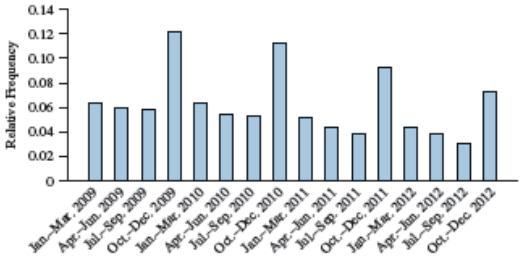
**19.** **(A)**



**(B)**

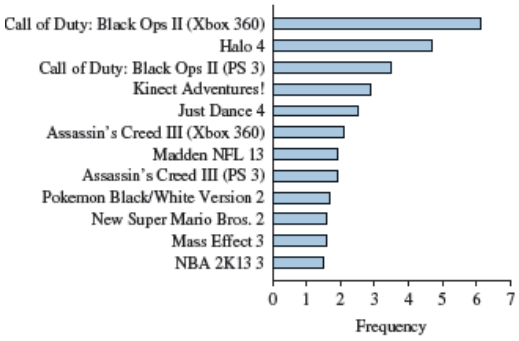
| Quarter | Relative Frequency |
|---|---|
| Jan.–Mar. 2009 | 0.064 |
| Apr.–Jun. 2009 | 0.059 |
| Jul.–Sep. 2009 | 0.059 |
| Oct.–Dec. 2009 | 0.122 |
| Jan.–Mar. 2010 | 0.063 |
| Apr.–Jun. 2010 | 0.055 |
| Jul.–Sep. 2010 | 0.053 |
| Oct.–Dec. 2010 | 0.113 |
| Jan.–Mar. 2011 | 0.052 |
| Apr.–Jun. 2011 | 0.044 |
| Jul.–Sep. 2011 | 0.038 |
| Oct.–Dec. 2011 | 0.089 |
| Jan.–Mar. 2012 | 0.045 |
| Apr.–Jun. 2012 | 0.039 |
| Jul.–Sep. 2012 | 0.031 |
| Oct.–Dec. 2012 | 0.074 |

**(C)**




**(D)** True

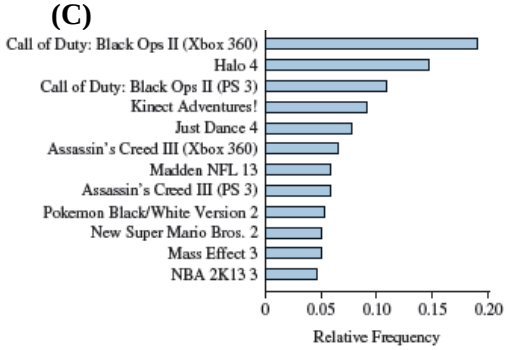
**20. (A)**




**(B)**

| Game Platform | Relative Frequency |
|---|---|
| Call of Duty: Black Ops II (Xbox 360) | 0.191 |
| Halo 4 (Xbox 360) | 0.147 |
| Call of Duty: Black Ops II (PS 3) | 0.109 |
| Kinect Adventures! (Xbox 360) | 0.091 |
| Just Dance 4 (Wii) | 0.078 |
| Assassin's Creed III (Xbox 360) | 0.066 |
| Madden NFL 13 (Xbox 360) | 0.059 |
| Assassin's Creed III (PS 3) | 0.059 |
| Pokemon Black/White Version 2 (DS) | 0.053 |
| New Super Mario Bros. 2 (3DS) | 0.050 |
| Mass Effect 3 (Xbox 360) | 0.050 |
| NBA 2K13 3 (Xbox 360) | 0.047 |

**(C)**

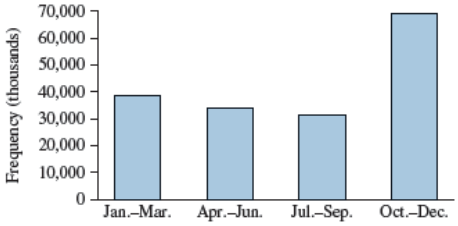



**(D)** True $\left(\frac{9.6}{32} = 30\% \right) > 20\%$

**21. (A)**

| Quarter | Frequency (thousands) |
|---|---|
| Jan.–Mar. | 38,591 |
| Apr.–Jun. | 33,916 |
| Jul.–Sep. | 31,183 |
| Oct.–Dec. | 68,513 |

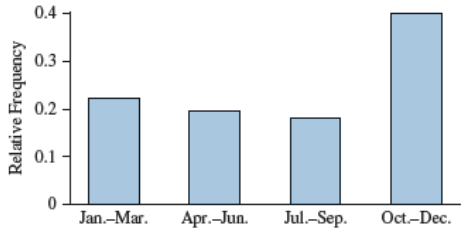
**(B)**



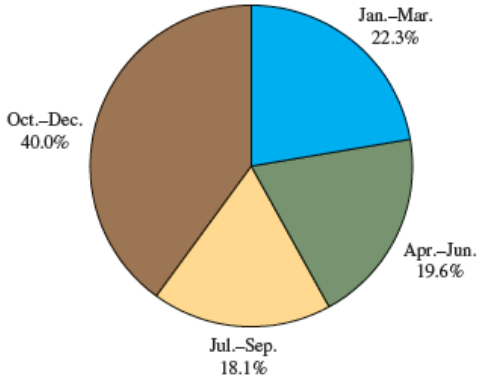

**(C)**

| Quarter | Relative Frequency |
|---|---|
| Jan.–Mar. | 0.224 |
| Apr.–Jun. | 0.197 |
| Jul.–Sep. | 0.181 |
| Oct.–Dec. | 0.398 |

**(D)**



**(E)**

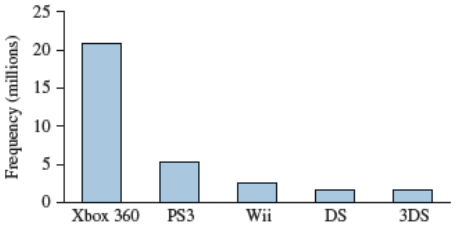



**(F)** False $\left(\frac{68,513}{172,203} = 39.8\% \right) < 50\%$

**22. (A)**

| Platform | Frequency (millions) |
|---|---|
| Xbox 360 | 20.8 |
| PS3 | 5.4 |
| Wii | 2.5 |
| DS | 1.7 |
| 3DS | 1.6 |

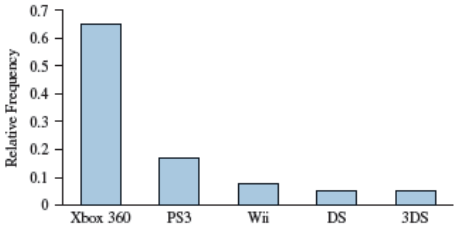
**(B)**



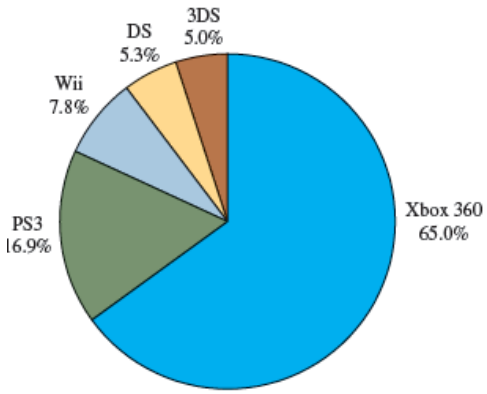

**(C)**

| Platform | Relative Frequency |
|---|---|
| Xbox 360 | 0.650 |
| PS3 | 0.169 |
| Wii | 0.078 |
| DS | 0.053 |
| 3DS | 0.050 |

**(D)**

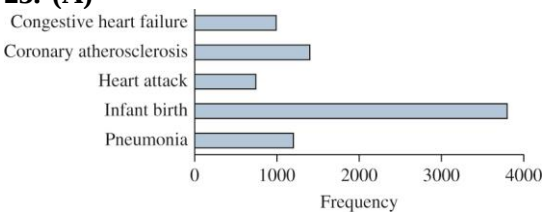



**(E)**




**(F)** True (65% > 50%)

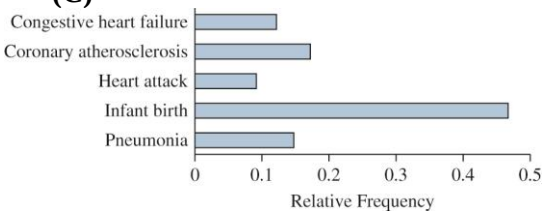
**23. (A)**



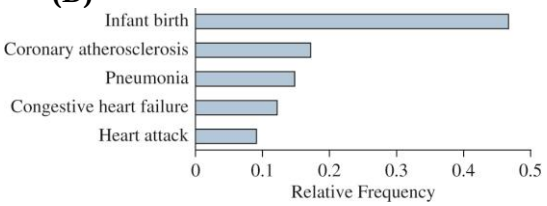

**(B)**

| Reason | Relative Frequency |
|---|---|
| Congestive heart failure | 0.122 |
| Coronary atherosclerosis | 0.172 |
| Heart attack | 0.091 |
| Infant birth | 0.467 |
| Pneumonia | 0.148 |

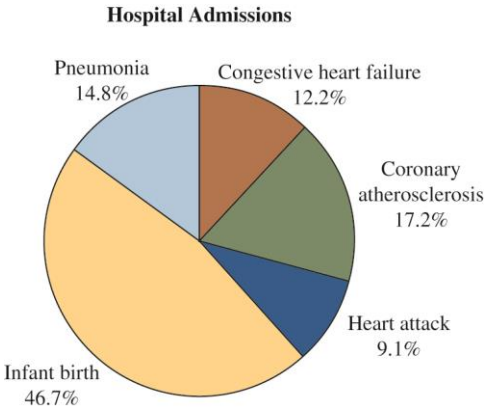
**(C)**




**(D)**

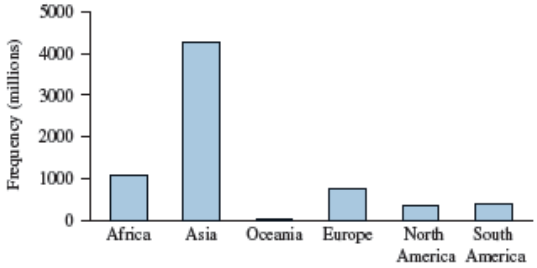



**(E)**




**(F)** True. (3800 > 3134)

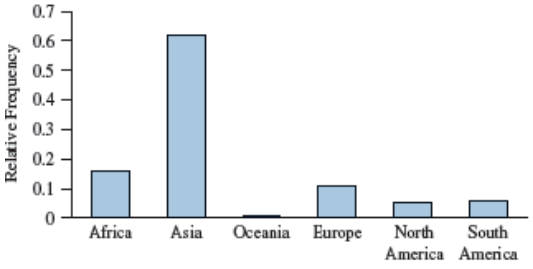
**24. (A)**



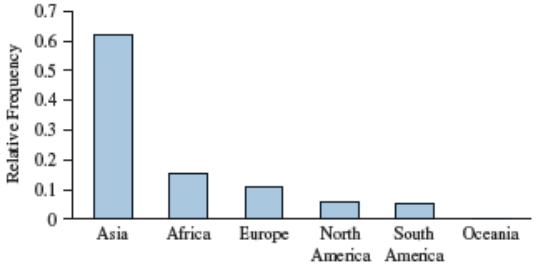

**(B)**

| Continent | Relative Frequency |
|---|---|
| Africa | 0.156 |
| Asia | 0.621 |
| Oceania | 0.005 |
| Europe | 0.108 |
| North America | 0.051 |
| South America | 0.058 |

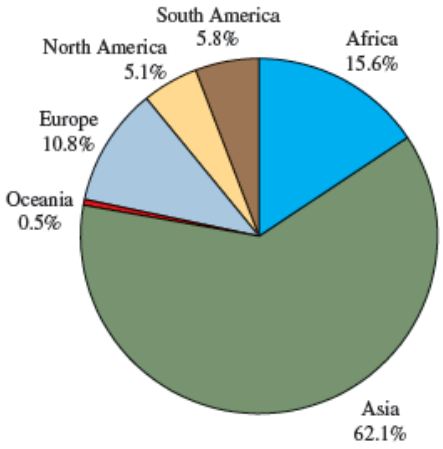
**(C)**




**(D)**



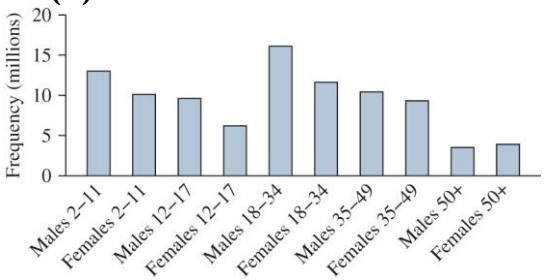

**(E)**




**(F)** True. 62.1% > 50%

**(G)** False. 10.8% < 10.9%

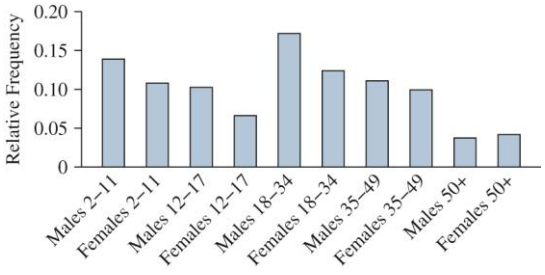
**25. (A)**



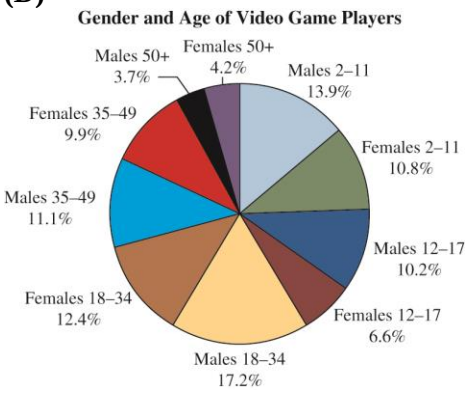

**(B)**

| Gender and Age Group | Relative Frequency |
|---|---|
| Males 2–11 | 0.139 |
| Females 2–11 | 0.108 |
| Males 12–17 | 0.102 |
| Females 12–17 | 0.066 |
| Males 18–34 | 0.172 |
| Females 18–34 | 0.124 |
| Males 35–49 | 0.111 |
| Females 35–49 | 0.099 |
| Males 50+ | 0.037 |
| Females 50+ | 0.042 |

