# *Understanding Basic Statistics 8th edition Brase Solutions Manual*

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# Complete Solutions Manual to Accompany

# Understanding Basic Statistics

## EIGHTH EDITION

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Understanding Basic Statistics 8th edition Brase Solutions Manual

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# Chapter 1: Getting Started

## Section 1.1

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**1.** Individuals are people or objects included in the study, while a variable is a characteristic of the individual that is measured or observed.

**2.** Nominal data are always qualitative.

**3.** A parameter is a numerical measure that describes a population. A statistic is a numerical value that describes a sample.

**4.** If the population does not change, the values of the parameters will not change. Thus, for a fixed population, parameter values are constant. If we take three samples of the same size from a population, the values of the sample statistics will almost surely differ.

**5.** **(a)** These numerical assignments are at the nominal level. There is no apparent ordering in the responses.
**(b)** These numerical assignments are at the ordinal level. There is an increasing relationship from worst to best levels of service. These assignments are not at the interval or ratio level. The distances between numerical responses are not meaningful. The ratios are also not meaningful.

**6.** Lucy's observations do not apply to all adults; they apply only to her friends. Since the sample is not random, we cannot draw any conclusions about a larger group using this data.

**7.** **(a)** Meal ordered at fast-food restaurants.
**(b)** Qualitative
**(c)** Response for all U.S. adult fast-food consumers.

**8.** **(a)** Miles per gallon.
**(b)** Quantitative.
**(c)** All new small hybrid cars.

**9.** **(a)** Nitrogen concentration (milligrams of nitrogen per liter of water).
**(b)** Quantitative.
**(c)** Nitrogen concentration in the entire lake.

**10.** **(a)** Number of ferromagnetic artifacts per 100 square meters.
**(b)** Quantitative.
**(c)** The number of ferromagnetic artifacts per each distinct 100-square-meter plot in the Tara region.

**11.** **(a)** Ratio. **(b)** Interval. **(c)** Nominal. **(d)** Ordinal. **(e)** Ratio. **(f)** Ratio.

**12.** **(a)** Ordinal. **(b)** Ratio. **(c)** Nominal. **(d)** Interval. **(e)** Ratio. **(f)** Nominal.

**13.** **(a)** Nominal. **(b)** Ratio. **(c)** Interval. **(d)** Ordinal. **(e)** Ratio. **(f)** Interval.

**14.** *Form B* is better. Statistical methods can be applied to the ordinal data obtained from *Form B* but not to the open-response answers obtained from *Form A*.

**15.** **(a)** Answers vary. Ideally, weigh the packs in pounds using a digital scale that has tenths of pounds for accuracy.
**(b)** Some students may refuse to have their backpacks weighed.
**(c)** Informing students before class may cause students to remove items before class.

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## Section 1.2

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**1.** In stratified samples, we select a random sample from each stratum. In cluster sampling, we randomly select clusters to be included, and then each member of the cluster is sampled.

**2.** In simple random samples, every sample of size $n$ has an equal chance of being selected. In a systematic sample, the only possible samples are those including every $k$th member of the population with respect to the random starting position.

**3.** Sampling error is the difference between the value of the population parameter and the value of the sample statistic that stems from the random selection process. The term is being used incorrectly here. Certainly larger boxes of cereal will cost more than smaller boxes of cereal.

**4.** The sample frame consists of students who use the college recreation center. No, some students may not use the recreation center.

**5.** No, even though the sample is random, some students younger than 18 or older than 20 may not have been included in the sample.

**6.** No, a random sample could include only music majors.

**7.** **(a)** Stratified.
**(b)** No, because each pooled sample would have 100 season ticket holders from men's basketball games and 100 for women's basketball games. Samples, for example, with 125 ticket holders for men's basketball games and 75 for women's games are not possible.

**8.** **(a)** Yes. Every student has a 50% chance of being selected.
**(b)** It is not possible based on this method of selecting students. Since every sample of size 20 is notpossible, this is not a simple random sample.
**(c)** Assign numbers 1, 2, …, 40 to the students and use a random-digits table or a computer package to draw random numbers.

**9.** Simply use a random digits table or a computer package to randomly select four students from the class.
**(a)** Answers vary. Perhaps they are excellent students who make an effort to get to class early.
**(b)** Answers vary. Perhaps they are busy students who are never on time to class.
**(c)** Answers vary. Perhaps students in the back row are introverted.
**(d)** Answers vary. Perhaps taller students are healthier.

**10.** **(a)** Students who are absent from class on Monday cannot be included in the sample.
**(b)** Home-schooled students, drop out students, or homeless students cannot be included in the sample.

**11.** Answers vary. **12.** Answers vary. **13.** Answers vary.

**14.** Answers vary. One possibility is to use 0, 1, 2, 3, and 4 to indicate heads, and 5, 6, 7, 8, and 9 to indicate tails.

**15.** **(a)** Yes, it is appropriate, as a number can repeat itself once it has occurred. The outcome on the fourth roll is 2.
**(b)** We will most certainly not get the same sequence of outcomes. The process is random.

**16.** Answers vary. We do expect at least one match on birthdays on over 50% of the times we run this experiment.

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**17.** Answers vary. Use single digits on the table to determine the placement of correct answers.

**18.** Answers vary. The test key would be a random arrangement of *True* and *False* responses.



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**19.** **(a)** Simple random sampling. Every sample of size *n* from the population has an equal chance of being selected, and every member of the population has an equal chance of being included in the sample.
**(b)** Cluster sampling. The state, Hawaii, is divided into ZIP Codes. Then, within each of the 10 selected ZIP Codes, all businesses are surveyed.
**(c)** Convenience sampling. This technique uses results or data that are conveniently and readily obtained.
**(d)** Systematic sampling. Every fiftieth business is included in the sample.
**(e)** Stratified sampling. The population was divided into strata based on business type. Then a simple random sample was drawn from each stratum.

**20.** **(a)** Stratified sampling. The population was divided into strata (four categories of length of hospital stay), and then a simple random sample was drawn from each stratum.
**(b)** Simple random sampling.
**(c)** Cluster sampling. There are five geographic regions, and some facilities from each region are selected randomly. Then, for each selected facility, all patients on the discharge list are surveyed to create the patient satisfaction profiles.
**(d)** Systematic sampling. Every 500$^{th}$ patient is included in the sample.
**(e)** Convenience sampling.

## Section 1.3

**1.** Answers vary. People with higher incomes will likely have high-speed Internet access, which will lead to spending more time online. Spending more time online might lead to spending less time watching TV. Thus, spending less time watching TV cannot be attributed solely to high income or high-speed internet access.

**2.** A double-blind procedure would entail neither the patients nor those administering the treatments knowing which patients received which treatments. This process should eliminate potential bias from the treatment administrators and from patient psychology regarding benefits of the drug.

**3.** No, respondents do not constitute a random sample from the community for several reasons, for instance, the sample frame includes only those at a farmer's market, Jill might not have approached people with large dogs or those who were busy, and participation was voluntary. Jill's T-shirt may have influenced respondents.

**4.** No, the pooled sample had a fixed number of students from each block.

**5.** **(a)** No, those aged 18 – 29 in 2006 became aged 20 – 31 in 2008. The study is looking at the same generation.
**(b)** 1977 to 1988, inclusive.

**6.** By 2020, the Echo generation will be aged 32-43, and their perception of items as necessities or luxuries might have changed by then.

**7.** **(a)** This is an observational study. The data collection method did not influence the outcome.
**(b)** This is an experiment. A treatment was imposed on the sheep in order to prevent heartworm.
**(c)** This is an experiment. The restrictions on fishing possibly led to a change in the length of trout in the river.
**(d)** This is an observational study. The data was collected without influencing the turtles.

**8.** **(a)** Sampling. **(b)** Simulation. **(c)** Census. **(d)** Experiment.

**9.** **(a)** Use randomization to select ten calves to inoculate with the vaccine. After a period of time, test all calves for the infection. No placebo is being used.
**(b)** Use randomization to select nine schools to visit. After ten weeks, survey students in all 18 schools for their views on police officers. No placebo is being used.
**(c)** Use randomization to select 40 subjects to use the skin patch. A placebo is used for the other 35 subjects. At the end of the trial, survey all 75 subjects about their smoking habits.

