# CHAPTER 1

## Section 1.1
### *Statistical Literacy and Critical Thinking*

**1**    The two meanings are: (1) statistics is the *science* of collecting, organizing, and interpreting data; and (2) statistics are the *data* (numbers or other pieces of information) that describe or summarize some characteristic from a sample. Note that for the first meaning, the word "statistics" is singular and for the second it is plural.

**2**    A *population* is the complete set of people or things being studied, while a *sample* is a subset of a population. In other words, the sample is only a part of the complete population. A *population parameter* is a characteristic of a population. A *sample statistic* is a characteristic of a sample found by consolidating or summarizing raw data. *Raw data* are all measurements or observations collected. It is usually impractical to directly measure population parameters for large populations, so we usually infer likely values of the population parameters from the measured sample statistics.

**3**    The margin of error is used to describe the range of values in a confidence interval. We add and subtract the margin of error from a sample statistic to find the confidence interval, or the range of values that is likely to contain some population parameter. The confidence interval is used to estimate the population parameter, and the confidence level (e.g. 95%) tells us how confident we should be that the population parameter lies within the quoted range.

**4**    The basic steps, summarized in Figure 1.1, are: (1) identify the goals; (2) choose a representative sample from the population; (3) collect raw data from the sample and summarize them with sample statistics; (4) use the sample statistics to make inferences about the population; (5) draw conclusions from your results. Students should come up with their own example.

**5**    This statement does not make sense. The statement is drawing a conclusion about all American adults, which means it is identifying the exact value of a population parameter. But the pollster only surveyed a sample of 1009 adults, so it is not possible to know with certainty the value of the population parameter.

**6**    This statement does make sense. The margin of error suggests a (presumably 95%) confidence interval from 52% to 58%. However, there is always some chance that the actual population proportion is outside the confidence interval, and in this case it would not need to be far outside for the candidate to lose. Moreover, the poll was taken 2 months before the election, and voters may change their minds by election time.

**7**    This statement does not make sense. A margin of error of zero would imply that there is no uncertainty in a survey result, and that could happen only if the entire population was surveyed, rather than just a sample.

**8**    This statement does not make sense. The confidence interval tells us that we can have 95% confidence that the values from 55% to 60% contain the population parameter, but we cannot be absolutely certain that the true population parameter isn't significantly lower or higher.

**9**    This statement does not make sense. Inferences about one population (males) do not necessarily apply to a different population (females).

**10**   This statement does make sense. The purpose of statistics is to help with decision making, and if the survey was conducted well, it is possible to draw conclusions with high confidence from a survey of a 1000-person sample. If the survey results indicate that most people like the song, then it makes sense to promote it, even though there is no guarantee that the promotion will be successful.

*Concepts and Applications*

**11**   Sample: the 1018 adults selected. Population: the complete set of all adults (presumably in the United States). Sample statistic: 22%. The value of the population parameter is not known, but it is the percentage of all adults (presumably in the United States) who smoked cigarettes in the past week.

**12**   Sample: the 186 babies selected. Population: the complete set of all babies. Sample statistic: 3103 g. The value of the population parameter is not known, but it is the average (mean) birth weight of all babies.

**13**   Sample: the 47 subjects treated with Garlicin. Population: the complete set of all adults. Sample statistic: 3.2 mg/dL. The value of the population parameter is not known, but it is the average (mean) change in LDL cholesterol.

**14**   Sample: the 150 senior executives who were surveyed. Population: the complete set of all senior executives. Sample statistic: 47%. The value of the population parameter is not known, but it is the percentage of all senior executives who say that the most common job interview mistake is to have little or no knowledge of the company where the applicant is being interviewed.

**15**   The range of values likely to contain the true value of the population parameter is from 77% - 2% to 77% + 2% or from 75% to 79%.

**16**   The range of values likely to contain the true value of the population parameter is from 85% - 1% to 85% + 1% or from 84% to 86%.