**(C)**




**(D)**

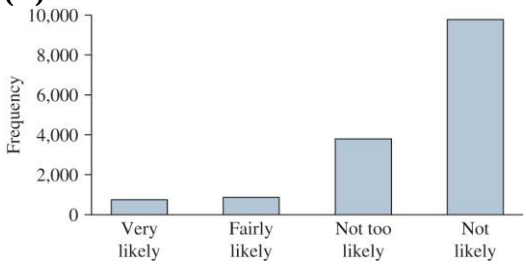



**(E)** True. (56.1% > 50%)

**(F)** True. 43.9% are females

**(G)** 0.289

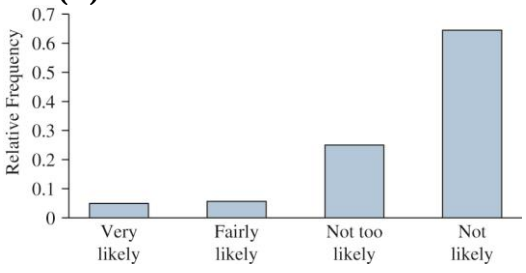
**26. (A)**



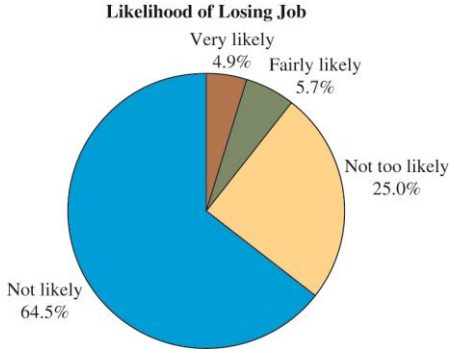

**(B)**

| Response | Relative Frequency |
|---|---|
| Very likely | 0.049 |
| Fairly likely | 0.057 |
| Not too likely | 0.250 |
| Not likely | 0.645 |

**(C)**



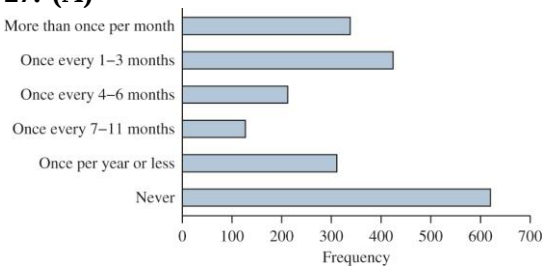

**(D)**




**(E)** True. (64.5% > 50%)

**(F)** 0.106

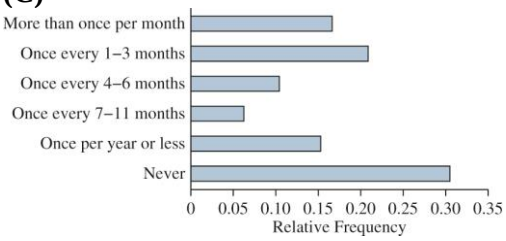
**27. (A)**



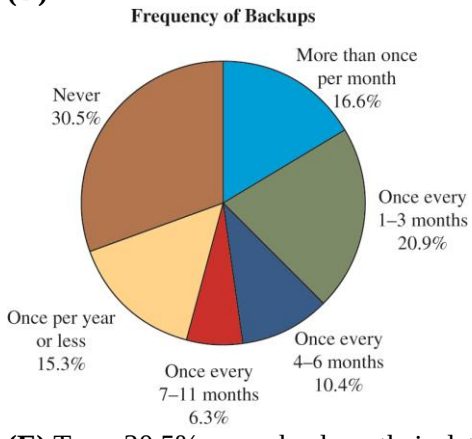

**(B)**

| Response | Relative Frequency |
|---|---|
| More than once per month | 0.166 |
| Once every 1–3 months | 0.209 |
| Once every 4–6 months | 0.104 |
| Once every 7–11 months | 0.063 |
| Once per year or less | 0.153 |
| Never | 0.305 |

**(C)**



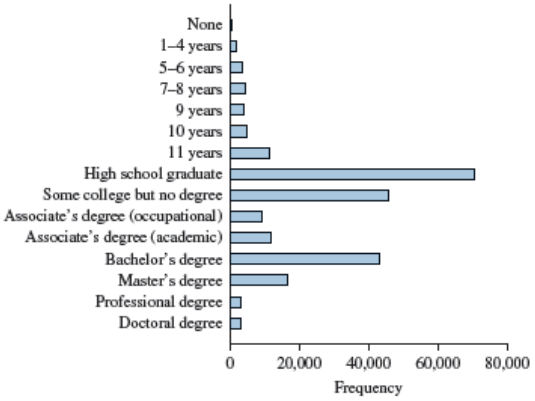

**(D)**




**(E)** True. 30.5% never back up their data.

**(F)** False.

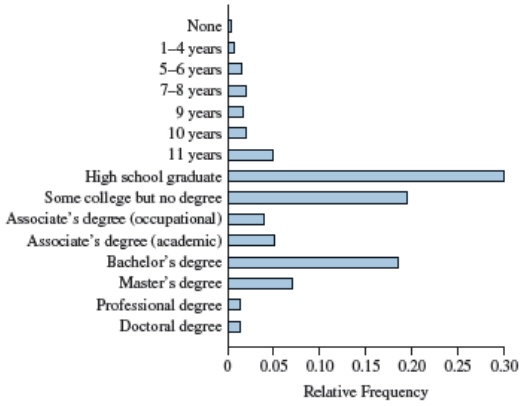
**28. (A)**




**(B)**

| Educational Attainment | Relative Frequency |
|---|---|
| None | 0.004 |
| 1–4 years | 0.008 |
| 5–6 years | 0.015 |
| 7–8 years | 0.019 |
| 9 years | 0.017 |
| 10 years | 0.020 |
| 11 years | 0.049 |
| High school graduate | 0.300 |
| Some college but no degree | 0.194 |
| Associate's degree (occupational) | 0.040 |
| Associate's degree (academic) | 0.052 |
| Bachelor's degree | 0.184 |
| Master's degree | 0.071 |
| Professional degree | 0.013 |
| Doctoral degree | 0.014 |

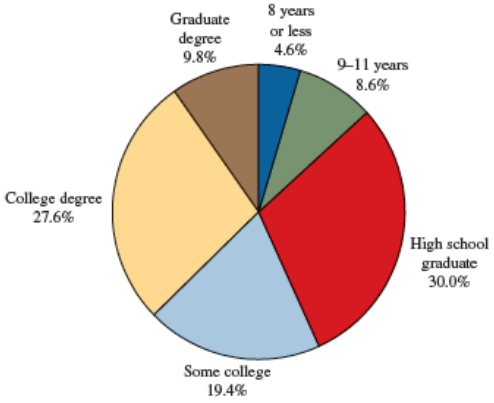
**(C)**




**(D)**

| Educational Attainment | Frequency (thousands) |
|---|---|
| 8 years or less | 10,791 |
| 9–11 years | 20,311 |
| High school graduate | 70,441 |
| Some college but no degree | 45,645 |
| College degree | 64,757 |
| Graduate degree | 22,915 |

**(E)**




**(F)** 0.132

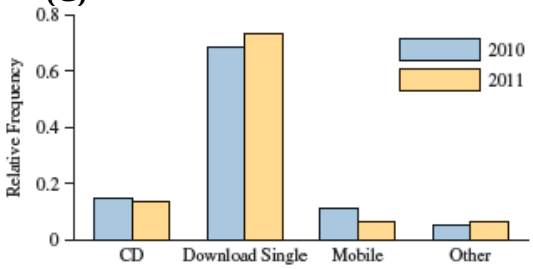
**29. (A)**

| Type of Music | Relative Frequency |
|---|---|
| CD | 0.148 |
| Download single | 0.687 |
| Mobile | 0.110 |
| Other | 0.056 |

**(B)**

| Type of Music | Relative Frequency |
|---|---|
| CD | 0.136 |
| Download single | 0.735 |
| Mobile | 0.065 |
| Other | 0.064 |

**(C)**




**(D)** True. (0.735 > 0.5)

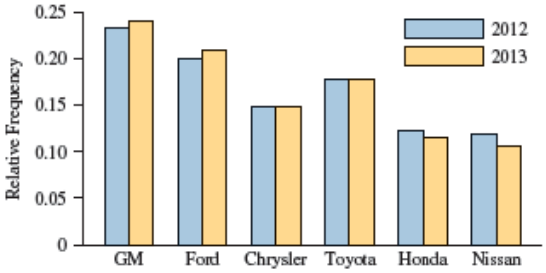
**30. (A)**

| Manufacturer | Relative Frequency |
|---|---|
| General Motors | 0.233 |
| Ford | 0.199 |
| Chrysler LLC | 0.149 |
| Toyota | 0.178 |
| Honda | 0.123 |
| Nissan | 0.119 |

**(B)**

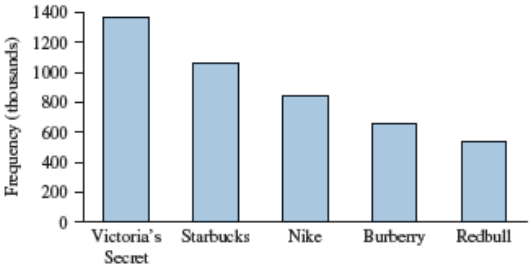
| Manufacturer | Relative Frequency |
|---|---|
| General Motors | 0.241 |
| Ford | 0.209 |
| Chrysler LLC | 0.149 |
| Toyota | 0.178 |
| Honda | 0.116 |
| Nissan | 0.107 |

**(C)**




**(D)** False. Honda's and Nissan's went down.

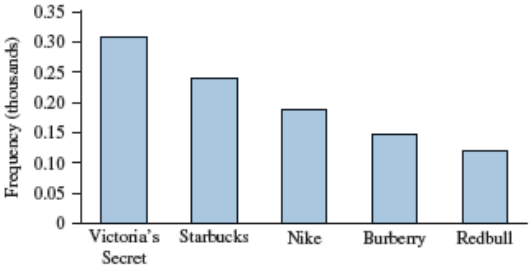
**31. (A)**



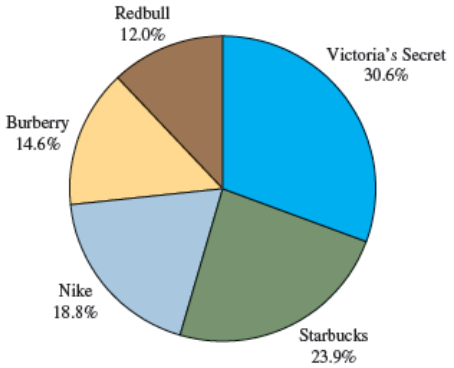

**(B)**

| Brand | Relative Frequency |
|---|---|
| Victoria's Secret | 0.306 |
| Starbucks | 0.239 |
| Nike | 0.188 |
| Burberry | 0.146 |
| Redbull | 0.120 |

**(C)**

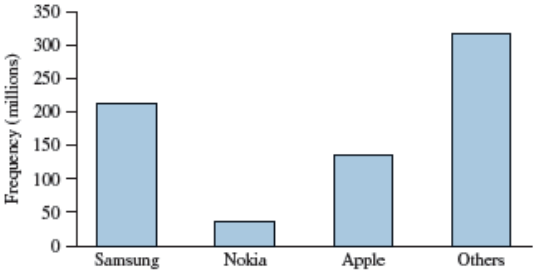



**(D)**




**(E)** 0.239

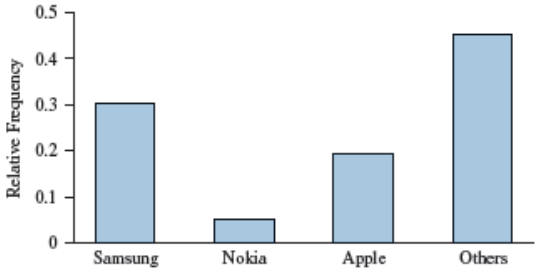
**32. (A)**



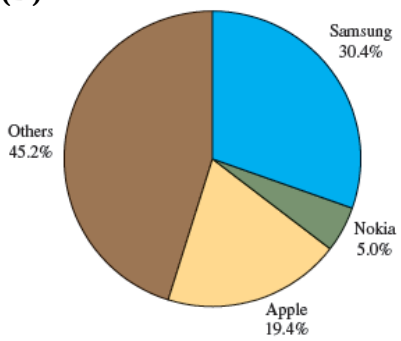

**(B)**

| Vendor | Relative Frequency |
|---|---|
| Samsung | 0.304 |
| Nokia | 0.050 |
| Apple | 0.194 |
| Others | 0.452 |

**(C)**

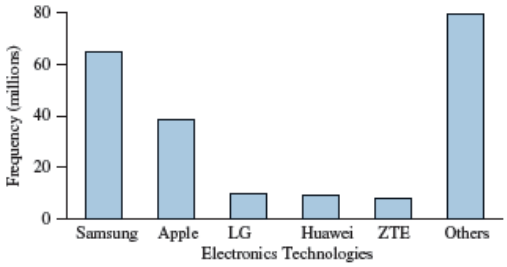


**(D)**




**(E)** 0.304

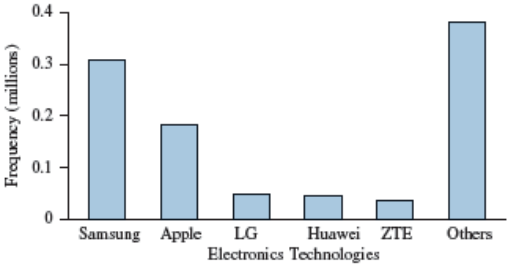
**33. (A)**



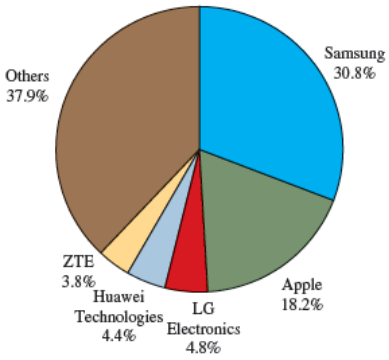

**(B)**

| Company | Relative Frequency |
|---|---|
| Samsung | 0.308 |
| Apple | 0.182 |
| LG Electronics | 0.048 |
| Huawei Technologies | 0.044 |
| ZTE | 0.038 |
| Others | 0.379 |