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**10.** **(a)** No. "Over the last few years" could mean 2 years, 3 years, 7 years, etc. A more precise phrase is, "Over the past 5 years."

**(b)** Yes. If a respondent is first asked, "Have you ever run a stop sign," chances are that their response to the question, "Should fines be doubled," will change. Those who run stop signs probably don't want the fine to double.

**(c)** Answers vary.

**11.** Based on the information, scheme A will be better because the blocks are similar. The plots bordering the river should be similar, and the plots away from the river should be similar.

## Chapter Review Problems

**1.** If a numerical measure describes an aspect of a sample, it is a statistic.

**2.** If a variable describes an individual by placing the individual in a category or group, the variable is qualitative.

**3.** If data consists of names, label, or categories with no implied criteria by which the data can be ordered from smallest to largest, the highest level of measurement for the data is nominal.

**4.** If it makes sense to say that one data measurement in a data set is twice that of another measurement in the set, the highest level of measurement for the data is ratio.

**5.** If every sample of size n has an equal chance of being selected, this is a simple random sample.

**6.** If a treatment is applied to subjects or objects in a study in order to observe a possible change in the variable of interest, the study is an experiment.

**7.** Using a random-number table to select numbers for a Sudoku puzzle would be very inefficient. It would be much better to look at existing numbers that meet the puzzle's requirements and eliminate numbers that don't work.

**8.** Alisha's study has a few problems and results will be anecdotal. For instance, it's not clear that the puzzles she wants to download are all of the same difficulty level. Her friends willing to participate will likely have different levels of experience with the puzzles. Her friends are also volunteers and the self-timing may lead to some inaccurate measurements.

**9.** **(a)** Stratified.

**(b)** Students on your campus with work-study jobs.

**(c)** Number of hours scheduled to work each week; Quantitative; Ratio.

**(d)** Applicability to future employment goals, as measured by the scale given; Qualitative; Ordinal.

**(e)** Statistic.

**(f)** The nonresponse rate is 60%, and yes, this could introduce bias into the results. Answers vary.

**(g)** No, since the students were only drawn from one campus, then the results of the study would only generalize to that campus, if the data were collected using randomization.

**10.** The implied population is all the listeners (or even all the voters). The variable is the voting preference of a caller. There is probably bias in the selection of the sample because those with the strongest opinions are most likely to call in.

**11.** Using the random-number table, pick seven digits at random. Digits 0, 1, and 2 can correspond to "Yes," and digits 3, 4, 5, 6, 7, 8, and 9 can correspond to "No." This will effectively simulate a random draw from a population with 30% TIVO owners.

**12.** **(a)** Cluster. **(b)** Convenience. **(c)** Systematic. **(d)** Simple random. **(e)** Stratified.



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**13.** **(a)** This was an observational study because the researchers did not apply a treatment.
**(b)** This was an experiment because the two groups were given different tests and the results were compared.

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**14.** **(a)** Randomly select 500 donors to receive the literature and 500 donors to receive the phone call. After the donation collection period, compare the percentage who donated from each of the two treatment groups. A placebo is not being used.
**(b)** Randomly select the 43 adults to be given the treatment gel and the 42 adults to receive the placebo gel. After the treatment period, compare the whiteness of the two groups. To make this double blind, neither the treatment administrators nor would the patients would know which gel the patients are receiving.
**(c)** Before assigning donors to the literature or the phone call, first block them into the three age groups. In each age group, half would receive the literature and half would receive the phone call. Compare the amounts received within each block.

**15.** Answers vary. Some items, such as age and grade point average, might be sensitive information. You could ask the class to design a data form that can be filled out anonymously. Other issues to discuss involve the accuracy and honesty of responses.

**16.** No response required.

**17.** **(a)** This is an experiment; the treatment was the amount of light given to the colonies.
**(b)** The control group is the colony exposed to normal light, while the treatment group is the exposed to continuous light.
**(c)** The number of fireflies living at the end of 72 hours.
**(d)** Ratio.

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# Chapter 2: Organizing Data

## Section 2.1

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**1.** Class limits are possible data values, and they specify the span of data values that fall within a class. Class boundaries are not possible data values; they are values halfway between the upper class limit of one class and the lower class limit of the next class.

**2.** Each data value must fall into one class. Data values above 50 do not have a class.

**3.** The classes overlap. A data value such as 20 falls into two classes.

**4.** These class widths are 11.

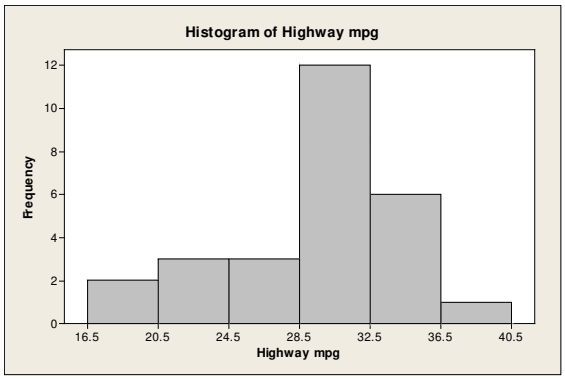
**5.** $\text{Width} = \frac{82-20}{7} \approx 8.86$, so round up to 9. The class limits are 20 – 28, 29 – 37, 38 – 46, 47 – 55, 56 – 64, 65 – 73, 74 – 82.

**6.** $\text{Width} = \frac{120-10}{5} = 22$, so round up to 23. The class limits are 10 – 32, 33 – 55, 56 – 78, 79 – 101, 102 – 124.

**7.** **(a)** The distribution is most likely skewed right, with many short times and only a few long wait times.
**(b)** A bimodal distribution might exist if there are different wait times during busy versus slow periods. During the morning rush, many long wait times might occur, but during the slow afternoon, most wait times will be very short.

**8.** The data set consists of the numbers 1 up through 100, with each value occurring once. The histogram will be uniform.

**9.** **(a)** Yes.
**(b)**

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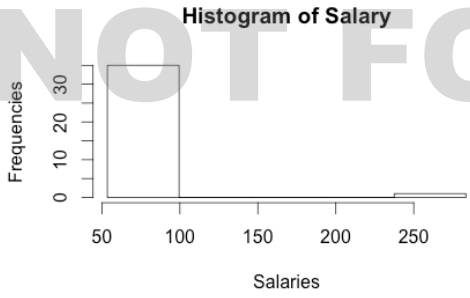
**10.** **(a)**

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**(b)** Yes. Yes.

**(c)**

**11.** **(a)** The range of data seem to fall between 7 and 13 with the bulk of the data between 8 and 12.

**(b)** All three histograms are somewhat mound-shaped with the top of the mound between 9.5 and 10.5. In all three histograms the bulk of the data fall between 8 and 12.

**12.** **(a)** Graph (i) midpoint: 5; graph (ii) midpoint: 4; graph (iii) midpoint: 2.

**(b)** Graph (i) 0-17; Graph (ii) 1-16; Graph (iii) 0-28.

**(c)** Graph (iii) is most clearly skewed right; Graph (ii) is somewhat skewed right; Graph (i) is barely skewed right.

**(d)** No, each random sample of same size froma population is equally likely to be drawn. Sample (iii) most clearly reflects the properties of the population. Sample (ii) reflects the properties fairly well, but sample(i) seems to differ more from the described population.