**17**   The range of values likely to contain the true value of the population parameter is from 96% – 3% to 96% + 3% or from 93% to 99%.

**18**   The range of values likely to contain the true value of the population parameter (mean body temperature) is 98.2º F – 0.1º F to 98.2º F + 0.1º F or from 98.1º F to 98.3º F degrees.

**19**   The range of values likely to contain the true value of the population parameter is from 57% – 4% to 57% + 4% or from 53% to 61%.

**20**   The range of values likely to contain the true value of the population parameter is from 0.032% – 0.006% to 0.032% + 0.006% or from 0.026% to 0.038%.

**21**   Based on the survey, the actual percentage of voters is expected to be between 67% and 73%, which does not include the 61% value from actual voting records. If the survey was conducted well, then it is unlikely that its result would be so different from the actual voter turnout, implying either that respondents intentionally lied to appear favorable to the pollsters or that their memories may have been faulty.

**22**   It appears that the men who were surveyed may have been influenced by the gender of the interviewer.  When they were interviewed by women, they may have been more inclined to respond in a way that they thought was more favorable to the female interviewers.

**23**   Yes, we can safely conclude that fewer than half of all students say they are tired on most days. Based on the confidence interval and margin of error, it is likely that the actual population parameter is fairly close to the 39% sample statistic, and very unlikely that the true value could be above 50%.

**24**   No, the results do not contradict Mendel's theory. Using the margin of error, it appears that the percentage of yellow peas is likely to be between 22% and 30%, and that range of values includes Mendel's claimed value of 25%, so the results do not contradict his theory.

**25**   a)   Goal: determine the percentage of employees who would like to have their boss's job. Population: the complete set of all employees. Population parameter: the percentage of all employees who would like to have their boss's job.
       b)   Sample: the 144 employees selected for the survey. Raw data: individual responses to the question. Sample statistic: 21%.
       c)   The range of values likely to contain the population parameter is from 21% - 7% to 21% + % (or from 14% to 28%).
**26**   a)   Goal: determine the percentage of older adults (aged 57 to 85 years) who use at least one prescription drug. Population: the complete set of all older adults. Population parameter: the percentage of all older adults who use at least one prescription drug.
       b)   Sample: the 3005 older adults selected for the survey. Raw data: individual responses to the question. Sample statistic: 82%.
       c)   The range of values likely to contain the population parameter is from 82% - 2% to 82% + 2% (or from 80% to 84%).
**27**   a)   Goal: determine the percentage of adults who say that they are underpaid. Population: the complete set of all adults. Population parameter: the percentage of all adults who say that they are underpaid.
       b)   Sample: the 557 adults randomly selected and surveyed. Raw data: individual responses to the survey question. Sample statistic: 51%.
       c)   The range of values likely to contain the population parameter is 51% - 4% to 51% + 4% (or from 47% to 55%).
**28**   a)   Goal: determine the percentage of human resource professionals who say that piercings or tattoos are big grooming red flags. Population: the complete set of all human resource professionals. Population parameter: the percentage of all human resource professionals who say that piercings or tattoos are big grooming red flags.
       b)   Sample: the 514 human resource professionals selected for the survey. Raw data: individual responses to the question. Sample statistic: 46%.
       c)   The range of values likely to contain the population parameter is 46% - 4% to 46% + 4% (or from 42% to 50%).
**29**   Step 1:   Goal: identify the percentage of all drivers who text while they are driving.
       Step 2:   Choose a representative sample of drivers.
       Step 3:   Somehow collect data on whether the drivers in the sample text while driving. Find the percentage who do.
       Step 4:   Use the sample statistic to make an inference about the percentage of all drivers who text while they are driving.
       Step 5:   Based on the likely value of the population parameter, form a conclusion about the percentage of drivers who text while they are driving.
**30**   Step 1:   Goal: identify the average (mean) FICO score of all adults in the United States.
       Step 2:   Choose a sample of adult consumers.
       Step 3:   Obtain the FICO scores of the selected adults. For this sample, find the average FICO score.
       Step 4:   Use the sample statistic to make an inference about the average FICO score of all adults in the United States.
       Step 5:   Based on the likely value of the population parameter, form a conclusion about the average FICO score of all adults in the United States.
**31**   Step 1:   Goal: identify the average (mean) weight of all commercial airline passengers.
       Step 2:   Choose a sample of airline passengers.
       Step 3:   Weigh each selected airline passenger, then find the average of those weights.