**(C)**




**(D)**

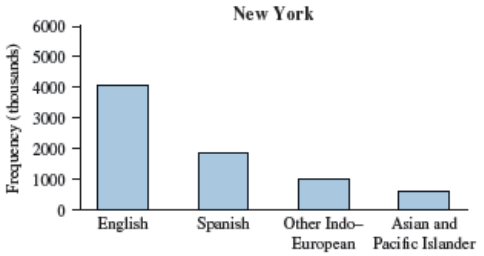


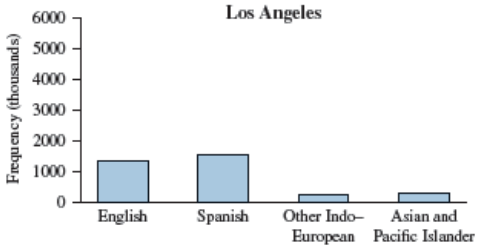

**(E)** False. (64.74 million < 65.62 million)

**34.** This is not a valid relative frequency distribution because the proportions do not sum to 1.

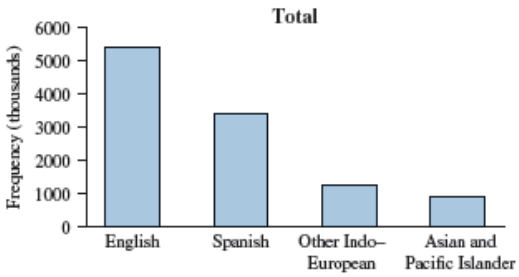
## Extending the Concepts

**35. (A)**

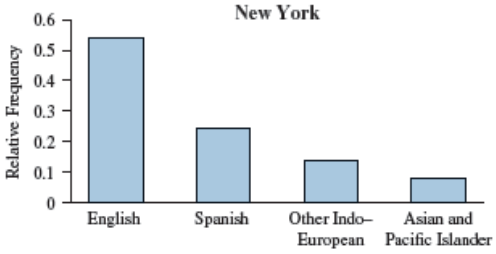


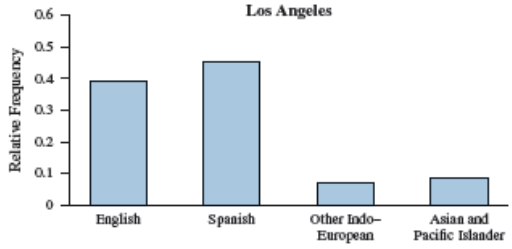




**(B)**

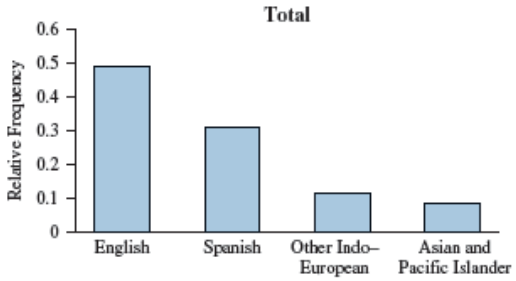



**(C)**



**(D)**




**(E)** The total frequency is equal to the sum of the frequencies for the two cities.

**(F)** The total relative frequency is the total frequency divided by the sum of all total frequencies. The relative frequency for each city is the frequency for that city divided by the sum of the frequencies for that city. Since the sum of the frequencies for each city is not the same as the sum of the total frequencies, the total relative frequency is not the sum of the relative frequencies for the two cities.

## Section 2.2 Exercises

**Exercises 1-4 are the Check Your Understanding exercises located within the section. Their answers are found on page 67.**

### Understanding the Concepts

**5.** symmetric
**6.** left, right
**7.** bimodal
**8.** cumulative frequency
**9.** False. In a frequency distribution, the class width is the difference between consecutive lower class limits.
**10.** False. The number of classes used has a large effect on the shape of the histogram.
**11.** True
**12.** True

### Practicing the Skills

**13.** Skewed to the left
**14.** Skewed to the right
**15.** Approximately symmetric
**16.** Approximately symmetric
**17.** Bimodal
**18.** Unimodal

### Working with the Concepts

**19.** **(A)** 11
**(B)** 1
**(C)** 70-71
**(D)** 9%
**(E)** approximately symmetric

**20.** **(A)** 3
**(B)** 19
**(C)** 3
**(D)** skewed to the right

**21.** **(A)** The sum of the proportions in the last 5 rectangles gives the percentage of men with levels above 240. The sum is: 0.13 + 0.1 + 0.05 + 0.01 + 0.02 = 0.31, which is closest to 30%.
**(B)** 240-260, because 13% > 8%.

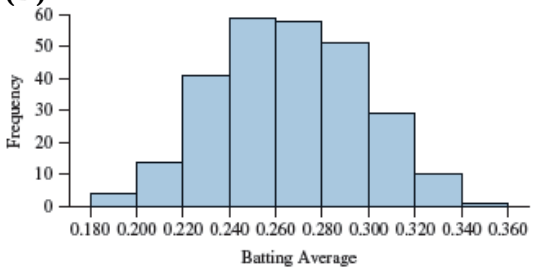
**22.** **(A)** The sum of the proportions in the last 8 rectangles gives the percentage of women with pressures above 120. The sum is: 0.14 + 0.12 + 0.11 + 0.04 + 0.04 + 0.02 + 0.01 + 0.01 = 0.49, which is closest to 50%.
**(B)** 130-135, because 11% > 6%.

**23.** **(A)** Right skewed, because there are many more words of small length than of larger length.
**(B)** Left skewed, because there are many more coins in circulation from recent years than older years.
**(C)** Left skewed, because there are many more high grades than low ones.

**24.** **(A)** Right skewed, because there are many more people with low incomes than high.
**(B)** Left skewed, because there are many more students finishing the exam close to (if not all of) the allotted 60 minutes.
**(C)** Right skewed, because there are many more people with younger ages than old.

**25.** **(A)** 9
**(B)** 0.020
**(C)** Lower limits: 0.180, 0.200, 0.220, 0.240, 0.260, 0.280, 0.300, 0.320, 0.340. Upper limits: 0.199, 0.219, 0.239, 0.259, 0.279, 0.299, 0.319, 0.339, 0.359.

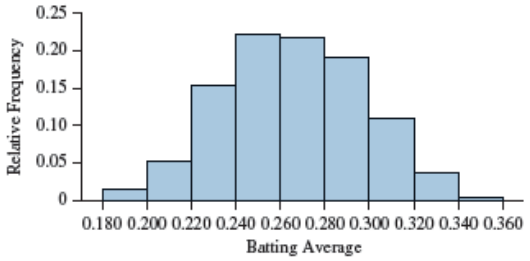
**(D)**




**(E)**

| Batting Average | Relative Frequency |
|---|---|
| 0.180–0.199 | 0.015 |
| 0.200–0.219 | 0.052 |
| 0.220–0.239 | 0.154 |
| 0.240–0.259 | 0.221 |
| 0.260–0.279 | 0.217 |
| 0.280–0.299 | 0.191 |
| 0.300–0.319 | 0.109 |
| 0.320–0.339 | 0.037 |
| 0.340–0.359 | 0.004 |

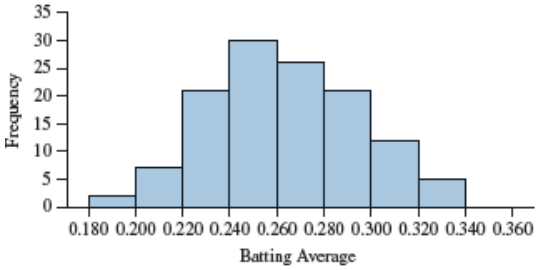
**(F)**



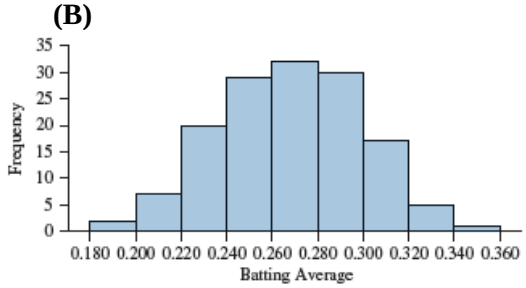

**(G)** 0.109 + 0.037 + 0.004 = 0.15 = 15%

**(H)** 0.015 + 0.052 = 0.067 = 6.7%

**26. (A)**




**(B)**



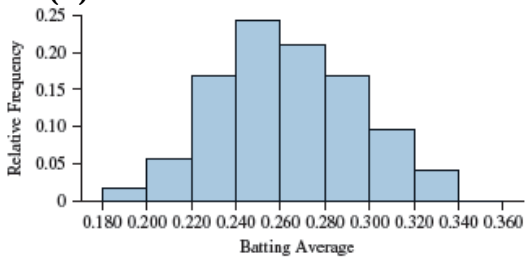

**(C)**

| Batting Average | Relative Frequency |
|---|---|
| 0.180–0.199 | 0.016 |
| 0.200–0.219 | 0.056 |
| 0.220–0.239 | 0.169 |
| 0.240–0.259 | 0.242 |
| 0.260–0.279 | 0.210 |
| 0.280–0.299 | 0.169 |
| 0.300–0.319 | 0.097 |
| 0.320–0.339 | 0.040 |
| 0.340–0.359 | 0.000 |

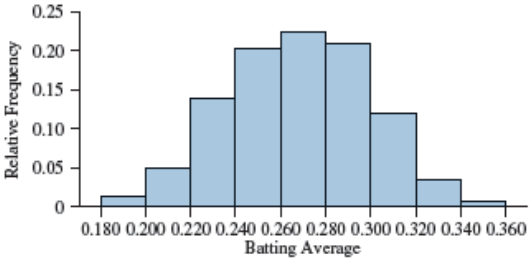
**(D)**

| Batting Average | Relative Frequency |
|---|---|
| 0.180–0.199 | 0.014 |
| 0.200–0.219 | 0.049 |
| 0.220–0.239 | 0.140 |
| 0.240–0.259 | 0.203 |
| 0.260–0.279 | 0.224 |
| 0.280–0.299 | 0.210 |
| 0.300–0.319 | 0.119 |
| 0.320–0.339 | 0.035 |
| 0.340–0.359 | 0.007 |

**(E)**




**(F)**




**(G)** 0.097 + 0.04 = 0.137 = 13.7%

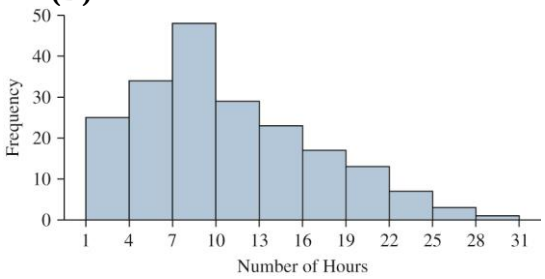
**(H)** 0.119 + 0.035 + 0.007 = 0.161 = 16.1%

**27. (A)** 10

**(B)** 3.0

**(C)** The lower class limits are 1.0, 4.0, 7.0, 10.0, 13.0, 16.0, 19.0, 22.0, 25.0, and 28.0. The upper class limits are 3.9, 6.9, 9.9, 12.9, 15.9, 18.9, 21.9, 24.9, 27.9, and 30.9.

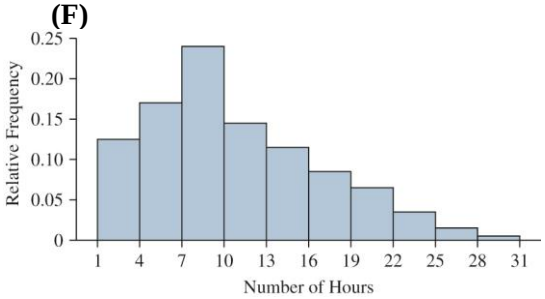
**(D)**




**(E)**

| Number of Hours | Relative Frequency |
|---|---|
| 1.0 – 3.9 | 0.125 |
| 4.0 – 6.9 | 0.170 |
| 7.0 – 9.9 | 0.240 |
| 10.0 – 12.9 | 0.145 |
| 13.0 – 15.9 | 0.115 |
| 16.0 – 18.9 | 0.085 |
| 19.0 – 21.9 | 0.065 |
| 22.0 – 24.9 | 0.035 |
| 25.0 – 27.9 | 0.015 |
| 28.0 – 30.9 | 0.005 |

**(F)**




**(G)** 0.125 + 0.17 + 0.24 = 0.535 = 53.5%

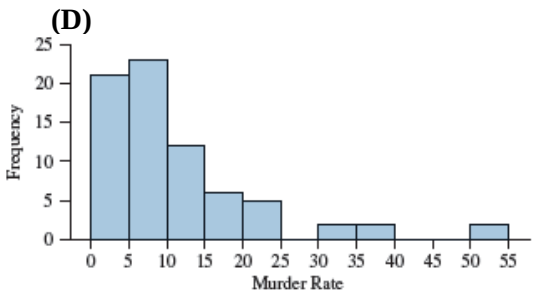
**(H)** 0.065 + 0.035 + 0.015 + 0.005 = 0.12 = 12.0%

**28. (A)** 11

**(B)** 5

**(C)** The lower class limits are 0.0, 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, and 50.0. The upper class limits are 4.9, 9.9, 14.9, 19.9, 24.9, 29.9, 34.9, 39.9, 44.9, 49.9, and 54.9.