**13.** **(a)** Because there are 50 data values, divide each cumulative frequency by 50 and convert to a percent.

**(b)** 35 states.

**(c)** 6 states.

**(d)** 2%

**14.** **(a)** Graph (i).

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**(b)** Graph (iii)



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**(c)** Graph (iii)

**15.** **(a)** Class width = 25

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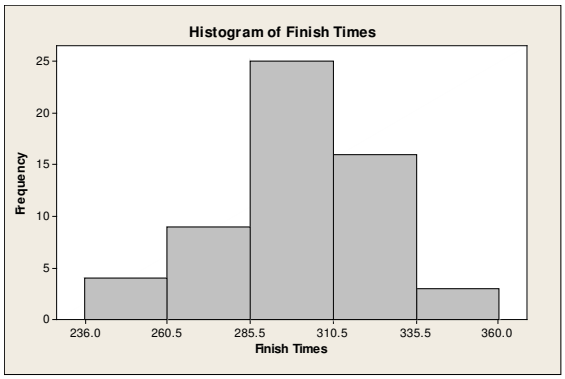
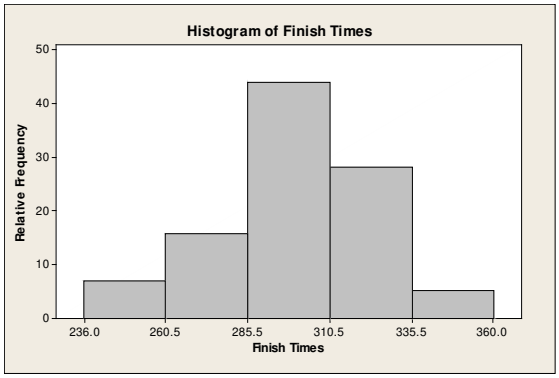
**(b)**

| Class Limits | Class Boundaries | Midpoints | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 236–260 | 235.5–260.5 | 248 | 4 | 0.07 | 4 |
| 261–285 | 260.5–285.5 | 273 | 9 | 0.16 | 13 |
| 286–310 | 285.5–310.5 | 298 | 25 | 0.44 | 38 |
| 311–335 | 310.5–335.5 | 323 | 16 | 0.28 | 54 |
| 336–360 | 335.5–360.5 | 348 | 3 | 0.05 | 57 |

**(c)**




**(d)**




**(e)** This distribution is slightly skewed to the left but fairly mound-shaped, symmetric.

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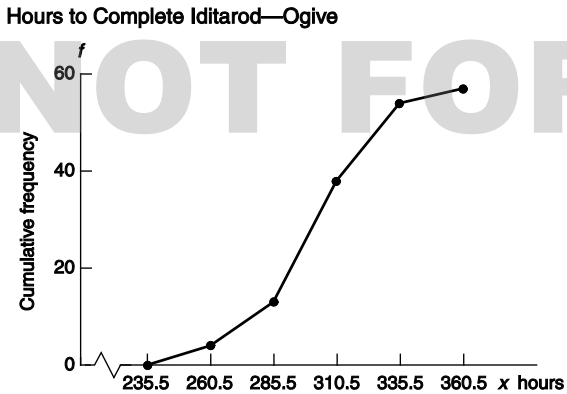
**(f)**

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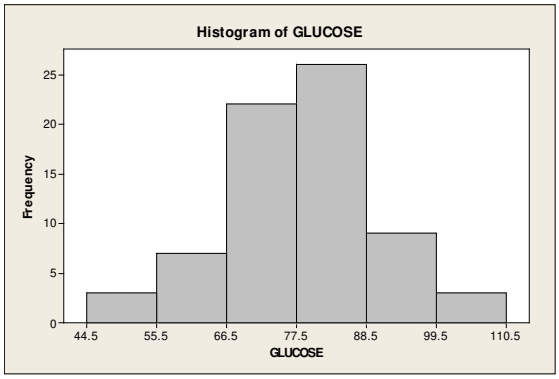
**(g)** Answers vary.

**16.** **(a)** Class width = 11

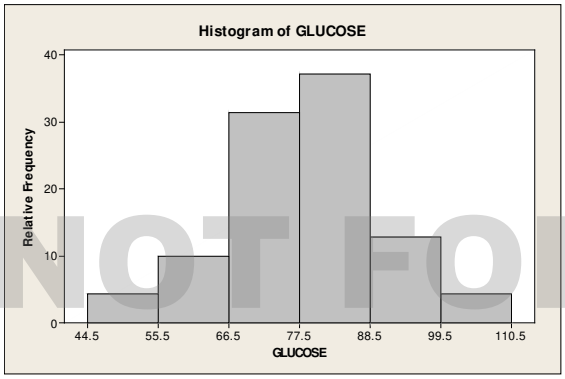
**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 45–55 | 44.5–55.5 | 50 | 3 | 0.0429 | 3 |
| 56–66 | 55.5–66.5 | 61 | 7 | 0.8714 | 10 |
| 67–77 | 66.5–77.5 | 72 | 22 | 0.3143 | 32 |
| 78–88 | 77.5–88.5 | 83 | 26 | 0.3714 | 58 |
| 89–99 | 88.5–99.5 | 94 | 9 | 0.1286 | 67 |
| 100–110 | 99.5–110.5 | 105 | 3 | 0.0429 | 70 |

**(c)**




**(d)**

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**(e)** Approximately mound-shaped, symmetric.

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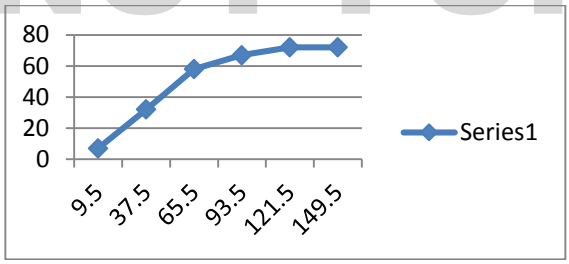
**(f)**



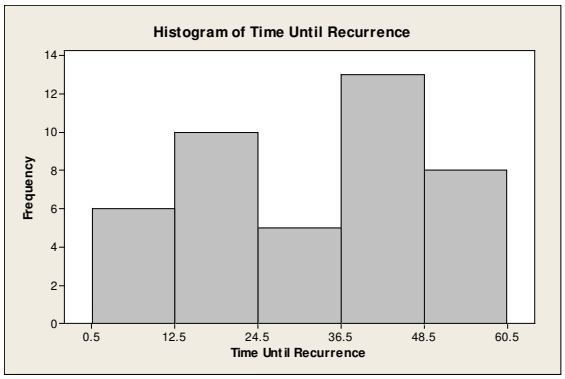

**(g)** Answers vary.

**17.** **(a)** Class width = 12

**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 1–12 | 0.5–12.5 | 6.5 | 6 | 0.14 | 6 |
| 13–24 | 12.5–24.5 | 18.5 | 10 | 0.24 | 16 |
| 25–36 | 24.5–36.5 | 30.5 | 5 | 0.12 | 21 |
| 37–48 | 36.5–48.5 | 42.5 | 13 | 0.31 | 34 |
| 49–60 | 48.5–60.5 | 54.5 | 8 | 0.19 | 42 |

**(c)**

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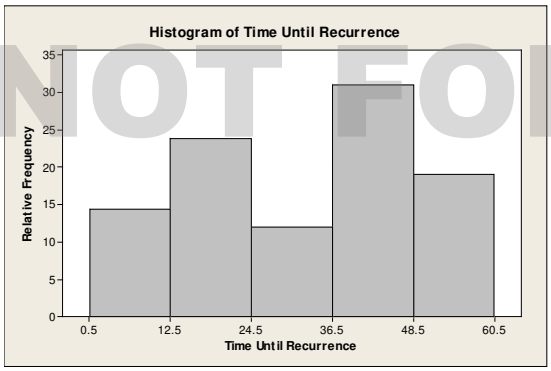
**(d)**

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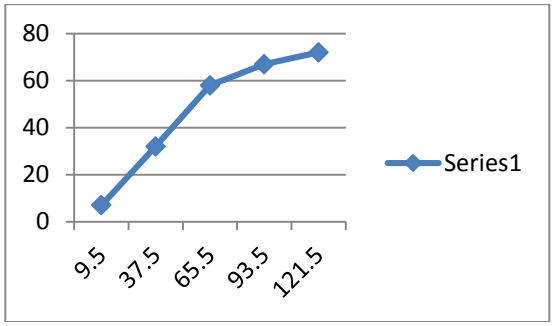
**(e)** The distribution is bimodal.