Step 4:    Use the sample statistic to make an inference about the average weight of all airline passengers.

Step 5:    Based on the likely value of the population parameter, form a conclusion about the average weight of all airline passengers.

**32**   Step 1:    Goal: identify the average (mean) length of time that pacemaker batteries last before failure.

Step 2:    Choose a sample of pacemaker batteries.

Step 3:    Record the length of time that each battery in the sample lasts before failure. Find the average of those times.

Step 4:    Use the sample statistic to make an inference about the average length of time that all pacemaker batteries last before failure.

Step 5:    Based on the likely value of the population parameter, form a conclusion about the average length of time that all pacemaker batteries last before failure.

### Section 1.2
### *Statistical Literacy and Critical Thinking*

**1**   A *census* is a collection of data from every member of a population, but a *sample* is a collection of data from only part of a population.

**2**   A *representative sample* is a sample in which the relevant characteristics of the sample members are generally the same as the characteristics of the population. It is critically important to collect a sample that is representative of the population for which you intend to make inferences about. Failure to obtain a representative sample is a major contributor to misleading statistics.

**3**   A *biased sample* is a sample that somehow tends to favor certain results. Because a biased sample is not representative of the population, results obtained from a biased sample are likely to be misleading. Preventing bias is one of the greatest challenges in statistical research.

**4**   The five common sampling methods described in the text are:
- Simple random sampling: A sample of items is collected in such a way that every sample of the same size has an equal chance of being selected.
- Systematic sampling: A simple system is used to choose the sample, such as selecting every 10th or every 50th member of the population.
- Convenience sampling: A sample is collected that happens to be convenient to select.
- Cluster sampling: The population is first divided into groups, or clusters, and some of these clusters are selected at random. The sample is collected by choosing *all* the members within each of the selected clusters.
- Stratified sampling: This method is used when we are concerned about differences among subgroups, or *strata*, within a population. First, we identify the strata and divide the population based on the strata. A random sample within each stratum is collected. The total sample consists of all the samples from the individual strata.

**5**   This statement does not make sense because it is not possible or practical to survey every undergraduate statistics student, as would be required for a census.

**6**   This statement does make sense. Even though the sample is a convenience sample, there is no reason to think that students in a statistics class would differ in any fundamental way from the general population of all students at the school in terms of handedness.

**7**   This statement does make sense. The gender makeup of the sample should reflect the gender makeup of the movie-going population. While that population might not have precisely equal proportions of males and females, it certainly is not so male-dominated as this sample, so the study used a biased sample.

**8**   This statement does make sense. The procedure described does result in a simple random sample, and it is a procedure that is commonly used.

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**9**   A census is practical. Even though NFL team rosters include about 1700 players, it is easy to find their weights on the Internet.

**10**   A census is not practical because the number of high school football players in California is too large and their weights are not readily available.

**11**   A census is not practical. The number of statistics students in the United States is too large (hundreds of thousands), and it would probably be difficult to find their ages.

**12**   A census is practical. The number of members of Congress is not large (535), and their annual salaries are available on the Internet.

**13**   Sample: the 1002 surveyed subjects. Population: all adults. Sampling method: simple random sampling. The sample is likely to be representative of the population.

**14**   Sample: the 4500 mailed responses from women. Population: all women. Sampling method: convenience sampling. The sample is not likely to be representative of the population.

**15**   Sample: the 47 responses from the website. Population: all adult Americans. Sampling method: convenience sampling. Because the sample is very small and is limited to Internet users, it is not likely to be representative of the population.