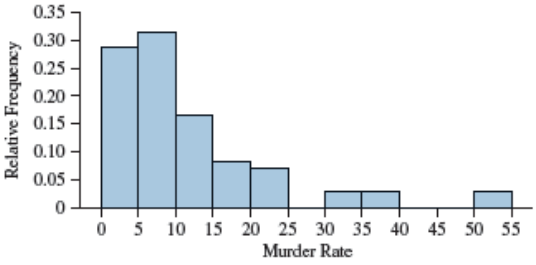
**(D)**




**(E)**

| Murder Rate | Relative Frequency |
|---|---|
| 0.0–4.9 | 0.288 |
| 5.0–9.9 | 0.315 |
| 10.0–14.9 | 0.164 |
| 15.0–19.9 | 0.082 |
| 20.0–24.9 | 0.068 |
| 25.0–29.9 | 0.000 |
| 30.0–34.9 | 0.027 |
| 35.0–39.9 | 0.027 |
| 40.0–44.9 | 0.000 |
| 45.0–49.9 | 0.000 |
| 50.0–54.9 | 0.027 |

**(F)**



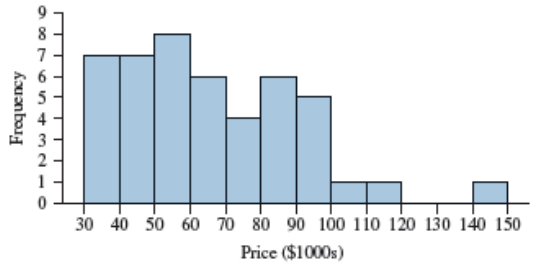

**(G)** 0.288 + 0.315 = 0.603 = 60.3%

**(H)** 0.027 + 0.027 + 0.027 = 0.081 = 8.1%

**29. (A)**

| Price ($1000s) | Frequency |
|---|---|
| 30–39.9 | 7 |
| 40–49.9 | 7 |
| 50–59.9 | 8 |
| 60–69.9 | 6 |
| 70–79.9 | 4 |
| 80–89.9 | 6 |
| 90–99.9 | 5 |
| 100–109.9 | 1 |
| 110–119.9 | 1 |
| 120–129.9 | 0 |
| 130–139.9 | 0 |
| 140–149.9 | 1 |

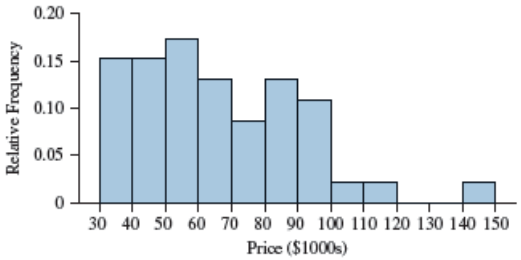
**(B)**



**(C)**

| Price ($1000s) | Relative Frequency |
|---|---|
| 30–39.9 | 0.152 |
| 40–49.9 | 0.152 |
| 50–59.9 | 0.174 |
| 60–69.9 | 0.130 |
| 70–79.9 | 0.087 |
| 80–89.9 | 0.130 |
| 90–99.9 | 0.109 |
| 100–109.9 | 0.022 |
| 110–119.9 | 0.022 |
| 120–129.9 | 0.000 |
| 130–139.9 | 0.000 |
| 140–149.9 | 0.022 |

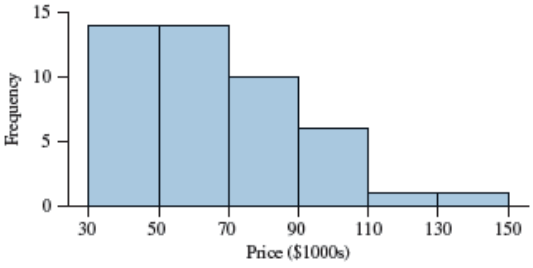
**(D)**



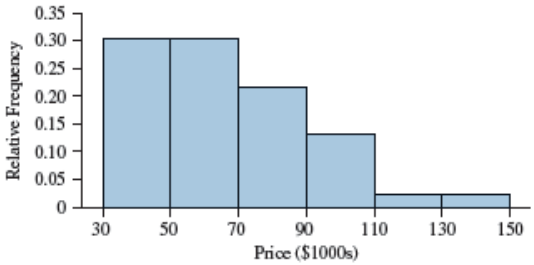

**(E)** Unimodal

**(F)**

| Price ($1000s) | Frequency |
|---|---|
| 30–49.9 | 14 |
| 50–69.9 | 14 |
| 70–89.9 | 10 |
| 90–109.9 | 6 |
| 110–129.9 | 1 |
| 130–149.9 | 1 |




| Price ($1000s) | Relative Frequency |
|---|---|
| 30–49.9 | 0.304 |
| 50–69.9 | 0.304 |
| 70–89.9 | 0.217 |
| 90–109.9 | 0.130 |
| 110–129.9 | 0.022 |
| 130–149.9 | 0.022 |

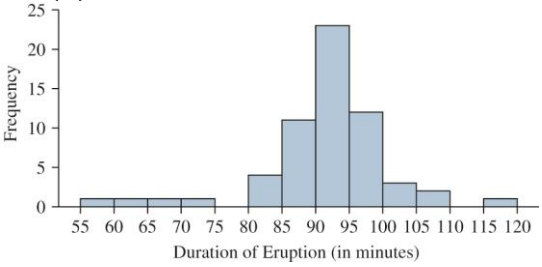



**(G)** Both are reasonably good choices for class widths. The number of classes are both at least 5, but less than 20. Also, neither class widths are too narrow or too wide.

**30. (A)**

| Dormancy Period | Frequency |
|---|---|
| 55 – 59.9 | 1 |
| 60 – 64.9 | 1 |
| 65 – 69.9 | 1 |
| 70 – 74.9 | 1 |
| 75 – 79.9 | 0 |
| 80 – 84.9 | 4 |
| 85 – 89.9 | 11 |
| 90 – 94.9 | 23 |
| 95 – 99.9 | 12 |
| 100 – 104.9 | 3 |
| 105 – 109.9 | 2 |
| 110 – 114.9 | 0 |
| 115 – 119.9 | 1 |

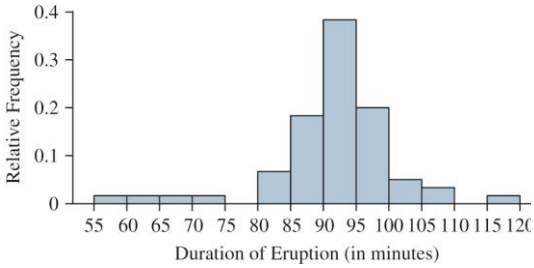
**(B)**



**(C)**

| Dormancy Period | Frequency |
|---|---|
| 55 – 59.9 | 0.017 |
| 60 – 64.9 | 0.017 |
| 65 – 69.9 | 0.017 |
| 70 – 74.9 | 0.017 |
| 75 – 79.9 | 0.000 |
| 80 – 84.9 | 0.067 |
| 85 – 89.9 | 0.183 |
| 90 – 94.9 | 0.383 |
| 95 – 99.9 | 0.200 |
| 100 – 104.9 | 0.050 |
| 105 – 109.9 | 0.033 |
| 110 – 114.9 | 0.000 |
| 115 – 119.9 | 0.017 |

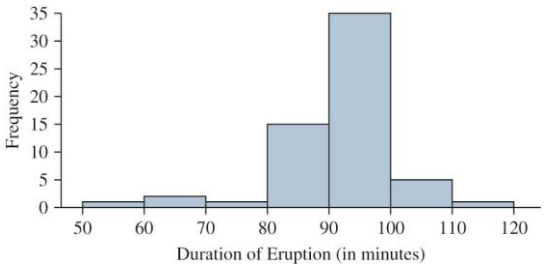
**(D)**



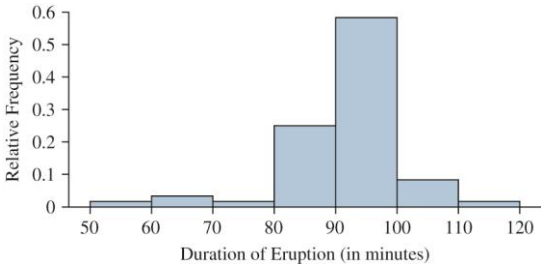

**(E)** skewed to the left

**(F)**

| Dormancy Period | Frequency |
|---|---|
| 50 – 59.9 | 1 |
| 60 – 69.9 | 2 |
| 70 – 79.9 | 1 |
| 80 – 89.9 | 15 |
| 90 – 99.9 | 35 |
| 100 – 109.9 | 5 |
| 110 – 119.9 | 1 |




| Dormancy Period | Frequency |
|---|---|
| 50 – 59.9 | 0.017 |
| 60 – 69.9 | 0.033 |
| 70 – 79.9 | 0.017 |
| 80 – 89.9 | 0.250 |
| 90 – 99.9 | 0.583 |
| 100 – 109.9 | 0.083 |
| 110 – 119.9 | 0.017 |

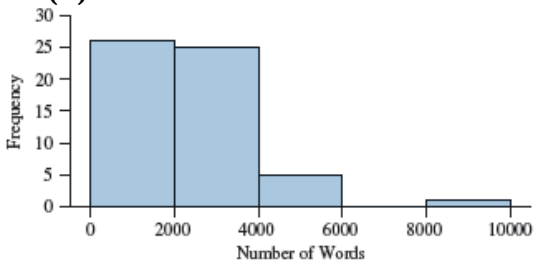



**(G)** Both are reasonably good choices for class widths. The number of classes are both at least 5, but less than 20. Also, neither class widths are too narrow or too wide.

**31. (A)** Answers will vary. Here is one possibility:

| Number of Words | Frequency |
|---|---|
| 0–1999 | 26 |
| 2000–3999 | 25 |
| 4000–5999 | 5 |
| 6000–7999 | 0 |
| 8000–9999 | 1 |

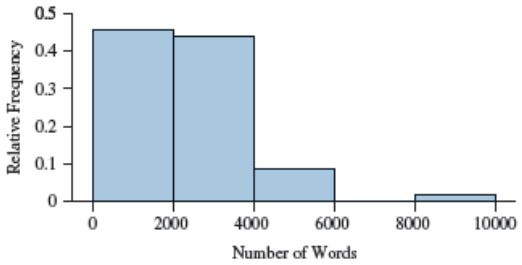
**(B)**




**(C)** Answers will vary. Here is one possibility:

| Number of Words | Relative Frequency |
|---|---|
| 0–1999 | 0.456 |
| 2000–3999 | 0.439 |
| 4000–5999 | 0.088 |
| 6000–7999 | 0.000 |
| 8000–9999 | 0.018 |

**(D)**

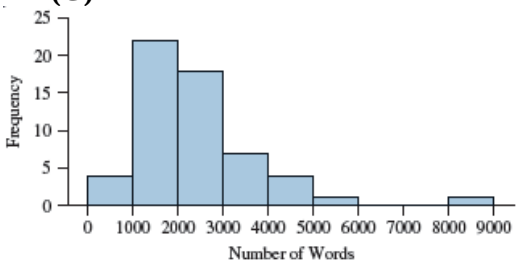



**(E)** skewed to the right

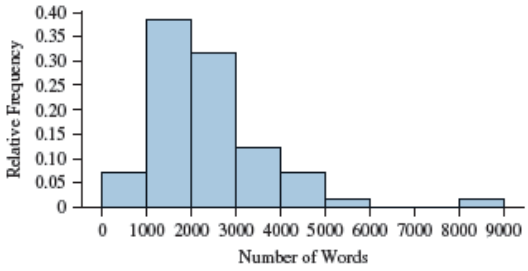
**(F)** Answers will vary. Here is one possibility:

| Number of Words | Frequency |
|---|---|
| 0–999 | 4 |
| 1000–1999 | 22 |
| 2000–2999 | 18 |
| 3090–3999 | 7 |
| 4000–4999 | 4 |
| 5000–5999 | 1 |
| 6000–6999 | 0 |
| 7000–7999 | 0 |
| 8000–8999 | 1 |

**(G)**




| Number of Words | Relative Frequency |
|---|---|
| 0–999 | 0.070 |
| 1000–1999 | 0.386 |
| 2000–2999 | 0.316 |
| 3090–3999 | 0.123 |
| 4000–4999 | 0.070 |
| 5000–5999 | 0.018 |
| 6000–6999 | 0.000 |
| 7000–7999 | 0.000 |
| 8000–8999 | 0.018 |

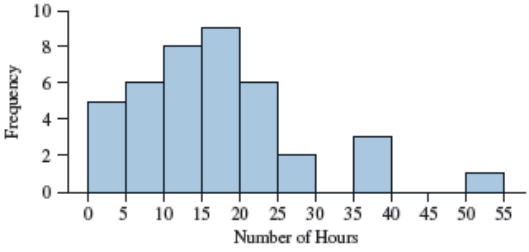



**(H)** The one with 9 classes is more appropriate than the one with only 5 classes. This is because the one with only 5 classes is too wide. Only the most basic features of the data are visible.

**32. (A)**

| Number of Hours | Frequency |
|---|---|
| 0–4 | 5 |
| 5–9 | 6 |
| 10–14 | 8 |
| 15–19 | 9 |
| 20–25 | 6 |
| 25–29 | 2 |
| 30–34 | 0 |
| 35–39 | 3 |
| 40–44 | 0 |
| 45–49 | 0 |
| 50–54 | 1 |

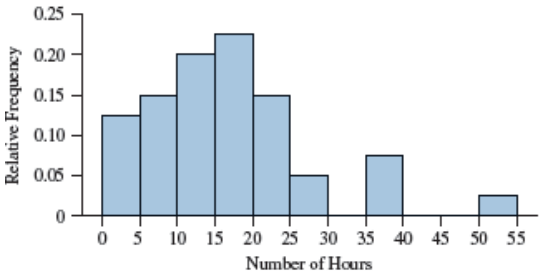
**(B)**




**(C)**

| Number of Hours | Relative Frequency |
|---|---|
| 0–4 | 0.125 |
| 5–9 | 0.150 |
| 10–14 | 0.200 |
| 15–19 | 0.225 |
| 20–25 | 0.150 |
| 25–29 | 0.050 |
| 30–34 | 0.000 |
| 35–39 | 0.075 |
| 40–44 | 0.000 |
| 45–49 | 0.000 |
| 50–54 | 0.025 |

**(D)**

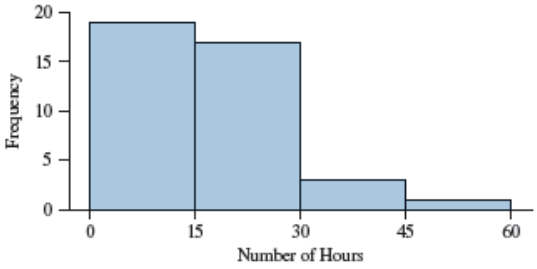



**(E)** skewed to the right

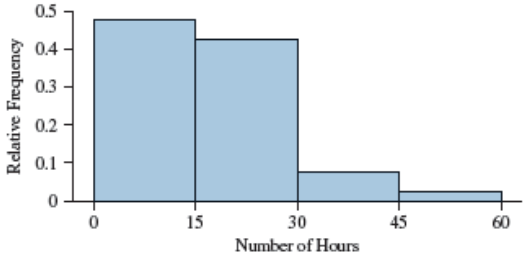
**(F)** Answers will vary. Here is one possibility:

| Number of Hours | Frequency |
|---|---|
| 0–14 | 19 |
| 15–29 | 17 |
| 30–45 | 3 |
| 46–60 | 1 |

**(G)**

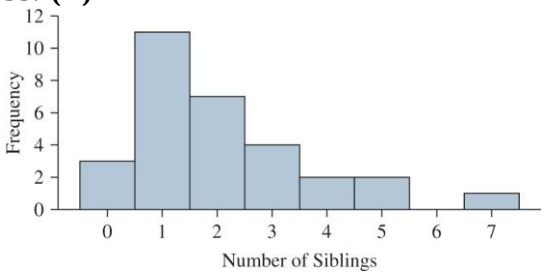



| Number of Hours | Relative Frequency |
|---|---|
| 0–14 | 0.475 |
| 15–29 | 0.425 |
| 30–45 | 0.075 |
| 46–60 | 0.025 |

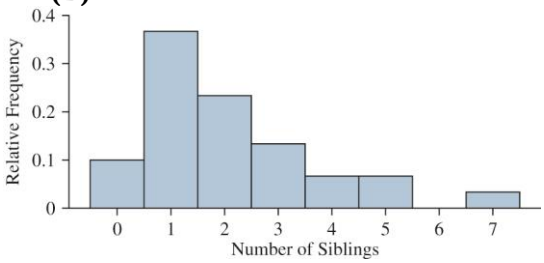



**(H)** The graphs with nine classes are more appropriate much than those with only 4 classes. This is because only the most basic features of the data are visible, when the class widths are too wide, as they are in the graphs containing only four classes.