**(f)**



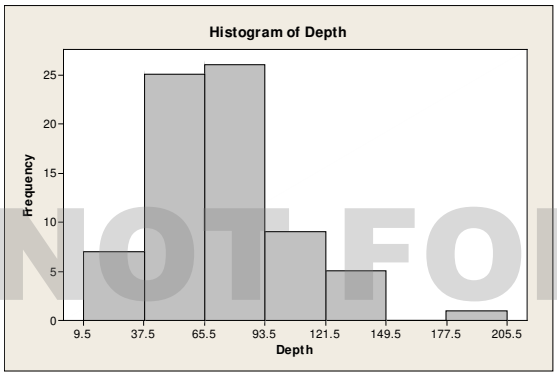

**(g)** Answers vary.

**18.** **(a)** Class width = 28.

**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency |
|---|---|---|---|---|
| 10–37 | 9.5–37.5 | 23.5 | 7 | 7 |
| 38–65 | 37.5–65.5 | 51.5 | 25 | 32 |
| 66–93 | 65.5–93.5 | 79.5 | 26 | 58 |
| 94–121 | 93.5–121.5 | 107.5 | 9 | 67 |
| 122–149 | 121.5–149.5 | 135.5 | 5 | 72 |
| 150–177 | 149.5–177.5 | 163.5 | 0 | 72 |
| 178–205 | 177.5–205.5 | 191.5 | 1 | 73 |

**(c)**

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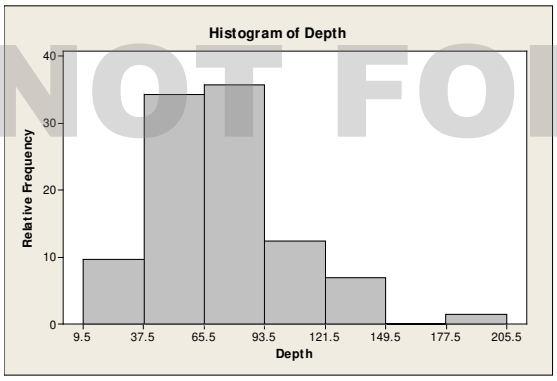
**(d)**

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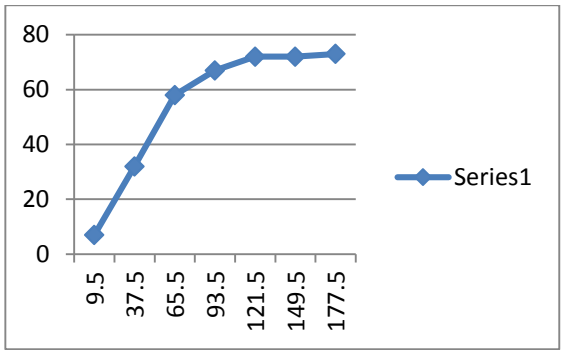
**(e)** This distribution is skewed right with a possible outlier.

**(f)**




**(g)** Answers vary.

**19.** **(a)** Class width = 11

**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 26–36 | 26.5–36.5 | 31 | 4 | 0.08 | 4 |
| 37–47 | 36.5–47.5 | 42 | 21 | 0.42 | 25 |
| 48–58 | 47.5–58.5 | 53 | 22 | 0.44 | 47 |
| 59–69 | 59.5–69.5 | 64 | 1 | 0.02 | 48 |
| 70–80 | 69.5–80.5 | 75 | 2 | 0.04 | 50 |

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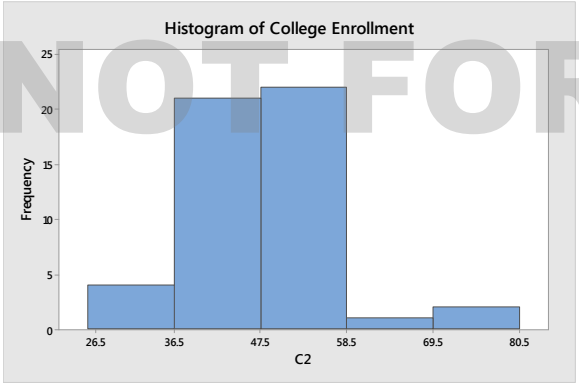
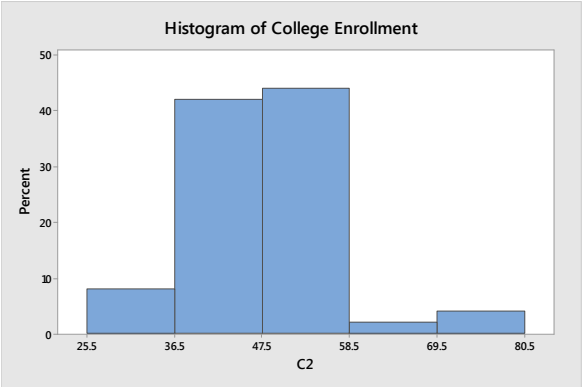
**(c)**

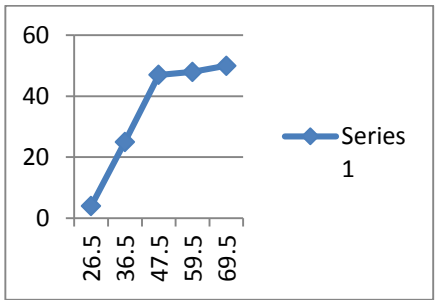



**(d)**




**(e)** This distribution is skewed right.

**(f)**




**(g)** Answers vary.

**20.** **(a)** Class width = 6

**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 0–5 | 0.5–5.5 | 2.5 | 13 | 0.24 | 13 |
| 6–11 | 5.5–11.5 | 8.5 | 15 | 0.27 | 28 |
| 12–17 | 11.5–17.5 | 14.5 | 11 | 0.20 | 39 |

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| | | | | | |
|---|---|---|---|---|---|
| 18–23 | 17.5–23.5 | 20.5 | 3 | 0.05 | 42 |
| 24–29 | 23.5–29.5 | 26.5 | 6 | 0.11 | 48 |
| 30–35 | 29.5–35.5 | 32.5 | 4 | 0.07 | 52 |
| 36–41 | 35.5–41.5 | 38.5 | 2 | 0.04 | 54 |
| 42–47 | 41.5–47.5 | 44.5 | 1 | 0.02 | 55 |

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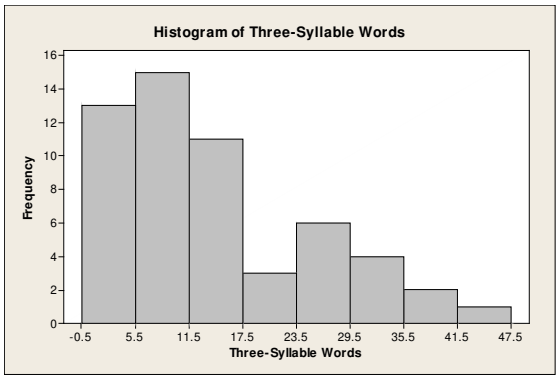
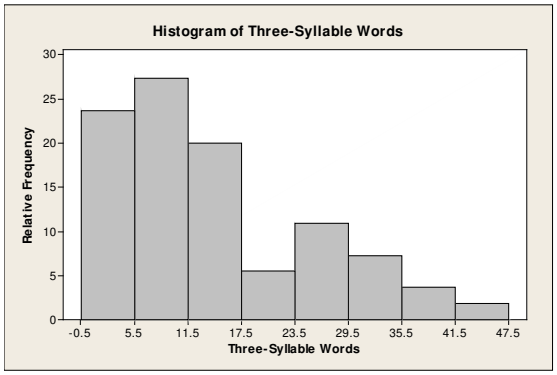
**(c)**

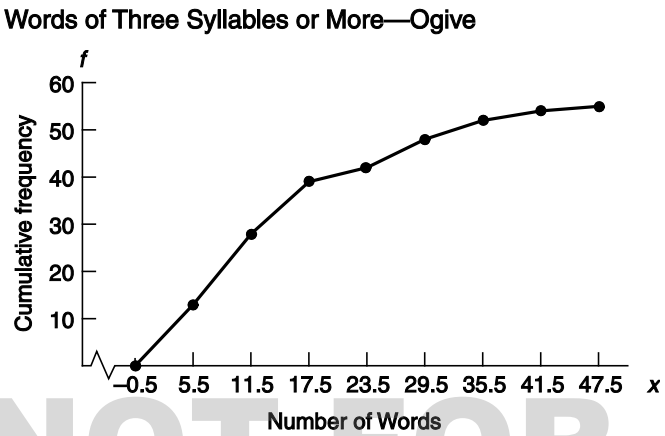



**(d)**




**(e)** The distribution is skewed right.

**(f)**




**(g)** Answers vary.

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**21.** **(a)** Multiply each value by 100.