**16**   Sample: the 1,059 selected adults. Population: the complete set of all adults. Sampling method: simple random sampling. Because the sample is fairly large and was obtained by a reputable firm, it is likely to be representative of the population.

**17**   Sample 3 is the most representative, because the list is a random sample that is not likely to be biased. Sample 1 is a convenience sample limited to readers of the newspaper and is therefore likely to be biased. Sample 2 is likely to be biased because it is limited to the geographic region of Anchorage. Sample 4 is biased because it includes only car owners and does not include those who cannot afford a car or choose not to own a car.

**18**   Sample 4 is the most representative and is a good use of systematic sampling. Sample 1 is biased because it consists of people from one geographic region located at the extreme southern part of the state. Sample 2 is biased because it consists of people from one specific geographic urban region. Sample 3 is likely to be biased because it is a self-selected sample.

**19**   There is no bias. The U.S. Department of Labor and its employees have nothing to gain by distorting the results, and they typically use very sound sampling methods.

**20**   There is no bias. Because the magazine does not accept free products or run advertisements, it is not influenced by the manufacturers of the cars that it reviews.

**21**   Yes, there is a possibility of bias. The university scientists receive funding from Monsanto, so they might be inclined to please the company in the hope of getting further funding in the future. Thus, there may be an inclination to provide favorable results. To determine whether this bias is a problem, you would need to explore the methods and conclusions very carefully.

**22** Yes, there is a possibility of bias. Because the physicians receive funding from the pharmaceutical company, they might be more inclined to provide favorable results so that they can get additional funding in the future. (The magazine now requires that all such physician authors disclose funding sources, and those disclosures are included in the articles.)

**23** The sample is a simple random sample that is likely to be representative because there is no bias in the selection process.

**24** The sample is systematic and is likely to be representative because there is no inherent bias in the way that it was selected.

**25** The sample is a cluster sample. It is likely to be representative, although the exact method of selecting the polling stations could affect whether the sample is biased.

**26** The sample is stratified. It is likely to be representative because it has about the same proportion of males and females as is found in the population.

**27** The sample is a convenience sample. It is likely to be biased, because it consists of family members likely to have similar physical characteristics and exercise habits.

**28** The sample is a cluster sample. It is likely to be biased for several reasons. The servers are not likely to give accurate responses. Also, the small number of restaurants could easily result in a sample that is not representative.

**29** The sample is a stratified sample. It is likely to be biased because people from those age groups are not evenly distributed throughout the population. However, the results could be weighted to reflect the age distribution of the population.

**30** The sample is a convenience sample. The sample is likely to be biased because the customers are all shopping at one upscale store, so they not likely to be representative of all consumers.

**31** The sample is a systematic sample. The sample is likely to be representative of students at the college, but not representative of all college students in the United States.

**32** The sample is a simple random sample. Because it is a simple random sample and the sample size is fairly large, it is likely to be representative.

**33** The sample is a stratified sample. It is likely to be biased because the population does not have equal numbers of people in each of the 50 states. However, the results could be weighted to reflect the actual distribution of the population.

**34** The sample is a cluster sample. It is likely to be representative of students at the college but not representative of all college students in the United States.

**35** The sample is a convenience sample. It is likely to be biased because it is a self-selected sample and consists of those with strong feelings about the topic.

**36** The sample is a simple random sample. Because it is a simple random sample, it is likely to be representative, although a larger sample size would be better.

**37** The sampling plan results in a simple random sample, which is likely to be representative.

**38** The sample is a systematic sample. The sample is likely to be representative, unless there are special factors, such as a manufacturing process that somehow systematically results in defective items.

**39** a. Stratified sampling would require that samples be obtained from every one of the 3000 rice farms, and that would be an overwhelmingly large project.

   b. Cluster sampling would require that all of the rice be tested at randomly selected farms.

     c.     First, select a random sample of farms. Next, at each farm, randomly select a sample of rice to be tested.