**33. (A)**

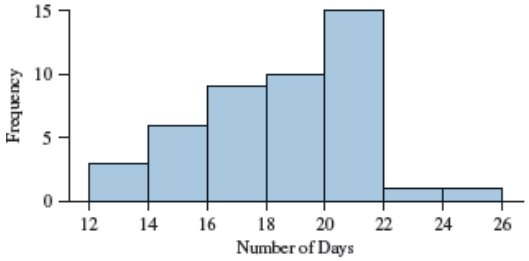



**(B)**

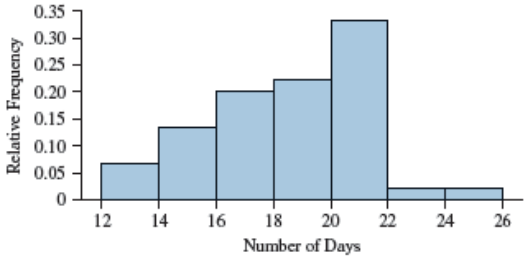



**(C)** skewed to the right

**34. (A)**

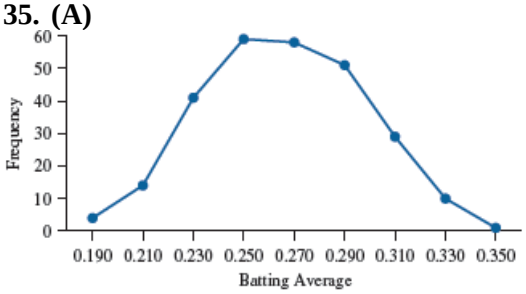



**(B)**

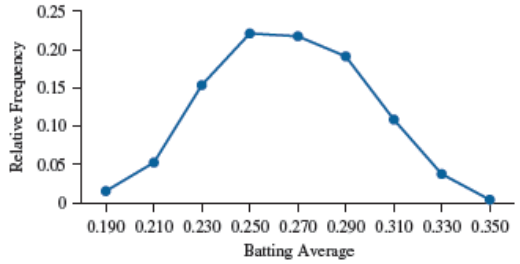



**(C)** skewed to the left

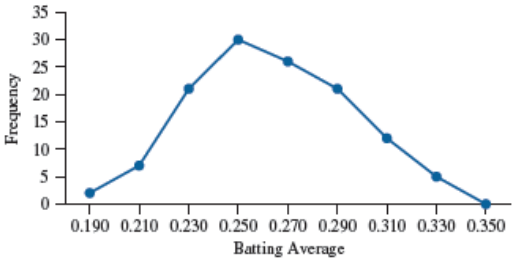
**35. (A)**



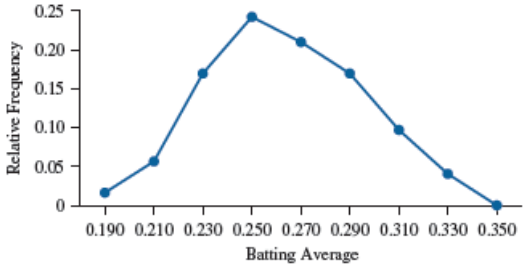
**(B)**



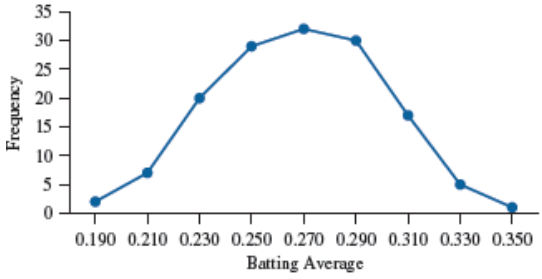

**36. (A)**



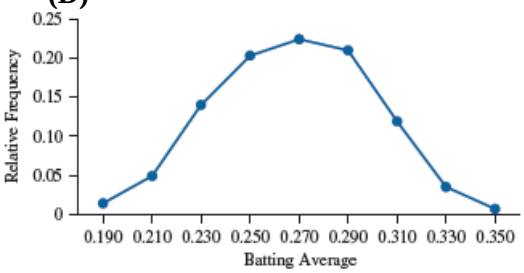

**(B)**



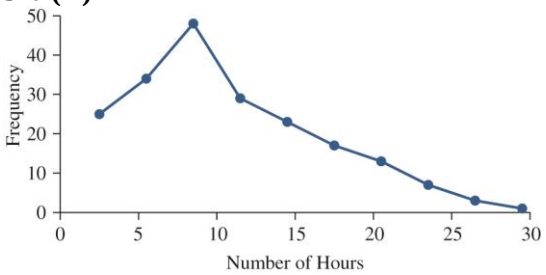

**(C)**



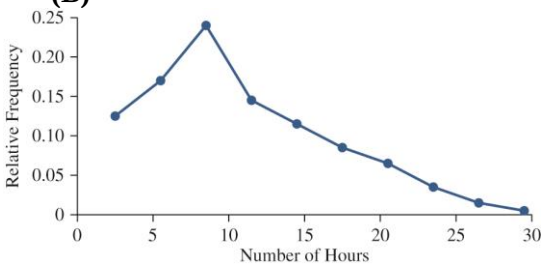

**(D)**



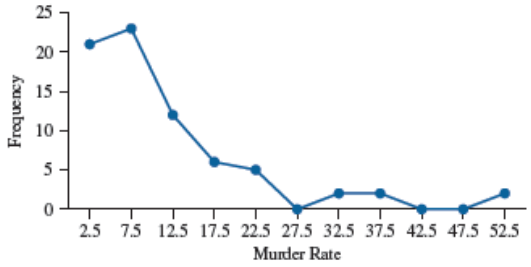

**37. (A)**



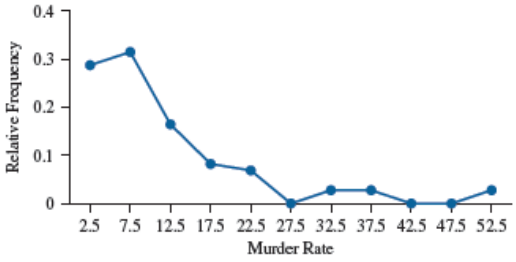

**(B)**




**38. (A)**



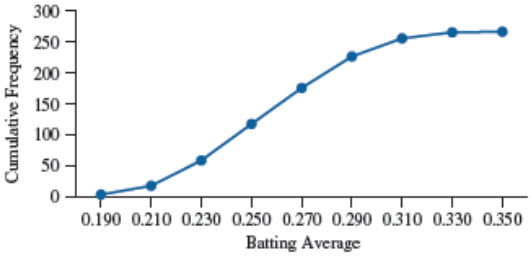

**(B)**




**39. (A)**

| Batting Average | Cumulative Frequency |
|---|---|
| 0.180–0.199 | 4 |
| 0.200–0.219 | 18 |
| 0.220–0.239 | 59 |
| 0.240–0.259 | 118 |
| 0.260–0.279 | 176 |
| 0.280–0.299 | 227 |
| 0.300–0.319 | 256 |
| 0.320–0.339 | 266 |
| 0.340–0.359 | 267 |

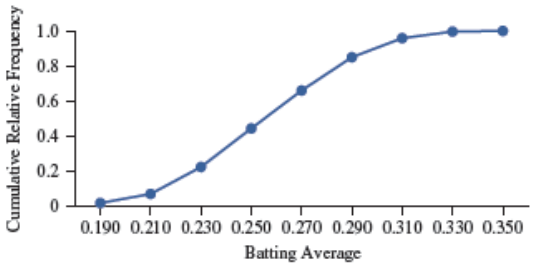
**(B)**




**(C)**

| Batting Average | Cumulative Relative Frequency |
|---|---|
| 0.180–0.199 | 0.015 |
| 0.200–0.219 | 0.067 |
| 0.220–0.239 | 0.221 |
| 0.240–0.259 | 0.442 |
| 0.260–0.279 | 0.659 |
| 0.280–0.299 | 0.850 |
| 0.300–0.319 | 0.959 |
| 0.320–0.339 | 0.996 |
| 0.340–0.359 | 1.000 |

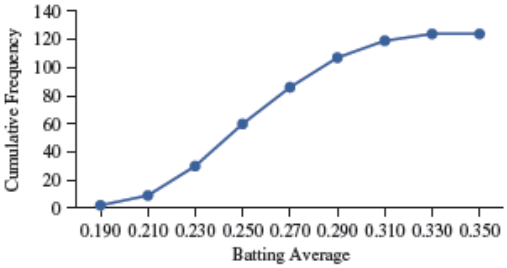
**(D)**




**40. (A)**

| Batting Average | Cumulative Frequency |
|---|---|
| 0.180–0.199 | 2 |
| 0.200–0.219 | 9 |
| 0.220–0.239 | 30 |
| 0.240–0.259 | 60 |
| 0.260–0.279 | 86 |
| 0.280–0.299 | 107 |
| 0.300–0.319 | 119 |
| 0.320–0.339 | 124 |
| 0.340–0.359 | 124 |

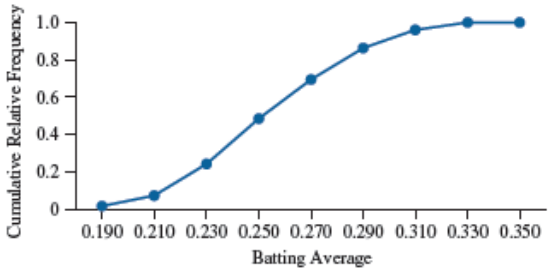
**(B)**




**(C)**

| Batting Average | Cumulative Relative Frequency |
|---|---|
| 0.180–0.199 | 0.016 |
| 0.200–0.219 | 0.073 |
| 0.220–0.239 | 0.242 |
| 0.240–0.259 | 0.484 |
| 0.260–0.279 | 0.694 |
| 0.280–0.299 | 0.863 |
| 0.300–0.319 | 0.960 |
| 0.320–0.339 | 1.000 |
| 0.340–0.359 | 1.000 |

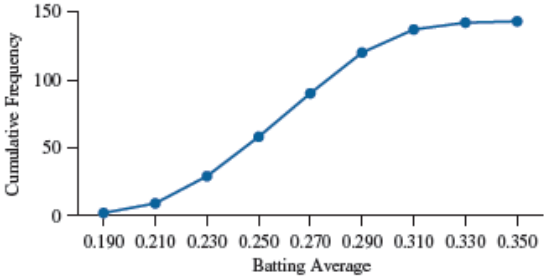
**(D)**




**(E)**

| Batting Average | Cumulative Frequency |
|---|---|
| 0.180–0.199 | 2 |
| 0.200–0.219 | 9 |
| 0.220–0.239 | 29 |
| 0.240–0.259 | 58 |
| 0.260–0.279 | 90 |
| 0.280–0.299 | 120 |
| 0.300–0.319 | 137 |
| 0.320–0.339 | 142 |
| 0.340–0.359 | 143 |

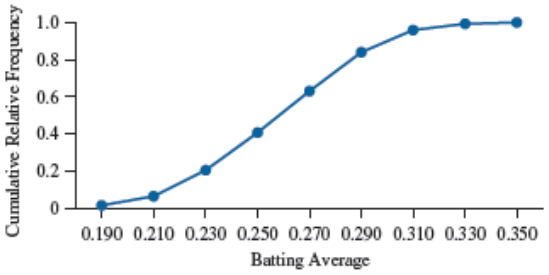
**(F)**



**(G)**

| Batting Average | Cumulative Relative Frequency |
|---|---|
| 0.180–0.199 | 0.014 |
| 0.200–0.219 | 0.063 |
| 0.220–0.239 | 0.203 |
| 0.240–0.259 | 0.406 |
| 0.260–0.279 | 0.629 |
| 0.280–0.299 | 0.839 |
| 0.300–0.319 | 0.958 |
| 0.320–0.339 | 0.993 |
| 0.340–0.359 | 1.000 |

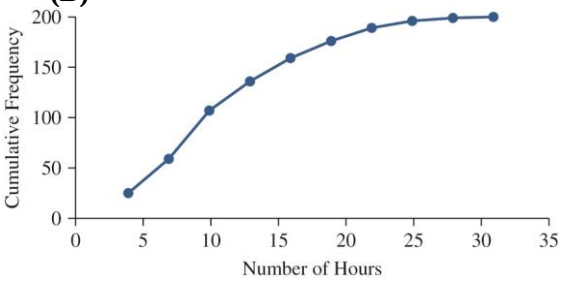
**(H)**




**41. (A)**

| Number of Hours | Cumulative Frequency |
|---|---|
| 3.9 | 25 |
| 6.9 | 59 |
| 9.9 | 107 |
| 12.9 | 136 |
| 15.9 | 159 |
| 18.9 | 176 |
| 21.9 | 189 |
| 24.9 | 196 |
| 27.9 | 199 |
| 30.9 | 200 |