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**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency |
|---|---|---|---|
| 46–85 | 45.5–85.5 | 65.5 | 4 |
| 86–125 | 85.5–125.5 | 105.5 | 5 |
| 126–165 | 125.5–165.5 | 145.5 | 10 |
| 166–205 | 165.5–205.5 | 185.5 | 5 |
| 206–245 | 205.5–245.5 | 225.5 | 5 |
| 246–285 | 245.5–285.5 | 265.5 | 3 |

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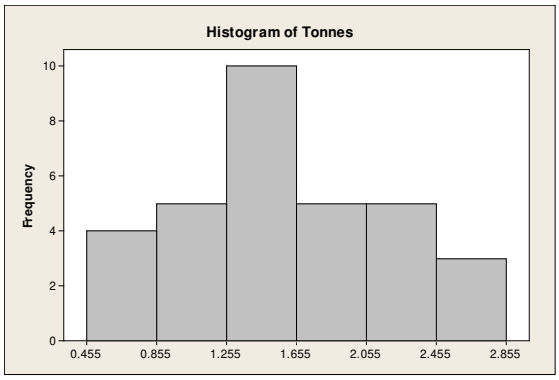


**(c)**

| Class Limits | Class Boundaries | Midpoint | Frequency |
|---|---|---|---|
| 0.46–0.85 | 0.455–0.855 | 0. 655 | 4 |
| 0.86–1.25 | 0.855–1.255 | 1.055 | 5 |
| 1.26–1.65 | 1.255–1.655 | 1.455 | 10 |
| 1.66–2.05 | 1.655–2.055 | 1.855 | 5 |
| 2.06–2.45 | 2.055–2.455 | 2.255 | 5 |
| 2.46–2.85 | 2.455–2.855 | 2.655 | 3 |

**22.** **(a)** Multiply each value by 1000.

**(b)**

| Class Limits | Class Boundaries | Midpoint | Frequency |
|---|---|---|---|
| 107–149 | 106.5–149.5 | 128 | 3 |
| 150–192 | 149.5–192.5 | 171 | 4 |
| 193–235 | 192.5–235.5 | 214 | 3 |
| 236–278 | 235.5–278.5 | 257 | 10 |
| 279–321 | 278.5–321.5 | 300 | 6 |

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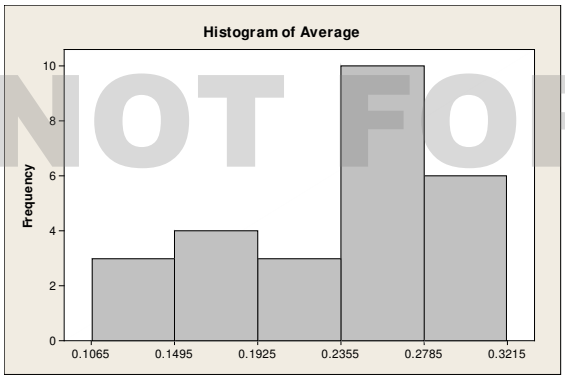



NOT FOR SALE

**(c)**

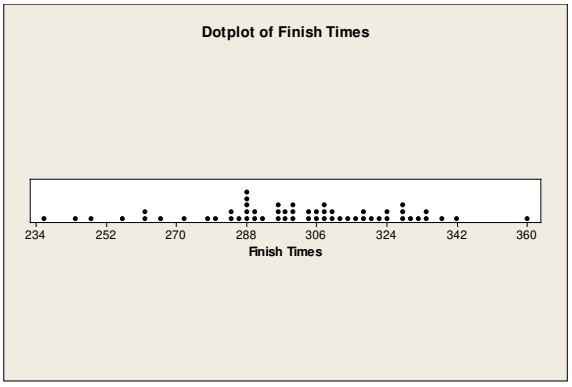
| Class Limits | Class Boundaries | Midpoint | Frequency |
|---|---|---|---|
| 0.107–0.149 | 0.1065–0.1495 | 0.128 | 3 |
| 0.150–0.192 | 0.1495–0.1925 | 0.171 | 4 |
| 0.193–0.235 | 0.1925–0.2355 | 0.214 | 3 |
| 0.236–0.278 | 0.2355–0.2785 | 0.257 | 10 |
| 0.279–0.321 | 0.2785–0.3215 | 0.300 | 6 |

**23.** **(a)** 1

**(b)** About 5/51 = 0.098 = 9.8%

**(c)** 650 to 750

**24.**




The dotplot shows some of the characteristics of the histogram, such as more dot density from 280 to 340, for instance, that corresponds roughly to the histogram bars of heights 25 and 16. However, the dotplot and histogram are somewhat difficult to compare because the dotplot can be thought of as a histogram with one value, the class mark (i.e., the data value), per class. Because the definitions of the classes (and therefore the class widths) differ, it is difficult to compare the two figures.

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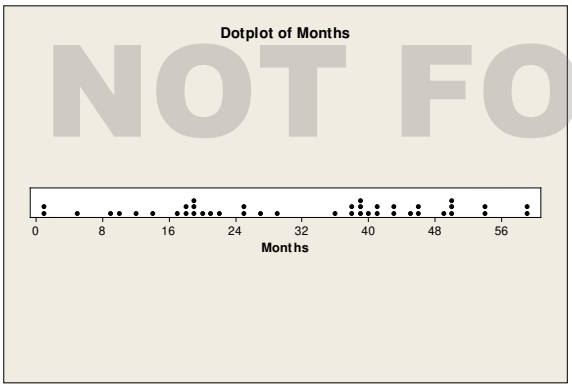
**25.**

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The dotplot shows some of the characteristics of the histogram, such as the concentration of most of the data in two peaks, one from 13 to 24 and another from 37 to 48. However, the dotplot and histogram are somewhat difficult to compare because the dotplot can be thought of as a histogram with one value, the class mark (i.e., the data value), per class. Because the definitions of the classes (and therefore the class widths) differ, it is difficult to compare the two figures.

## Section 2.2

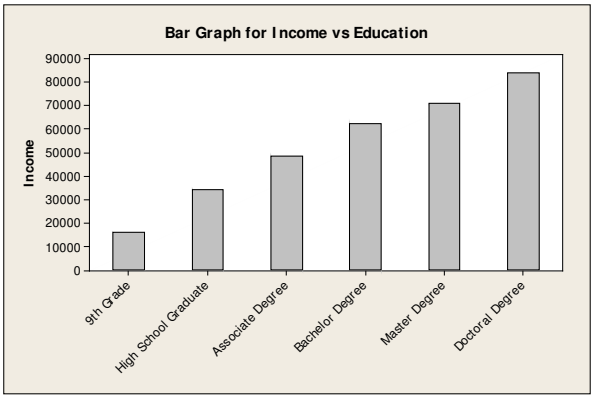
**1.** **(a)** Yes, since the percentages total more than 100%.
**(b)** No. In a circle graph, the percentages must total 100%.
**(c)** Yes. The graph is organized from most frequently selected to least frequently selected.

**2.** This is not proper because the bars differ in both length and width.

**3.** A Pareto chart because it shows the five conditions in their order of importance to employees.

**4.** A time-series graph because the pattern of stock prices over time is more relevant than just the frequency of a specific range of closing prices.

**5.**




**6.** **(a)** 45% of the 18 – 34 year olds and approximately 30% of the 45 – 54 year olds said "Influential". Perhaps the vertical scales should be labeled similarly.