**40**   Simple random sampling may be adequate. Better, however, would be stratified sampling with the different ethnic groups as the strata, since there may be differences in blood type distribution among these groups.

**41**   A stratified sample in which you choose a few parents at each school would be effective.

**42**   a.     A serious manufacturing problem could potentially be missed. As one example, if the end of a production run is affected by worn machinery, systematic sampling might be too slow to allow for recognition of the problem.

     b.     A potential problem of a simple random sample of only 5 altimeters is that it is probably too small to represent the population.

**Section 1.3**
***Statistical Literacy and Critical Thinking***

**1**   A *variable* is any item or quantity that can vary or take on different values.  The *variables of interest* in a statistical study are the items or quantities that the study seeks to measure. When cause and effect may be involved, an *explanatory variable* is a variable that may explain or cause the effect, while a *response variable* is a variable that responds to changes in the explanatory variable.

**2**   *Confounding* is the mixing of effects from different factors so that we cannot determine the effects from the specific factors being studied. If males are given the treatment and females are given placebos, we would not know whether effects are due to the treatment or the gender of the participant.

**3**   A *placebo* is physically similar to a treatment, but it lacks any active ingredients, so it should not by itself produce any effects. Use of a placebo is important so that results from subjects given the real treatment can be compared with results from subjects given the placebo.

**4**   *Blinding* is the practice whereby participants and/or experimenters do not know who belongs to the treatment group and who belongs to the control group. It is important to use blinding for participants so that they are not affected by the knowledge that they are receiving the real treatment, and it is important to use it for experimenters so that they can evaluate results objectively instead of being influenced by knowledge about who is getting the real treatment.

**5**   This statement does not make sense. The subjects who exercise obviously know that they are exercising. Those who evaluate results should not know whether a subject is in the treatment group of those exercising or a control group of those not exercising. In this case, a single-blind experiment is practical, but a double-blind experiment is not.

**6**   This statement does not make sense. The variable of interest in this study is the durability of paints in hot weather, and the cost of the paint is not relevant.

**7**   This statement does not make sense. As described, this experiment lacks a control group (e.g., a group that does not do the breathing exercises) and also is subject to experimenter effects in which the psychologist may somehow influence the responses of his subjects (for example, through facial expression, tone of voice, or attitude).

**8**   This statement does make sense. It would be unethical to conduct an experiment in which some passengers were told to drive cars with air bags and others to drive cars without them, so a retrospective study that uses past data from accidents is the only legitimate way to investigate this issue.

### Concepts and Applications

**9** This is an observational study because the TV viewers are being measured, but they are not treated.

**10** This is an experiment because the samples of glass are treated.

**11** This is an experiment. The treatment group consists of those treated with magnets. The control group consists of those given the non-magnetic devices.

**12** This is an observational study because the subjects were tested, but they were not given any treatment.

**13** This is an observational study. The subjects were tested, but they were not given any treatment.

**14** This is a retrospective observational study comparing those who were texting and those who were not.

**15** This is an experiment because the subjects were given a treatment. The treatment group consists of the 945 couples given the XSORT treatment. The control group consists of others not given any treatment.

**16** This is an observational study since no treatment was given.

**17** This is an experiment. The treatment group consists of the genetically modified corn, and the control group consists of corn not genetically modified.

**18** This is an observational study because the subjects were surveyed, but they were not given any treatment.

**19** This is a meta-analysis in which all of the individual studies are observational.

**20** This is meta-analysis in which all of the individual studies are observational.

**21** Confounding is likely to occur. If there are differences in tree growth in the two groups, it will be impossible to tell if those differences are due to the treatment (fertilizer or irrigation) or to the type of region (moist or dry). This confounding can be avoided by using blocks of fertilized trees in both regions and blocks of irrigated trees in both regions.

**22** Confounding is not likely to occur. Because every possible combination of site and treatment was used, it becomes possible to identify the effects of the site and the effects of the treatment. This was a well-planned experiment.