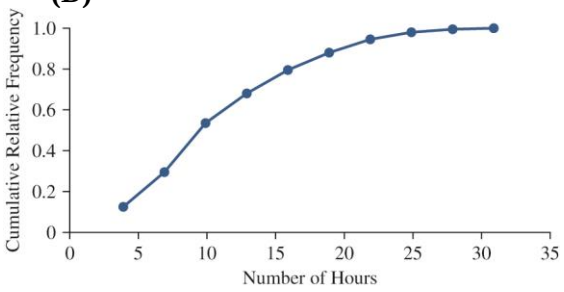
**(B)**




**(C)**

| Number of Hours | Cumulative Relative Frequency |
|---|---|
| 3.9 | 0.125 |
| 6.9 | 0.295 |
| 9.9 | 0.535 |
| 12.9 | 0.680 |
| 15.9 | 0.795 |
| 18.9 | 0.880 |
| 21.9 | 0.945 |
| 24.9 | 0.980 |
| 27.9 | 0.995 |
| 30.9 | 1.000 |

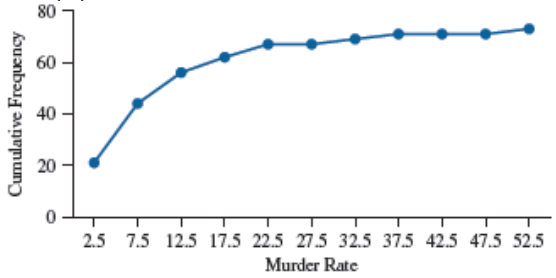
**(D)**




**42. (A)**

| Murder Rate | Cumulative Frequency |
|---|---|
| 0.0–4.9 | 21 |
| 5.0–9.9 | 44 |
| 10.0–14.9 | 56 |
| 15.0–19.9 | 62 |
| 20.0–24.9 | 67 |
| 25.0–29.9 | 67 |
| 30.0–34.9 | 69 |
| 35.0–39.9 | 71 |
| 40.0–44.9 | 71 |
| 45.0–49.9 | 71 |
| 50.0–54.9 | 73 |

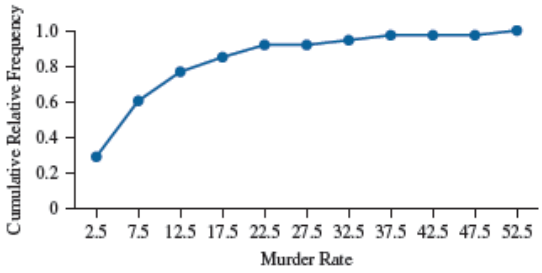
**(B)**



**(C)**

| Murder Rate | Cumulative Frequency |
|---|---|
| 0.0–4.9 | 0.288 |
| 5.0–9.9 | 0.603 |
| 10.0–14.9 | 0.767 |
| 15.0–19.9 | 0.849 |
| 20.0–24.9 | 0.918 |
| 25.0–29.9 | 0.918 |
| 30.0–34.9 | 0.945 |
| 35.0–39.9 | 0.973 |
| 40.0–44.9 | 0.973 |
| 45.0–49.9 | 0.973 |
| 50.0–54.9 | 1.000 |

**(D)**




**43.** Because "30 or more" represents an open ended class.

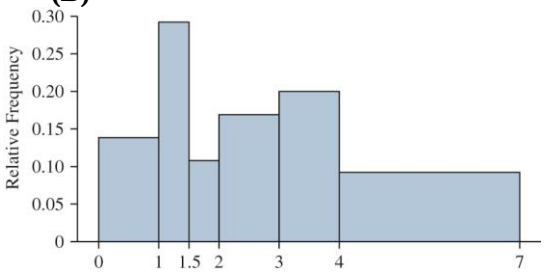
**44.** Yes. The last class would become 30-34.9.

**Extending the Concepts**

**45.** We need to solve the following equation: 0.2 + 0.3 + 0.15 + $x$ + 0.1 + 0.1 = 1 Answer: $x$ = 0.15

**46. (A)** The respective class widths are 1, 0.5, 0.5, 1, 1, and 3.

**(B)**

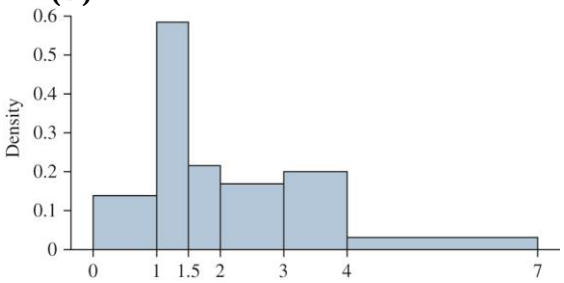



This histogram gives a distorted picture of the data because it makes it look like this is a bimodal distribution, when in reality, Figure 2.6 shows that the data has one mode and is skewed to the right.

**(C)**

| Class | Relative Frequency | Density |
|---|---|---|
| 0.00–0.99 | 0.138 | 0.138 |
| 1.00–1.49 | 0.292 | 0.584 |
| 1.50–1.99 | 0.108 | 0.216 |
| 2.00–2.99 | 0.169 | 0.169 |
| 3.00–3.99 | 0.200 | 0.200 |
| 4.00–6.99 | 0.092 | 0.031 |

**(D)**




**(E)** The histogram in part (D) also has only one mode and is skewed to the right, just as the histogram in Figure 2.6. The differing class widths in a density histogram do not distort the data because dividing the relative frequency by the class width puts the proportionality into the respective classes.

**47. (i)** is skewed and **(ii)** is approximately symmetric

**48.** Skewed to the right because the first two classes have relative frequencies of 0.2 and 0.37, whereas the rest are all less than 0.15.

## Section 2.3 Exercises

**Exercises 1 and 2 are the Check Your Understanding exercises located within the section. Their answers are found on page 78.**

**Understanding the Concepts**

**3.** leaf

**4.** stems

**5.** time-series plot

**6.** time

**7.** True

**8.** False. In a stem-and-leaf plot, each leaf must be a single digit.

**9.** True

**10.** False. In a time-series plot, the horizontal axis represents time.

**Practicing the Skills**

**11.**

| | |
|---|---|
| 1 | 1225566 |
| 2 | 0012779 |
| 3 | 19 |
| 4 | 556 |
| 5 | 02578 |

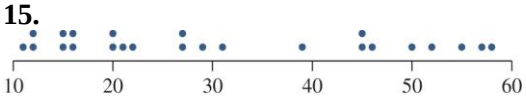
**12.**

| | |
|---|---|
| 48 | 019 |
| 49 | 12445999 |
| 50 | 13345 |
| 51 | 047799 |
| 52 | 2455 |

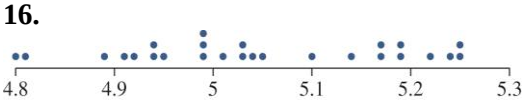
**13.** The list is: 30 30 31 32 35 36 37 37 39 42 43 44 45 46 47 47 47 47 48 48 49 50 51 51 51 52 52 52 52 54 56 57 58 58 59 61 63

**14.** The list is: 14.4 14.6 14.8 14.9 15.1 15.2 15.2 15.4 15.5 15.7 15.7 15.8 16.0 16.1 16.1 16.1 16.2 16.3 16.7 16.7 16.9 18.2 18.3 18.8

**15.**




**16.**




**Working with the Concepts**

**17. (A)**

| | |
|---|---|
| 3 | 1137999 |
| 4 | 3447888 |
| 5 | 0355678 |
| 6 | 0034459 |
| 7 | 0458 |
| 8 | 12679 |
| 9 | 001447 |
| 10 | 8 |
| 11 | 5 |
| 12 | |
| 13 | |
| 14 | 1 |

**(B)**

| | |
|---|---|
| 3 | 113 |
| 3 | 7999 |
| 4 | 344 |
| 4 | 7888 |
| 5 | 03 |
| 5 | 55678 |
| 6 | 00344 |
| 6 | 59 |
| 7 | 04 |
| 7 | 58 |
| 8 | 12 |
| 8 | 679 |
| 9 | 00144 |
| 9 | 7 |
| 10 | |
| 10 | 8 |
| 11 | |
| 11 | 5 |
| 12 | |
| 12 | |
| 13 | |
| 13 | |
| 14 | 1 |
| 14 | |

**(C)** The one in part (A) is more appropriate because part (B) has too many stems with no leaves. The stem-and-leaf plot in part (A) shows that most prices are in the 30's, 40's, and 50's, and that the data is skewed to the right.

**18. (A)**

| | |
|---|---|
| 4 | 88 |
| 5 | 111222333566666788889 |
| 6 | 011123334455666677778889 |
| 7 | 011334566778 |

**(B)**

| | |
|---|---|
| 4 | |
| 4 | 88 |
| 5 | 111222333 |
| 5 | 566666788889 |
| 6 | 0111233344 |
| 6 | 55666677778889 |
| 7 | 011334 |
| 7 | 566778 |

**(C)** The one in part (B) is more appropriate because most of the leaves are on three stems (temperatures in the 50's, 60's, and 70's). For this reason, the stem-and-leaf plot in part (A) does not reveal much detail about the data.

**19. (A)**

| | |
|---|---|
| 0 | 3 |
| 0 | 55669999 |
| 1 | 01111112222333344 |
| 1 | 555666889 |
| 2 | 11124 |
| 2 | 556777 |
| 3 | 0111334 |
| 3 | 555678 |
| 4 | 02 |
| 4 | 6 |
| 5 | |
| 5 | 9 |
| 6 | |
| 6 | 66 |

**(B)** Both plots show that more leaves are on stem 1 than all other stems. However, the advantage to the split stem-and-leaf plot in part (A) is that it much better shows how the emissions data is skewed to the right.

**20.**

| | |
|---|---|
| 2 | 458 |
| 3 | 67 |
| 4 | 56 |
| 5 | 00179 |
| 6 | 1 |
| 7 | 01 |
| 8 | |
| 9 | 2889 |
| 10 | 8 |
| 11 | 9 |
| 12 | 4 |
| 13 | 017 |
| 14 | |
| 15 | 7 |
| 16 | 5 |
| 17 | |
| 18 | 2 |

**21. (A)**

| Wimbledon | | Master's |
|---|---|---|
| | 1 | |
| 87 | 1 | |
| 44444433322222222211111110 | 2 | 33 |
| 998777766665555 | 2 | 5666777888899 |
| 1100 | 3 | 01111222222333333 |
| | 3 | 5567888999 |
| | 4 | 123 |
| | 4 | 6 |

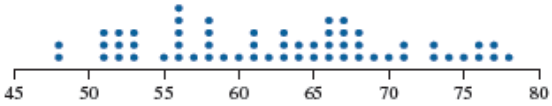
**(B)** Leaf 1 represents the ages of the Wimbledon winners and Leaf 2 represents the ages of the winners of the Master's. From this back-to-back split stem-and-leaf plot, we clearly see that the Wimbledon champions tend to be younger.

**22. (A)** In the following back-to-back split stem-and-leaf plot, Leaf 1 displays the lengths of time of the PG movies and Leaf 2 does so for the R rated movies.

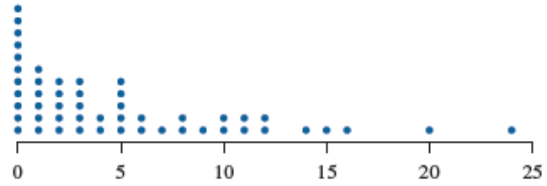
| PG or PG-13 | | R |
|---|---|---|
| 98 | 8 | 8 |
| 8877 | 9 | 34577 |
| 80 | 10 | |
| 542 | 11 | 0188 |
| 76 | 12 | 02 |
| | 13 | |
| 5 | 14 | |
| | 15 | 7 |
| 6 | 16 | 5 |

**(B)** They are roughly similar. Notice that the rows are roughly equal.

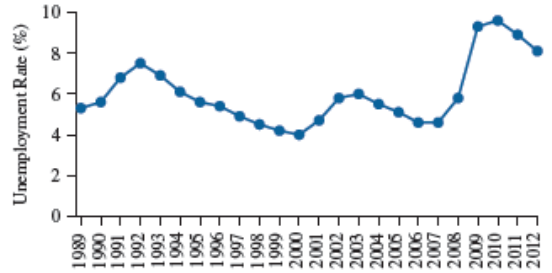
**23.** Yes, there are some gaps in the dotplot below for the Macon, GA temperature data.




**24.** This dotplot shows that the data is skewed to the right.

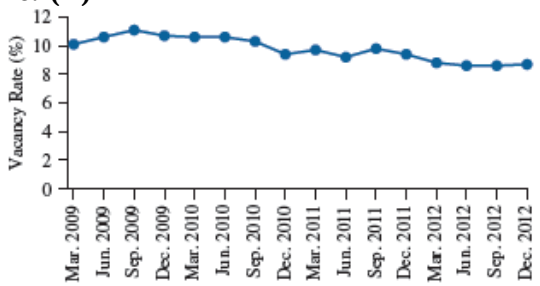



**25. (A)**



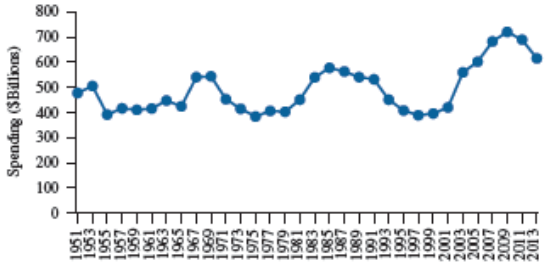

**(B)** Increasing: 89-92, 00-03, and 07-10
Decreasing: 92-00, 03-07 (06 = 07), and 10-12.

**26. (A)**




**(B)** Decreasing over that period.

**27. (A)**

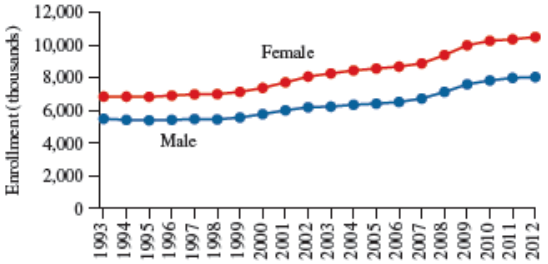



**(B)** It increased in the 50's, 60's, 80's, and 00's. It decreased in the 70's and 90's.

**(C)** It caused a big decrease.

**(D)** It increased from 1965 to 1969, and then decreased from 1969 to 1975.

**28. (A)**




**(B)** Female enrollment is growing faster.

**29. (A)** $800 billion

**(B)** $300 billion. From $700 billion to $1 trillion.

**(C)** True. $1100 is approximately twice $600.

**(D)** False. Almost, but it dipped from 2008 to 2009.

**30. (A)** 1980. As evidenced by 0 gold medals.

**(B)** 85

**(C)** Staying about the same

**31. (A)** 115 inches

**(B)** 1910

**(C)** Less than

**(D)** True. It occurred in the 1880s.

**(E)** False.

**32. (A)** 1999

**(B)** The two events decreased their average salaries.

**33. (A)** False. It increased in 5 years and decreased in only 2.

**(B)** True.

**(C)** False. 2005 spent less than 2009.

**(D)** True.

**34. (A)** 1991

**(B)** 2011

**(C)** True.

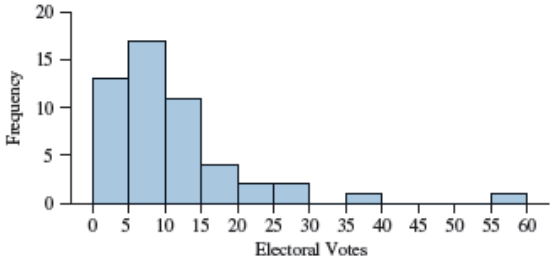
**(D)** False. It increased in 5 of those years.