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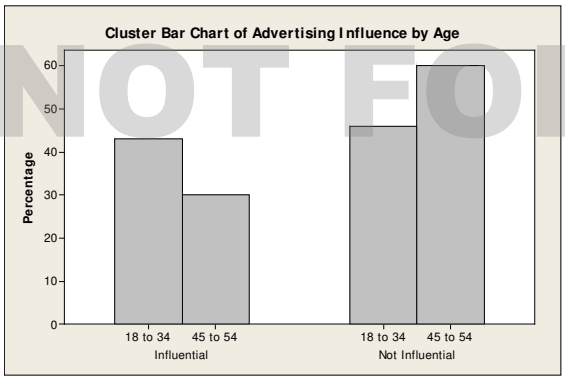
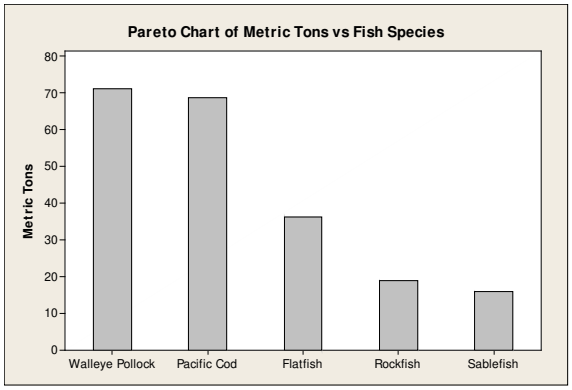
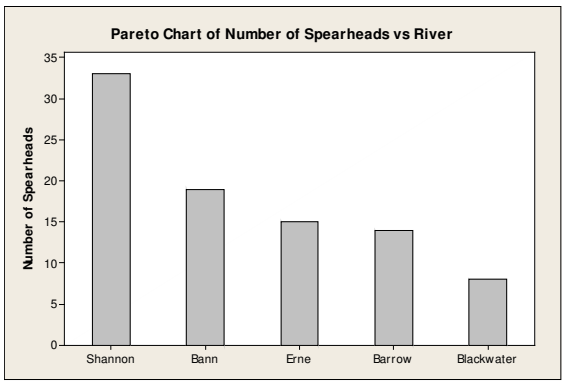
**(b)**



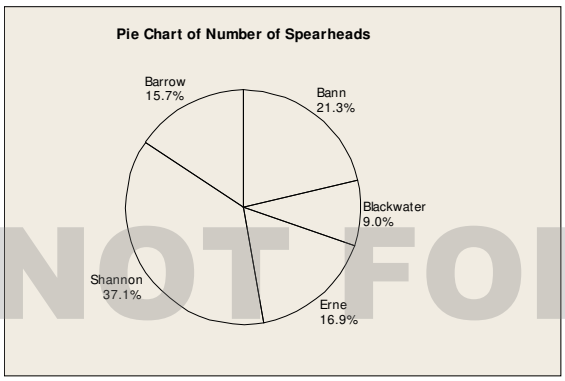

**7.**




**8.** **(a)**




**(b)**

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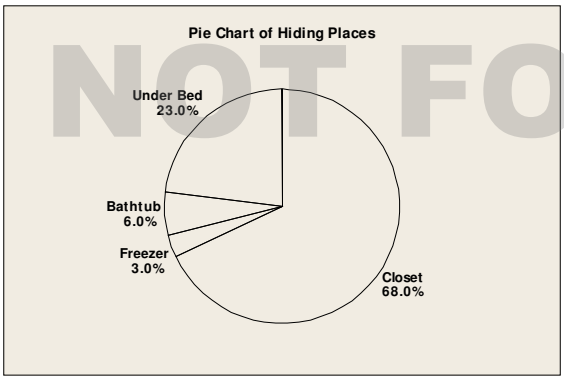
**9.**

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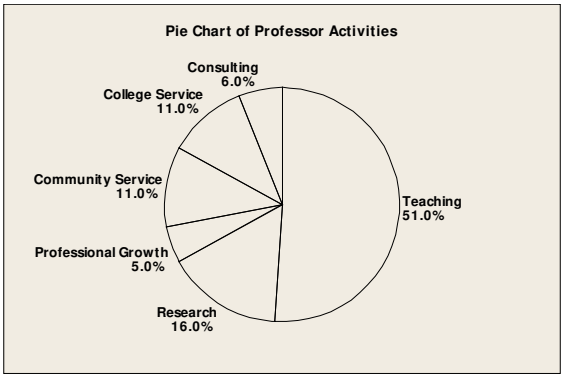
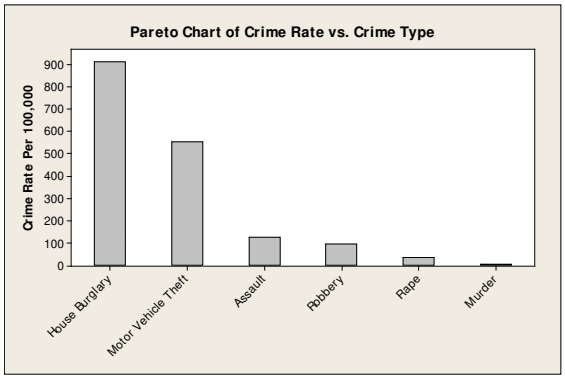
**10.**




**11.** **(a)**




**(b)** Yes, but the graph would take into account only these particular crimes and would not indicate if multiple crimes occurred during the same incident.

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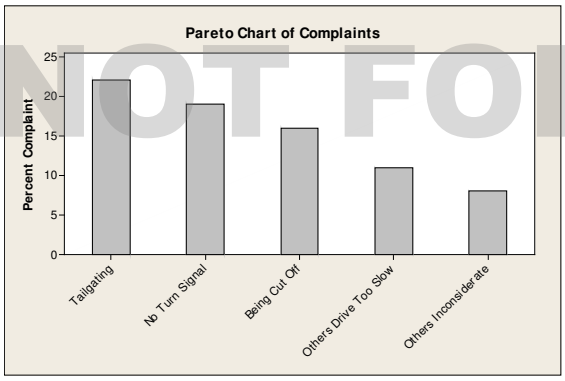
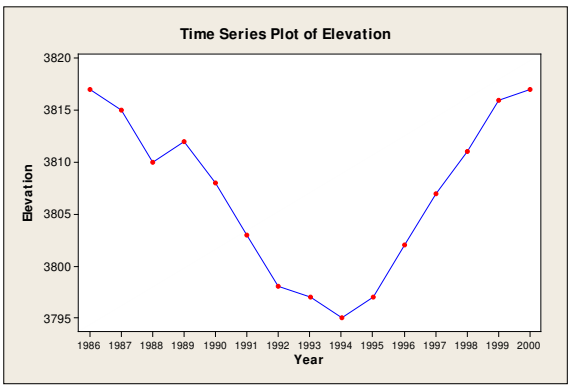
**12.** **(a)**

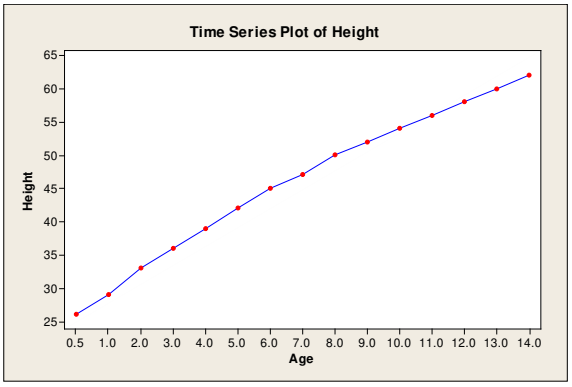



**(b)** Since the percentages do not add to 100%, a circle graph cannot be used. If we create an "other" category and assume that all other respondents fit this category, then a circle could be created.

**13.**




**14.**




**15.** **(a)** The size of the donut hole is smaller on the rightmost graph. To correct the situation, simply make all donuts exactly the same size, with the radii of the respective holes the same size as well. Data labels showing the percentages for each response would also be useful.

**(b)** The college graduates answered "no" more frequently than those with a high school education or less.

**16.** **(a)** Worry that the technologies cause too much distraction and are dangerous.

**(b)** The Matures.

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**(c)** Gen X.

## Section 2.3

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**1.** **(a)** The smallest value is 47 and the largest value is 97, so we need stems 4, 5, 6, 7, 8, and 9. Use the tens digit as the stem and the ones digit as the leaf.