**23** Confounding is likely to occur. If there are differences in the amounts of gasoline consumed, there would be no way to know whether those differences are due to the octane rating of the gasoline or the type of vehicle. Confounding can be avoided by using 87 octane gasoline in half of the vans and half of the sport utility vehicles and 91 octane gasoline in the rest of the vehicles. Even better would be conducting an experiment in which identical vehicles are driven under the same conditions (speed, distance, etc.) with the different gasolines.

**24** Confounding is not likely. Confounding would have been possible if the categorization of the offspring peas had been subjective, but that was not the case.

**25** Confounding is not likely to occur. Evaluators did not affect how the money was used and applied no subjective judgment in identifying how it was used. Confounding might have occurred if the subjects were informed of the purpose of the study before they made their choice, but they were not told.

**26** Confounding is possible because the effects of the treatment may be mixed with the effects of the physicians' knowledge on their judgments. It would be better to use blinding so that the physicians do not know who is given the treatment and who is given the placebo.

**27** In this case, the tennis balls play the role of placebos. Confounding can occur because of a placebo effect and/or an experimenter effect, because it will be obvious to both subjects and experimenters whether they are lifting heavy weights. It would be better to use the heavy weights and the tennis balls with the same subjects at different times, to see if the different regimens affect blood pressure.

**28** Confounding is very possible. It is not possible to disguise the car models and they have different reputations and very different prices that could affect the evaluations made by the driver.

**29** The control group consists of those who do not listen to Beethoven's music, and the treatment group consists of those who do listen to it. This should be a single-blind experiment. Subjects know whether they are listening to Beethoven, but blinding should be used so that those who measure intelligence are not influenced by their knowledge about whether there was exposure to Beethoven's music. The blinding could be accomplished by assigning code numbers to subjects, with only the researchers knowing which code numbers belonged to the treatment group and which belonged to the control group.

**30** This should be a double-blind experiment with a control group consisting of subjects given placebos and a treatment group consisting of those treated with Echinacea. Participants should be randomly assigned to the two groups.

**31** The control group consists of smartphones with the current battery, and the treatment group consists of smartphones with the new battery. Blinding is not necessary for the smartphones because they are not that smart, and it is probably unnecessary for the researchers because the longevity of the batteries will likely be measured with objective tools.

**32** It is sufficient to use the three different groups of homes with aluminum siding, vinyl siding, and wood siding. It isn't necessary to identify one of the groups as a control group. Blinding is not necessary for the houses, and it is unnecessary for the researchers if the longevity is measured with objective tools. Blinding would be difficult to implement because whether a home has aluminum siding or vinyl siding or wood siding would be obvious to those who evaluate the results.

**Section 1.4**
***Statistical Literacy and Critical Thinking***

**1** The eight guidelines are as follows:
   1. Get a big picture view of the study.
   2. Consider the source.
   3. Look for bias in the sample.
   4. Look for problems in defining or measuring the variables of interest.
   5. Beware of confounding variables.
   6. Consider the setting and wording in surveys.
   7. Check that results are presented fairly.
   8. Consider the conclusions.

**2** Peer review is a process in which experts in a field evaluate a research report before the report is published. It is useful in lending credibility to the research because it implies that other experts agree that it was carried out properly.

**3** Selection bias occurs when researchers select their sample in a way that tends to make it unrepresentative of the population, and participation bias occurs when the participants themselves choose to be included in the study.

**4** When participants select themselves for a survey, those with strong opinions about the topic being surveyed are more likely to participate, and this group is typically not representative of the general population.

**5**     This statement does not make sense.  A survey involving a large sample could give very poor results if the sample is chosen with a poor sampling method (such as self-selection), while a smaller sample could produce much better results if a sound sampling method is used (such as simple random sampling).

**6**     This statement does not make sense. If a sample is biased, it is biased no matter how large it is.

**7**     This statement does not make sense. The clinical trial might show that the treatment   results in lower blood pressure levels, but if the amount of the decrease is very small, it is possible that the treatment does not have practical significance.