## Extending the Concepts

**35. (A)**

| | |
|---|---|
| 0 | 3333333344444 |
| 0 | 55566666677788999 |
| 1 | 00001111234 |
| 1 | 5668 |
| 2 | 00 |
| 2 | 99 |
| 3 | |
| 3 | 8 |
| 4 | |
| 4 | |
| 5 | |
| 5 | 5 |

**(B)**




**(C)** They both have the same shape (skewed to the right), because the class width in the histogram is 5, as is each line for each stem 5. The number of leaves in each stem is the frequency of occurrence, which is also the height of the bars in the histogram.

## Section 2.4 Exercises

**Exercises 1 and 2 are the Check Your Understanding exercises located within the section. Their answers are found on page 85.**

### Understanding the Concepts

**3.** 0

**4.** proportional

**5.** (i). Graph (A) presents an accurate picture, because the baseline is at zero. Graph (B) exaggerates the decline, because the baseline is above zero.

**6.** The bar graph does presents a more accurate picture because its baseline is correctly placed at 0. The time-series plot exaggerates the rate of the increase.

**7.** The bar graph is more accurate. The pictures of the dollars make the difference appear much larger than the bar graph does. The reason is that both the height and length of the dollar has been increased.

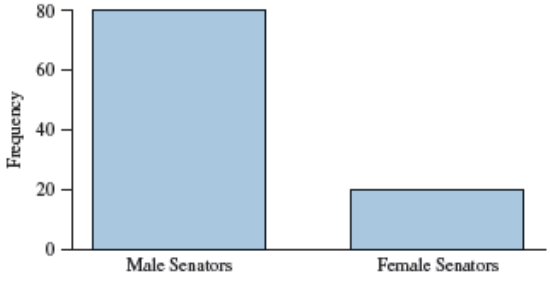
**8.** Graph (B) presents the more accurate picture, because it follows the area principle. In Graph (A), the area of the larger image is about four times that of the smaller image. This exaggerates the difference.

**9.** The bar graph is an accurate depiction because the baseline is at 0.

**10.** It is misleading because the baseline is not placed at zero.

**11.** **(A)** It is misleading because you can see the tops of the bars in the three-dimensional graph. This often causes them to look shorter than they really are.

**(B)**



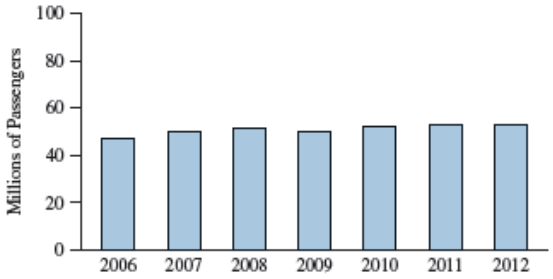

**12.** It is misleading because the baseline is not placed at zero.

**13.** (ii) is more accurate. The plot on the left has its baseline at zero, and presents an accurate picture. The plot on the right exaggerates the increase.

**14.** Option (ii) is the correct one, because it correspondingly matches up with graph (A) which is the correct one. Graph (B) does not have a baseline value of zero, so it gives the incorrect description of option (i).

### Extending the Concepts

**15.** **(A)**




**(B)** Yes, it makes the differences look smaller, because the scale on the *y*-axis extends much farther than the largest bar height.

**(C)** Figure 2.23 does. It has a baseline of zero (unlike Figure 2.24), with a more accurate depiction of the range of data values than the graph in part (A) above.

### Chapter Quiz

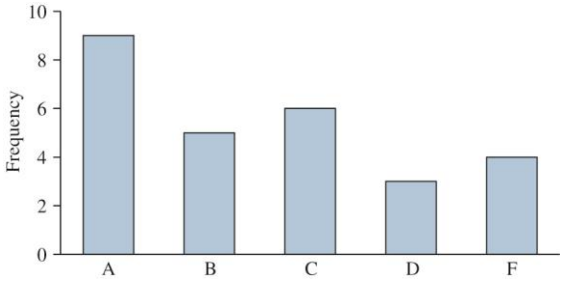
**1.**

| Grade | Frequency |
|---|---|
| A | 9 |
| B | 5 |
| C | 6 |
| D | 3 |
| F | 4 |

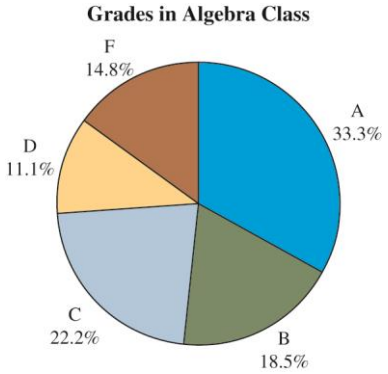
**2.**

| Grade | Relative Frequency |
|---|---|
| A | 0.333 |
| B | 0.185 |
| C | 0.222 |
| D | 0.111 |
| F | 0.148 |

**3.**



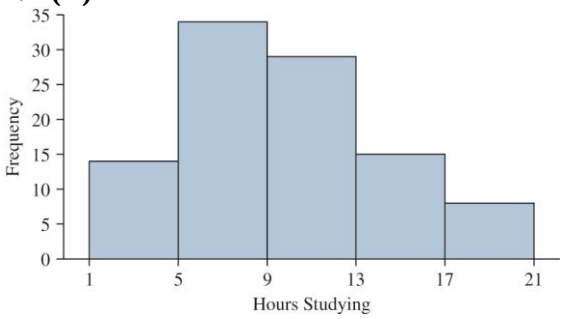

**4.**



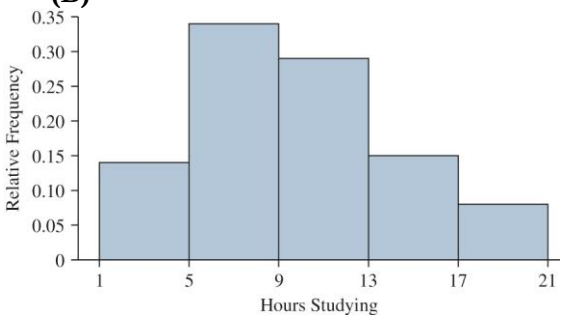

**5.** The classes are: 5.0-7.9, 8.0-10.9, 11.0-13.9, 14.0- 16.9, and 17.0-19.9. The class width is 3.

**6.** True

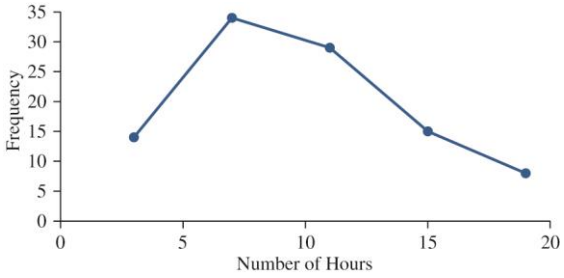
**7.** **(A)**



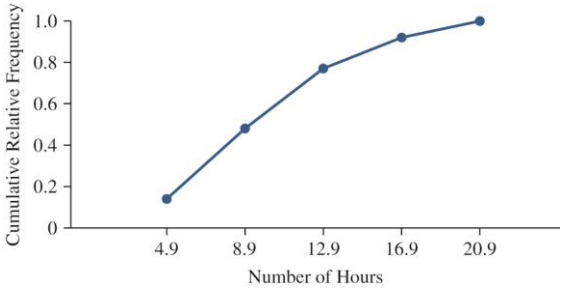

**(B)**




**8.**




**9.**




**10.** 11 11 15 15 19 19 19 22 22 23 25 27 28 30 30 38 44 45 47 48 50 51 53 53 55 56 58

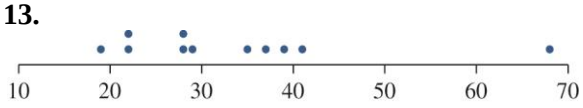
**11.**

| | |
|---|---|
| 1 | 9 |
| 2 | 22889 |
| 3 | 579 |
| 4 | 1 |
| 5 | |
| 6 | 8 |

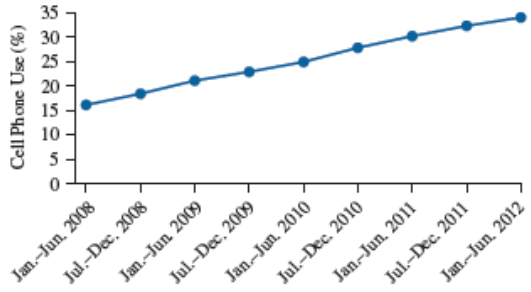
**12.**

| Espresso Makers | | Coffee Makers |
|---|---|---|
| | 1 | 9 |
| 5 | 2 | 22889 |
| 10 | 3 | 579 |
| 0 | 4 | 1 |
| 600 | 5 | |
| 5 | 6 | 8 |
| 70 | 7 | |
| | 8 | |
| 99 | 9 | |

**13.**



**14.**

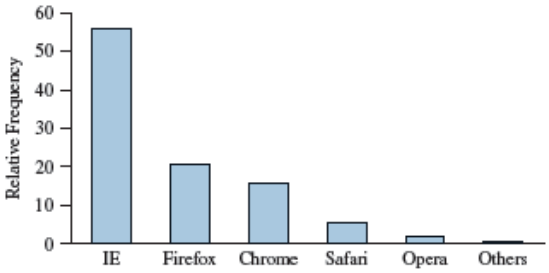



**15.** Twice

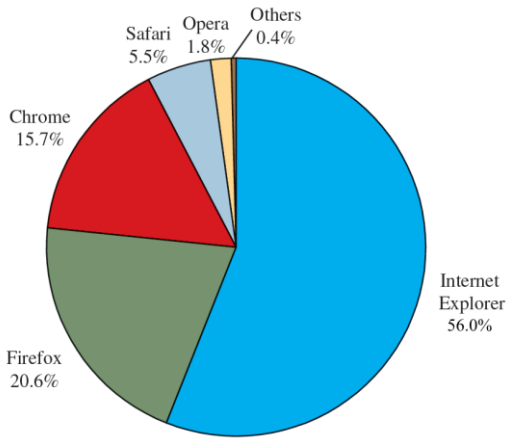
**Review Exercises**

**1.** **(A)** Somewhat
**(B)** True
**(C)** False. Roughly 36% believe these ways, which is less than half.
**(D)** True

**2.** **(A)**

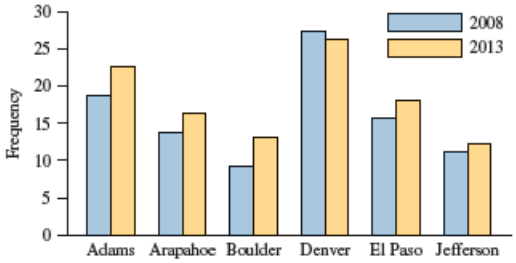



**(B)**



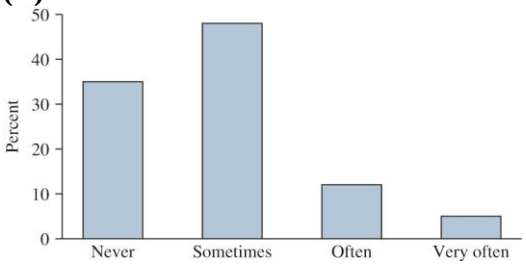

**(C)** False, they account for 21.2%, which is less than 30%.

**3.** **(A)**

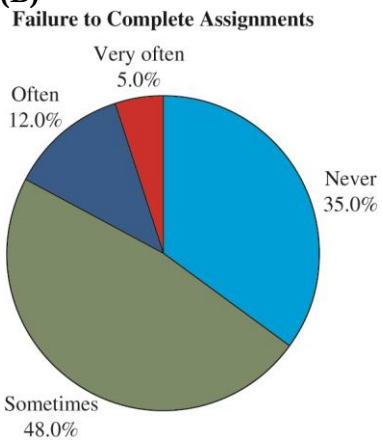



**(B)** False, this statement was almost true. It did increase for every county except Denver.
**(C)** Adams. It went up 4%.

**4.** **(A)**




**(B)**

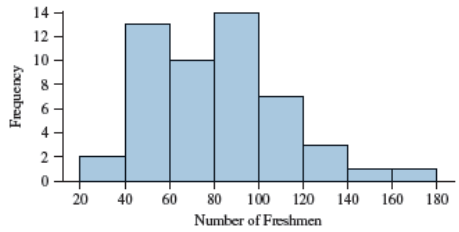



**(C)** False. 48% is less than half.

**5.** **(A)** 7
**(B)** 10
**(C)** $\frac{5}{50} = \frac{1}{10} = 10\%$
**(D)** Unimodal

**6.** **(A)** 8
**(B)** 20
**(C)** The lower class limit are 20, 40, 60, 80, 100, 120, 140, and 160. The upper class limits are 39, 59, 79, 99, 119, 139, 159, and 179.