Longevity of Cowboys

| | |
|---|---|
| 4 | 7 = 47 years |
| 4 | 7 |
| 5 | 2 7 8 8 |
| 6 | 1 6 6 8 8 |
| 7 | 0 2 2 3 3 5 6 7 |
| 8 | 4 4 4 5 6 6 7 9 |
| 9 | 0 1 1 2 3 7 |

**(b)** Yes, these cowboys certainly lived long lives, as evidenced by the high frequency of leaves for stems 7, 8, and 9 (i.e., 70-, 80-, and 90-year-olds).

**2.** The largest value is 91 (percent of wetlands lost) and the smallest value is 9 (percent), which is coded as 09. We need stems 0 to 9. Use the tens digit as the stem and the ones digit as the leaf. The percentages are concentrated from 20% to 50%. These data are fairly symmetric, perhaps slightly skewed right. There is a gap showing that none of the lower 48 states has lost from 10% to 19% of its wetlands.

Percent of Wetlands Lost

| | |
|---|---|
| 4 | 0 = 40% |
| 0 | 9 |
| 1 | |
| 2 | 0 3 4 7 7 8 |
| 3 | 0 1 3 5 5 5 6 7 8 8 9 |
| 4 | 2 2 6 6 6 8 9 9 |
| 5 | 0 0 0 2 2 4 6 6 9 9 |
| 6 | 0 7 |
| 7 | 2 3 4 |
| 8 | 1 5 7 7 9 |
| 9 | 0 1 |

**3.** The longest average length of stay is 11.1 days in North Dakota, and the shortest is 5.2 days in Utah. We need stems from 5 to 11. Use the digit(s) to the left of the decimal point as the stem and the digit to the right as the leaf.

Average Length of Hospital Stay

| | |
|---|---|
| 5 | 2 = 5.2 days |
| 5 | 2 3 5 5 6 7 |
| 6 | 0 2 4 6 6 7 7 8 8 8 8 9 9 |
| 7 | 0 0 0 0 0 0 1 1 1 2 2 2 3 3 3 3 4 4 5 5 6 6 8 |
| 8 | 4 5 7 |
| 9 | 4 6 9 |
| 10 | 0 3 |
| 11 | 1 |

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The distribution is skewed right.



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**4.** Number of Hospitals per State

| | | | |
|---|---|---|---|
| 0 | 8 = 8 hospitals | | |
| 0 | 8 | 15 | |
| 1 | 1 2 5 6 9 | 16 | 2 |
| 2 | 1 7 7 | 17 | 5 |
| 3 | 5 7 8 | 18 | |
| 4 | 1 2 7 | 19 | 3 |
| 5 | 1 2 3 9 | 20 | 9 |
| 6 | 1 6 8 | 21 | |
| 7 | 1 | 22 | 7 |
| 8 | 8 | 23 | 1 6 |
| 9 | 0 2 6 8 | | |
| 10 | 1 2 7 | 42 | 1 |
| 11 | 3 3 7 9 | 43 | |
| 12 | 2 3 9 | 44 | 0 |
| 13 | 3 3 6 | | |
| 14 | 8 | | |

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Texas and California have the highest number of hospitals, 421 and 440, respectively. Both states have large populations and large areas. The four largest states by area are Alaska, Texas, California, and Montana.

**5.** **(a)** The longest time during earlier period is 23 minutes (i.e., 2:23), and the shortest time is 9 minutes (2:09). We need stems 0, 1, and 2. We'll use the tens digit as the stem and the ones digit as the leaf, placing leaves 0, 1, 2, 3, and 4 on the first stem and leaves 5, 6, 7, 8, and 9 on the second stem.

Minutes Beyond 2 Hours (Earlier Period)

| | |
|---|---|
| 0 | 9 = 9 minutes past 2 hours |
| 0 | 9 9 |
| 1 | 0 0 2 3 3 4 |
| 1 | 5 5 6 6 7 8 8 9 |
| 2 | 0 2 3 3 |

**(b)** The longest time during the recent period was 14 (2:14) and the shortest was 7 (2:07), so we'll need stems 0 and 1 only.

Minutes Beyond 2 Hours (Recent Period)

| | |
|---|---|
| | 7 = 7 minutes past 2 hours |
| 0 | 7 7 7 8 8 8 8 9 9 9 9 9 9 9 9 |
| 1 | 0 0 1 1 4 |

**(c)** There were eight times under 2:15 during the earlier period, and there were 20 times under 2:15 during the recent period.

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**6.** **(a)** The largest (worst) score in the first round was 75; the smallest (best) score was 65. We need stems 6 and 7. Leaves 0–4 go on the first stem, and leaves 5–9 belong on the second stem.

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First-Round Scores

| | |
|---|---|
| 6 | 5 = score of 65 |
| 6 | 5 6 7 7 |
| 7 | 0 1 1 1 1 1 1 1 1 1 1 2 2 2 3 3 3 3 4 4 4 |
| 7 | 5 5 5 5 5 5 5 |

**(b)** The largest score in the fourth round was 74, and the smallest was 68. Here we need stems 6 and 7.

Fourth-Round Scores

| | |
|---|---|
| 6 | 8 = score of 68 |
| 6 | 8 9 9 9 9 9 |
| 7 | 0 0 0 0 1 1 1 1 1 1 1 1 2 2 2 2 2 2 3 3 3 3 3 4 4 4 |

**(c)** Scores are lower in the fourth round. In the first round, both the low and high scores were more extreme than in the fourth round.

**7.** The largest value in the data is 29.8 mg of tar per cigarette smoked, and the smallest value is 1.0. We will need stems from 1 to 29, and we will use the numbers to the right of the decimal point as the leaves.

Milligrams of Tar per Cigarette

| | |
|---|---|
| 1 | 0 = 1.0 mg tar |
| 1 | 0 |
| 2 | |
| 3 | |
| 4 | 1 5 |
| 5 | |
| 6 | |
| 7 | 3 8 |
| 8 | 0 6 8 |
| 9 | 0 |
| 10 | |
| 11 | 4 |
| 12 | 0 4 8 |
| 13 | 7 |
| 14 | 1 5 9 |
| 15 | 0 1 2 8 |
| 16 | 0 6 |
| 17 | 0 |
| . | |
| . | |
| . | |
| 29 | 8 |

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**8.** The largest value in the data set is 23.5 mg of carbon monoxide per cigarette smoked, and the smallest is 1.5. We need stems from 1 to 23, and we'll use the numbers to the right of the decimal point as leaves.

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Milligrams of Carbon Monoxide

| | |
|---|---|
| 1 | 5 = 1.5 mg CO |
| 1 | 5 |
| 2 | |
| 3 | |
| 4 | 9 |
| 5 | 4 |
| 6 | |
| 7 | |
| 8 | 5 |
| 9 | 0 5 |
| 10 | 0 2 2 6 |
| 11 | |
| 12 | 3 6 |
| 13 | 0 6 9 |
| 14 | 4 9 |
| 15 | 0 4 9 |
| 16 | 3 6 |
| 17 | 5 |
| 18 | 5 |
| . | |
| . | |
| . | |
| 23 | 5 |

**9.** The largest value in the data set is 2.03 mg of nicotine per cigarette smoked. The smallest value is 0.13. We will need stems 0, 1, and 2. We will use the number to the left of the decimal point as the stem and the first number to the right of the decimal point as the leaf. The number 2 placed to the right of the decimal point (the hundredths digit) will be truncated (not rounded).

Milligrams of Nicotine per Cigarette

| | |
|---|---|
| 0 | 1 = 0.1 milligram |
| 0 | 1 4 4 |
| 0 | 5 6 6 6 7 7 7 8 8 9 9 9 |
| 1 | 0 0 0 0 0 0 0 1 2 |
| 1 | |
| 2 | 0 |

**10.** **(a)** For Site I, the least depth is 25 cm, and the greatest depth is 110 cm. For Site II, the least depth is 20 cm, and the greatest depth is 125 cm.

**(b)** The Site I depth distribution is fairly symmetric, centered near 70 cm. Site II is fairly uniform in shape except that there is a huge gap with no artifacts from 70 to 100 cm.