**8**     This statement does not make sense. It generally isn't possible to control for all confounding variables, since you might not even know that some of them exist.

### *Concepts and Applications*

**9**     The survey was funded by a source that can benefit through increased sales fostered by the survey results, so there is a potential for bias in the survey. Guideline 2 is most relevant.

**10**    "Good" is not well defined and is difficult to measure. Guideline 4 is most relevant.

**11**    The weather and rainfall conditions in California are different from those in Hawaii. It is impossible to determine whether differences are due to the systems or the weather and rainfall conditions. Guideline 5 is most relevant.

**12**    The sample of male college students is a biased sample, so the effectiveness of the treatment does not necessarily apply to subjects in the general population of American adults. Guideline 3 is most relevant.

**13**    Because the researchers received funding from the pharmaceutical company, there is clearly potential for distorting the results so that they will please the pharmaceutical company. Guideline 2 (source) is most relevant

**14**    The results are not being reported fairly. Guideline 7 is most relevant.

**15**    The question is too vague and allows for different interpretations of how much violence is too much. The question does not address a variable that can be measured in a meaningful way. Guideline 4 is most relevant.

**16**    The use of the word "wasteful" is likely to encourage negative responses, so the wording is not appropriate. Guideline 6 is most relevant.

**17**    Because much of the funding was provided by Mars and the Chocolate Manufacturers Association, the researchers may have been inclined to provide favorable results. The bias could have been avoided if the researchers were not paid by the chocolate manufacturers. If that was the only way the research could be done, then the researchers should institute procedures to ensure that they publish all results, including negative ones.

**18**    The sample is self-selected and involves a small proportion of the population of women, so the responses were more likely to come from those with strong feelings about the issues. A better sampling procedure, such as interviews with 4,500 randomly chosen women, should have been used.

**19**    The wording of the question was biased to strengthen opposition against a particular candidate. The opinion poll is likely to be a "push poll" financed by supporters of another candidate, rather than a legitimate poll. A better survey would pose questions devoid of such bias.

**20**    A list of property owners is clearly biased toward those who can afford to own property. Also, a mail survey will result in a self-selected sample. A better sampling method, such as the simple random sampling used by most polling companies, should be used.

**21**   The word "wrong" in the first question could be misleading. Some people
       might believe that abortion is wrong, but still favor choice. The second
       question could also be confusing, as some people might think that "advice of
       her doctor" means that the woman's life is in danger, which could alter
       their opinion about abortion in this situation. Groups opposed to abortion
       would be likely to cite the results of the first question, while groups
       favoring choice would be more likely to cite the results of the second
       question.
**22**   The first question refers to "government programs," which many people
       consider to be generally wasteful. The second question lists specific
       programs that are very popular. Groups favoring tax cuts would be likely to
       cite the results of the first question, and groups opposed to tax cuts would
       be more likely to cite the results of the second question.
**23**   The headline refers to drugs whereas the story specifically cites "drug use,
       drinking, or smoking." Because "drugs" are generally considered to consist
       of drugs other than cigarettes or alcohol, the headline is very misleading.
**24**   The story does not include the margin of error. With a sample size of 500,
       the margin of error is around 4 percentage points, so the likely range for a
       satisfying sex life is 78% to 86%, and the likely range for job satisfaction
       is 75% to 83%. Because these ranges overlap, it is quite possible that the
       headline is incorrect.
**25**   No information is given about the sample size, margin of error, or how
       subjects were selected and measured. The reported "percentage" of 1 in 4 is
       not very precise, and it is not really a percentage.
**26**   The report appears to be making a statement about the quality of restaurants
       in New York City (the "Big Apple"), but much information is missing. What
       about restaurants with ratings of 30 or 28? What criteria were used for the
       ratings? Who actually did the rating?
**27**   No information is given to justify the statement "More companies try to bet
       on forecasting weather." If only the four cited companies make up the
       increase, it is relatively insignificant.
**28**   The headline suggests that China has been thrown off balance, implying that
       some change is having a dramatic effect, but no information is given about
       any such change.