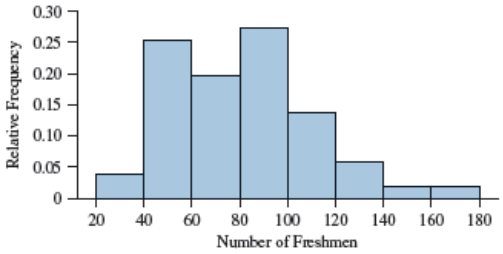
**(D)**




**(E)**

| Number of Freshmen | Relative Frequency |
|---|---|
| 20–39 | 0.039 |
| 40–59 | 0.255 |
| 60–79 | 0.196 |
| 80–99 | 0.275 |
| 100–119 | 0.137 |
| 120–139 | 0.059 |
| 140–159 | 0.020 |
| 160–179 | 0.020 |

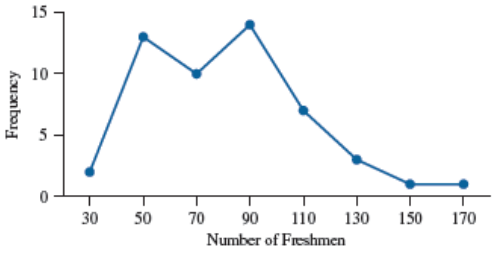
**(F)**



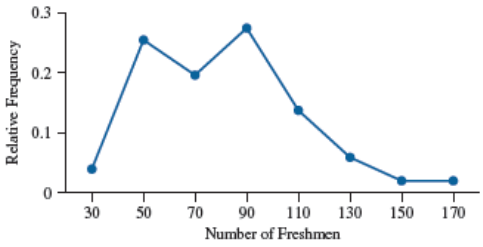

**(G)** $\frac{12}{51} = .235 = 23.5\%$

**(H)** $\frac{15}{51} = .294 = 29.4\%$

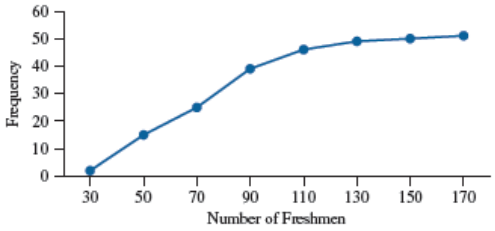
**7. (A)**



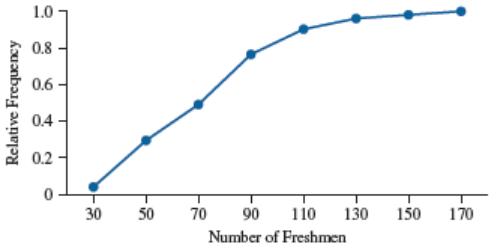

**(B)**




**(C)**



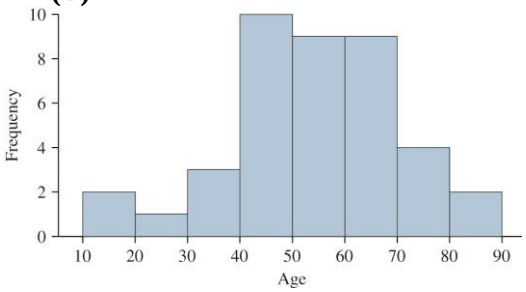

**(D)**




**8. (A)**

| Age | Frequency |
|---|---|
| 10–19 | 2 |
| 20–29 | 1 |
| 30–39 | 3 |
| 40–49 | 10 |
| 50–59 | 9 |
| 60–69 | 9 |
| 70–79 | 4 |
| 80–89 | 2 |

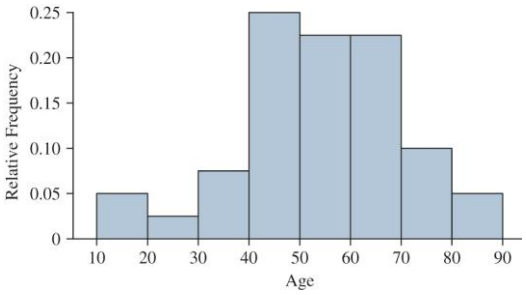
**(B)**




**(C)**

| Age | Relative Frequency |
|---|---|
| 10–19 | 0.050 |
| 20–29 | 0.025 |
| 30–39 | 0.075 |
| 40–49 | 0.250 |
| 50–59 | 0.225 |
| 60–69 | 0.225 |
| 70–79 | 0.100 |
| 80–89 | 0.050 |

**(D)**



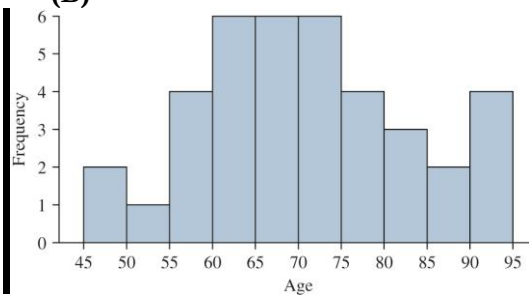

**9.**

| | |
|---|---|
| 1 | 25 |
| 2 | 8 |
| 3 | 235 |
| 4 | 0012368999 |
| 5 | 124566889 |
| 6 | 457777889 |
| 7 | 0167 |
| 8 | 11 |

**10. (A)**

| Age | Frequency |
|---|---|
| 45–49 | 2 |
| 50–54 | 1 |
| 55–59 | 4 |
| 60–64 | 6 |
| 65–69 | 6 |
| 70–74 | 6 |
| 75–79 | 4 |
| 80–84 | 3 |
| 85–89 | 2 |
| 90–94 | 4 |

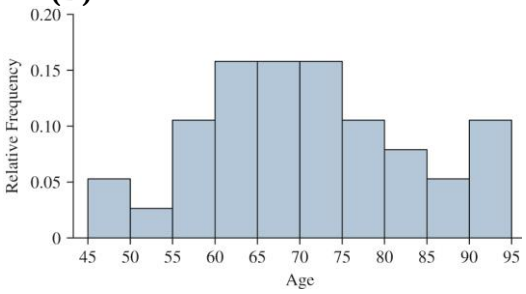
**(B)**




**(C)**

| Age | Relative Frequency |
|---|---|
| 45–49 | 0.053 |
| 50–54 | 0.026 |
| 55–59 | 0.105 |
| 60–64 | 0.158 |
| 65–69 | 0.158 |
| 70–74 | 0.158 |
| 75–79 | 0.105 |
| 80–84 | 0.079 |
| 85–89 | 0.053 |
| 90–94 | 0.105 |

**(D)**




**11. (A)**

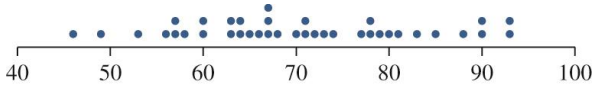
| Presidents | | Monarchs |
|---|---|---|
| | 1 | 25 |
| | 2 | 8 |
| | 3 | 235 |
| 96 | 4 | 0012368999 |
| 87763 | 5 | 124566889 |
| 877765443300 | 6 | 457777889 |
| 9887432110 | 7 | 0167 |
| 85310 | 8 | 11 |
| 3300 | 9 | |

**(B)**

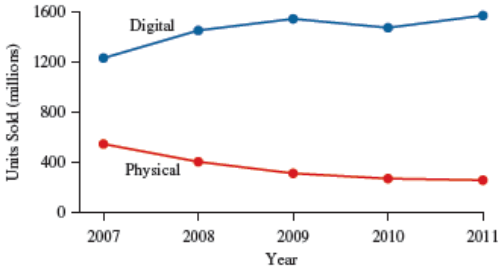
| Presidents | | Monarchs |
|---|---|---|
| | 1 | 2 |
| | 1 | 5 |
| | 2 | |
| | 2 | 8 |
| | 3 | 23 |
| | 3 | 5 |
| | 4 | 00123 |
| 96 | 4 | 68999 |
| 3 | 5 | 124 |
| 8776 | 5 | 566889 |
| 443300 | 6 | 4 |
| 877765 | 6 | 57777889 |
| 432110 | 7 | 01 |
| 9887 | 7 | 67 |
| 310 | 8 | 11 |
| 85 | 8 | |
| 3300 | 9 | |
| | 9 | |

**(C)** The one with split stems in part (B) provides a more appropriate level of detail.

**12.**

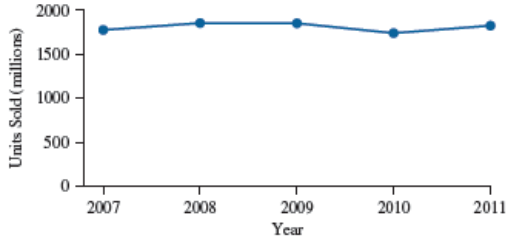



**13. (A)**

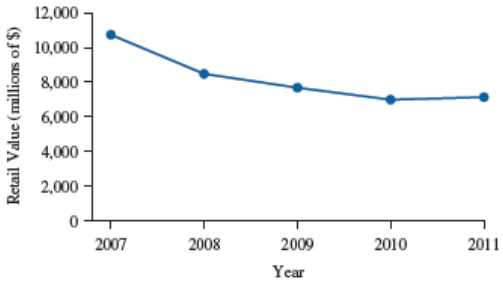



**(B)** They are inversely related. That is, as digital sales increase, physical sales decrease.

**14. (A)**




**(B)**




**(C)** The total units sold has been increasing, but the total retail value has been decreasing. This is because the total sold is going up due to increased units sold of the cheaper format (digital).

**15.** Option (i) is the correct statement, because the second graph is misleading due to the fact that its baseline does not start at zero.

**Write About It**

1. A frequency bar graph and the relative frequency bar graph for the same data are identical except for the scale on the vertical axis. This is because the relative frequency bar graph converts the frequencies to their corresponding proportional equivalents.
2. The main difference between frequency distributions for qualitative and quantitative data is that there are no natural categories for quantitative data. For quantitative data, the data must be divided into classes
3. Answers will vary.
4. Answers will vary.
5. Answers will vary.

**Case Study: Do Late-Model Cars Get Better Gas Mileage?**

**1.**

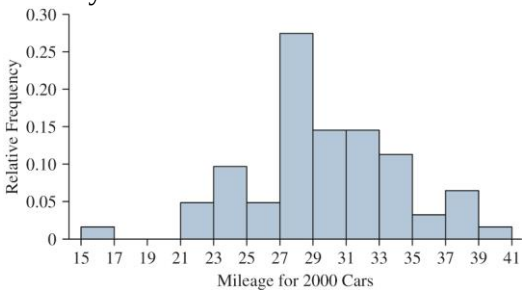
| Mileage | Frequency |
|---|---|
| 16.0–16.9 | 1 |
| 17.0–17.9 | 0 |
| 18.0–18.9 | 0 |
| 19.0–19.9 | 0 |
| 20.0–20.9 | 0 |
| 21.0–21.9 | 3 |
| 22.0–22.9 | 0 |
| 23.0–23.9 | 3 |
| 24.0–24.9 | 3 |
| 25.0–25.9 | 0 |
| 26.0–26.9 | 3 |
| 27.0–27.9 | 9 |
| 28.0–28.9 | 8 |
| 29.0–29.9 | 3 |
| 30.0–30.9 | 6 |
| 31.0–31.9 | 6 |
| 32.0–32.9 | 3 |
| 33.0–33.9 | 4 |
| 34.0–34.9 | 3 |
| 35.0–35.9 | 1 |
| 36.0–36.9 | 1 |
| 37.0–37.9 | 1 |
| 38.0–38.9 | 3 |
| 39.0–39.9 | 0 |
| 40.0–40.9 | 1 |

**2.** A class width of one is too narrow for these data because there are many classes with 0 or 1 car in them.

**3.**

| Mileage | Frequency | Relative Frequency |
|---|---|---|
| 15.0–16.9 | 1 | 0.016 |
| 17.0–18.9 | 0 | 0.000 |
| 19.0–20.9 | 0 | 0.000 |
| 21.0–22.9 | 3 | 0.048 |
| 23.0–24.9 | 6 | 0.097 |
| 25.0–26.9 | 3 | 0.048 |
| 27.0–28.9 | 17 | 0.274 |
| 29.0–30.9 | 9 | 0.145 |
| 31.0–32.9 | 9 | 0.145 |
| 33.0–34.9 | 7 | 0.113 |
| 35.0–36.9 | 2 | 0.032 |
| 37.0–38.9 | 4 | 0.065 |
| 39.0–40.9 | 1 | 0.016 |

**4.** We can see from the relative frequency histogram below, that it is unimodal, with very little skew.



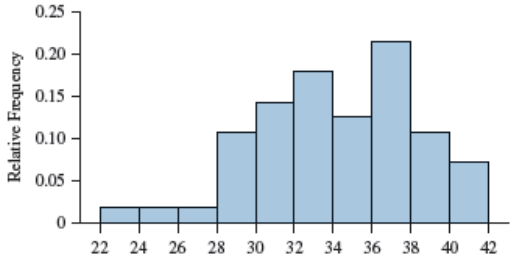

**5.** Answers will vary. Here is a frequency distribution with a class width of 2.

| Mileage | Frequency |
|---|---|
| 22–23.9 | 1 |
| 24–25.9 | 1 |
| 26–27.9 | 1 |
| 28–29.9 | 6 |
| 30–31.9 | 8 |
| 32–33.9 | 10 |
| 34–35.9 | 7 |
| 36–37.9 | 12 |
| 38–39.9 | 6 |
| 40–41.9 | 4 |

**6.** Answers will vary. Here is a relative frequency distribution with a class width of 2.

| Mileage | Relative Frequency |
|---|---|
| 22–23.9 | 0.018 |
| 24–25.9 | 0.018 |
| 26–27.9 | 0.018 |
| 28–29.9 | 0.107 |
| 30–31.9 | 0.143 |
| 32–33.9 | 0.179 |
| 34–35.9 | 0.125 |
| 36–37.9 | 0.214 |
| 38–39.9 | 0.107 |
| 40–41.9 | 0.071 |

**7.** We can see from the relative frequency histogram below, that it is unimodal, with slight skew to the left.




**8.** 2013 cars tend to have the higher MPG's.

**9.** The back-to-back stem-and-leaf plot (displayed immediately below) illustrates the comparison better than the histograms (displayed above) do. This is because all of the data in the comparison is right there in one plot, as opposed to having to look between two different histograms.

| 2000 Cars | | 2013 Cars |
|---|---|---|
| | 1 | |
| 6 | 1 | |
| 444333111 | 2 | 2 |
| 99988888888777777777666 | 2 | 57999999 |
| 4443333222111111000000 | 3 | 000001112222233333444 |
| 88765 | 3 | 555666667777778889996 |
| 0 | 4 | 0000 |