**(c)** It would appear that Site II probably was unoccupied during the time period associated with 70 to 100 cm.

## Chapter Review Problems

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**1.** Histogram matches statement (ii); Relative frequency graph matches statement (iii); Ogive matches statement (i).



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**2.** Quantitative data can be shown in a histogram.

**3.** Both qualitative and quantitative data can be shown in a bar graph.

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**4.** A stem-and-leaf plot shows each data value in order from smallest to largest.

**5.** If a histogram is skewed left, more of the data falls on the right side.

**6.** Data are plotted in a time series at regular intervals over time.

**7.** **(a)** Bar graphs, Pareto charts, pie charts
**(b)** All, but quantitative data must be categorized to use a bar graph, Pareto chart, or pie chart.

**8.** A time-series graph because a change over time is most relevant

**9.** Any large gaps between bars or stems might indicate potential outliers.

**10.** Dotplots and stem-and-leaf displays both show every data value. Stem-and-leaf plots group the data with the same stem, whereas dotplots only group the data with identical values.

**11.** **(a)** Figure 2-1(a) (in the text) is essentially a bar graph with a "horizontal" axis showing years and a "vertical" axis showing miles per gallon. However, in depicting the data as a highway and showing them in perspective, the ability to correctly compare bar heights visually has been lost. For example, determining what would appear to be the bar heights by measuring from the white line on the road to the edge of the road along a line drawn from the year to its mpg value, we get the bar height for 1983 to be approximately ⅞ inch and the bar height for 1985 to be approximately 1⅜ inches (i.e., 11/8 inches). Taking the ratio of the given bar heights, we see that the bar for 1985 should be $\frac{27.5}{26} \approx 1.06$ times the length of the 1983 bar. However, the measurements show a ratio of $\frac{\frac{11}{8}}{\frac{7}{8}} = \frac{11}{7} \approx 1.60$; i.e., the 1985 bar is (visually) 1.6 times the length of the 1983 bar. Also, the years are evenly spaced numerically, but the figure shows the more recent years to be more widely spaced owing to the use of perspective.

**(b)** Figure 2-1(b) is a time-series graph showing the years on the *x* axis and miles per gallon on the *y* axis. Everything is to scale and not distorted visually by the use of perspective. It is easy to see the mpg standards for each year, and you also can see how fuel economy standards for new cars have changed over the 8 years shown (i.e., a steep increase in the early years and a leveling off in the later years).

**12.** **(a)** We estimate the 1980 prison population at approximately 140 prisoners per 100,000 and the 1997 population at approximately 440 prisoners per 100,000 people.

**(b)** The number of inmates per 100,000 increased every year.

**(c)** The population 266,574,000 is 2,665.74 × 100,000, and 444 per 100,000 is $\frac{444}{100,000}$.

So $\frac{444}{100,000} \times (2,665.74 \times 100,000) \approx 1,183,589$ prisoners.

The projected 2020 population is 323,724,000, or 3,237.24 × 100,000.

So $\frac{444}{100,000} \times (3,237.24 \times 100,000) \approx 1,437,335$ prisoners.

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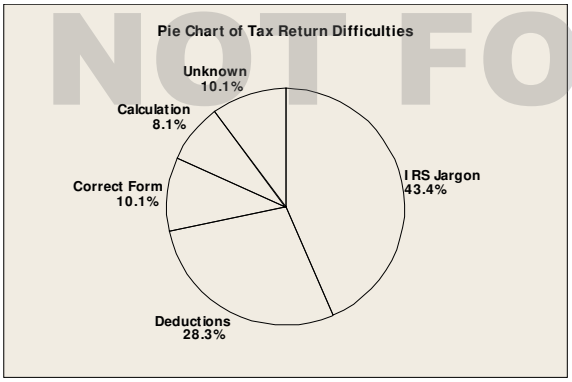
**13.** Owing to rounding, the percentages are slightly different from those in the text.

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**14.** **(a)** Since the ages are two-digit numbers, use the ten's digit as the stem and the one's digit as the leaf.

Age of DUI Arrests

| | |
|---|---|
| 1 | 6 = 16 years |
| 1 | 6 8 |
| 2 | 0 1 1 2 2 2 3 4 4 5 6 6 6 7 7 7 9 |
| 3 | 0 0 1 1 2 3 4 4 5 5 6 7 8 9 |
| 4 | 0 0 1 3 5 6 7 7 9 9 |
| 5 | 1 3 5 6 8 |
| 6 | 3 4 |

**(b)** The largest age is 64 and the smallest is 16, so the class width for seven classes is $\frac{64-16}{7} \approx 6.86$; use 7.

The lower class limit for the first class is 16; the lower class limit for the second class is 16 + 7 = 23. The total number of data points is 50, so calculate the relative frequency by dividing the class frequency by 50.

Age Distribution of DUI Arrests

| Class Limits | Class Boundaries | Midpoint | Frequency | Relative Frequency | Cumulative Frequency |
|---|---|---|---|---|---|
| 16–22 | 15.5–22.5 | 19 | 8 | 0.16 | 8 |
| 23–29 | 22.5–29.5 | 26 | 11 | 0.22 | 19 |
| 30–36 | 29.5–36.5 | 33 | 11 | 0.22 | 30 |
| 37–43 | 36.5–43.5 | 40 | 7 | 0.14 | 37 |
| 44–50 | 43.5–50.5 | 47 | 6 | 0.12 | 43 |
| 51–57 | 50.5–57.5 | 54 | 4 | 0.08 | 47 |
| 58–64 | 57.5–64.5 | 61 | 3 | 0.06 | 50 |

The class boundaries are the average of the upper class limit of the next class. The midpoint is the average of the class limits for that class.

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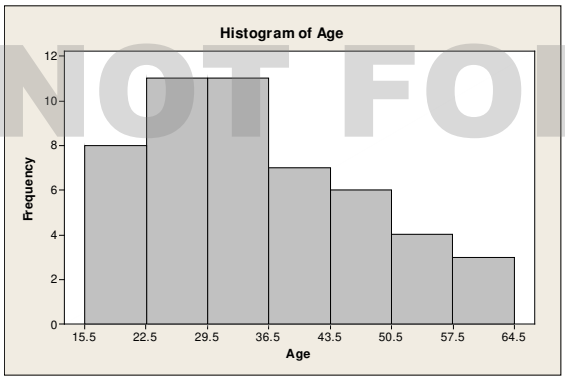
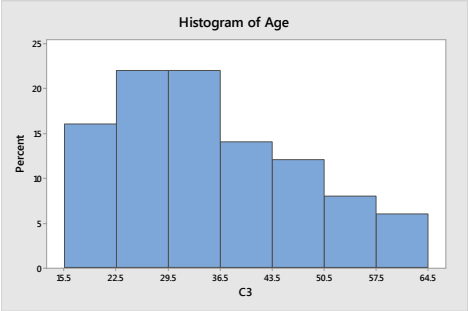
**(c)**

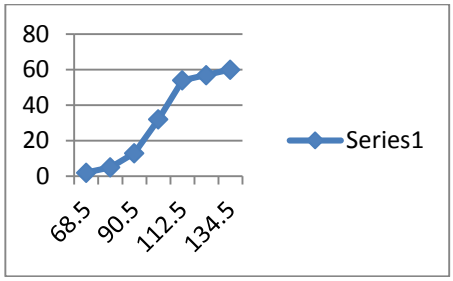



**(d)**




**(e)** The distribution is skewed right.

**(f)**




**(g)** Answers vary.

**15.** **(a)** Since the circumferences are two- and three-digit numbers, use the hundred's and ten's digit as the stem and the one's digit as the leaf.

Circumference (in mm)

| | |
|---|---|
| 10 | 6 = 106 years |
| 6 | 9 |
| 7 | 5 |
| 8 | 3 4 |
| 9 | 0 1 1 6 9 9 9 |
| 10 | 0 1 2 2 3 5 5 5 6 6 6 8 8 8 8 9 9 |
| 11 | 0 1 2 2 3 3 4 4 4 5 5 6 7 7 7 7 7 |
| 12 | 0 0 0 2 2 2 2 3 4 5 9 |
| 13 | 8 |
| 14 | 2 2 |

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