## Chapter 1 Review Exercises

**1**   a)   The range of values likely to contain the proportion of all adults
            with tattoos is from 82% - 1% to 82% + 1% or from 81% to 83%.
       b)   The population consists of all adults aged 57 through 85 years.
       c)   It is an observational study because the subjects were not treated or
            modified in any way. The variable of interest is whether the subject
            uses at least one prescription medication. For this survey, that
            variable has two values: yes or no.
       d)   The reported value is a sample statistic because it is based on the
            sample of 3005 adults aged 57 through 85 years, not the population of
            all adults in that age bracket.
       e)   No, because that method would produce a self-selected sample and a
            likely participation bias.
       f)   (i) Systematic sampling; (ii) simple random sampling; (iii) stratified
            sampling; (iv) convenience sampling; (v) cluster sampling
**2**   a)   It is a sample chosen in such a way that every sample of the same size
            has the same chance of being selected.
       b)   No, because not every sample of 2007 people has the same chance of
            being selected. For example, it is impossible to select a sample
            consisting of 2007 people in the same primary sampling unit. Instead
            of being a simple random sample, this is a stratified sample.

     c)    Repeat the process of randomly selecting a primary sampling unit from one of the 2007 that are available, then randomly selecting one of its members. If the same adult is selected more than once, ignore the second and any subsequent repeat selections.

**3**    a)    No. There is no information about the occurrence of rhinovirus infections among people who do not use Echinacea. Also, the subjects who did not get rhinovirus infections may have been influenced by factors other than the Echinacea treatment.

     b)    It appears that Echinacea users have about the same rate of rhinovirus infections as those given a placebo, so Echinacea use does not appear to have an effect on rhinovirus infections.

     c)    With blinding, the subjects do not know whether they are getting Echinacea or a placebo, and with double blinding, those who evaluate the results also do not know.

     d)    This is an experiment because subjects are given a treatment.

     e)    An experimenter effect occurs if the experimenter somehow influences subjects through such factors as facial expression, tone of voice, or attitude. It can be avoided through the use of blinding.

**4**    a)    Because the word "welfare" has negative connotations, the second question should be used.

     b)    The first question, because it is more likely to elicit negative responses.

     c)    This is largely a subjective judgment. Some professional pollsters are opposed to all such questions that are deliberately biased, but others believe that such questions can be used. An important consideration is that the wording of survey questions can modify how people think, and such modification should not occur without their awareness or agreement.

## Chapter 1 Quiz

**1**    Population: all Internet users. Sample: the 500 Internet users who were surveyed.

**2**    The method used is stratified sampling.

**3**    The value of 5% is a sample statistic.

**4**    (a) The results found for the sample are similar to those we would find for the entire population.

**5**    The survey results are a sample.

**6**    It is an experiment.

**7**    (b) This trial is double-blind.

**8**    (a) The purpose of the placebo is to prevent participants from knowing whether they belong to the treatment group or the control group.

**9**    (c) It means pulse rates were lowered among some of those in the placebo group.

**10**    (b) There is a danger of confounding.

**11**    The range of values likely to contain the true value of the population parameter is from 51% – 3% to 51% + 3% or from 48% to 54%.

**12**    No, we cannot conclude that the majority of people are most annoyed by the use of "whatever" in conversations because the population parameter the confidence interval spans from 48% to 54%. The true value of the population parameter could be less than 50% (less than majority).

**13**    (b) The variable of interest in this study is the weights of dolphins.

**14**    (c) People who use sunscreen are more likely to spend time in the sun.

**15**    (b) Whenever we do a statistical study using a sample from a population, there is always a small chance, even when everything is done correctly to try to ensure that the sample is representative of the population, that the conclusions drawn about the population based on the sample results are not correct.