Ways to get data:

Complete census

↑

| Population: ENTIRE GROUP OF SUBJECTS |

↓

| Sample Survey: get information about population |

↓
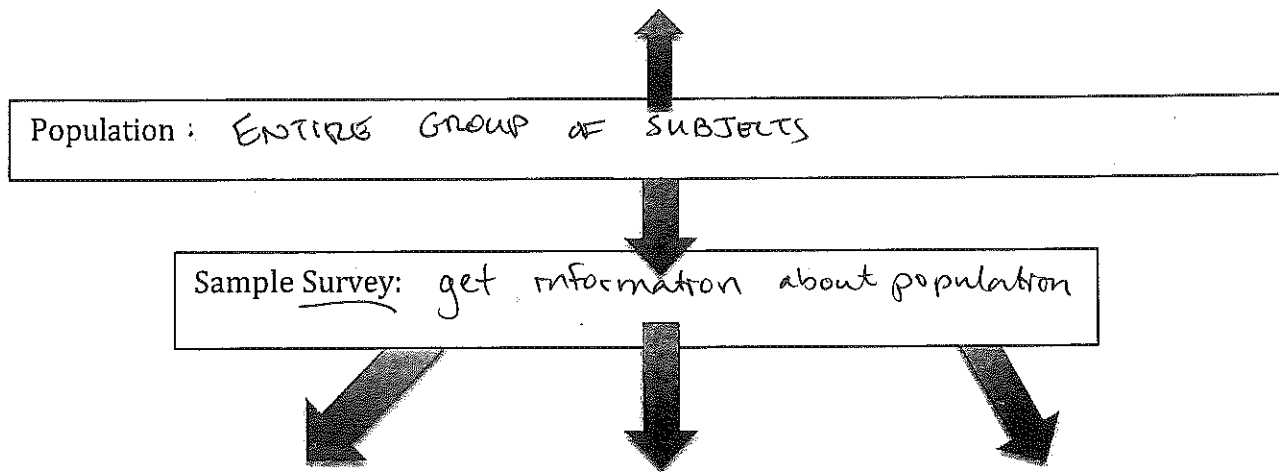
	Observational Study	Experiment

Problems	Bias: Tendency to favor an outcome
	
	• Selection Bias:
	HOW PEOPLE ARE CHOSEN
	
	• Unintentional Bias:
	SYSTEMATICALLY CHOOSING PEOPLE IN A BIASED WAY
	
	• Response Bias:
	HOW QUESTIONS ARE POSED, HOW SUBJECTS ARE CONTACTED
	
	   o Nonresponse Bias:
	 - HARD TO GET RESPONSES
	 - UNPASSIONATE PARTICIPANTS
	   o Undercoverage Bias:
	 - USING VOLUNTEERS IN A SURVEY DROWNS OUT OTHERS, LEAVING THEM UNDERREPRESENTED
		Confounded Variables:
		
		When there is uncertainty as to which variable is causing an effect.
		
		response ⊥ explanatory

Sources of Problems	Sources of bias: Flawed Sampling Design • Voluntary Response • Convenience Samples	Lurking variables underlying, unknown, unacknowledged variables that can't be separated from those in the study but which can influence

the picture painted

Methods	Eliminating Bias: Methods to proper sampling • Simple Random Sample (SRS) • Systematic Sampling: every nth person • Multistage: Pop → Groups → Groups, samples surveyed from each • Stratified break population into characteristics, sample within each strata.	• Randomization • Blinding Types of Experiments • Blocking - divides subjects by characteristic • before study Matched Pairs (type)
Important Terms	└ Cluster Sampling	• same subject, multiple treatments • Experimental Units - subjects receiving (not) treatment • Treatment / Treatment Group • Control / Control Group • Randomized paired comparison • Explanatory Variables (potentially) affect response
Generaliz- ations	The hope is that generalizations can be made about the population from a carefully selected sample	Any generalizations from experiments can only be made to those in the population who are like those in the study ✸

CHAPTER 5 REVIEW QUESTIONS

Multiple-Choice Questions
Answers can be found at the end of this section.

1. Which of the following is an appropriate sample for a study interested in the average interest rates on home loans form a national bank?

   (A) Less than one hundred loan rates from one branch in a town
   (B) Thousands of loan rates from all branches in the Midwest
   (C) All loan rates from all branches in one town and a random sample of loan rates from other area branches
   (D) A random sample of one thousand loan rates from one hundred randomly selected branches, nationally
   (E) Loan rates from ten of your neighbors who bank at the local branch

2. Which of the following is NOT a method of random sampling?

   (A) systematic
   (B) stratified
   (C) volunteer
   (D) proportional
   (E) cluster

3. If a study has three factors, each with three levels, how many treatments are there?

   (A) 6
   (B) 27
   (C) 5
   (D) 4
   (E) 10

4. A survey is administered to a random sample of participants. Which of the following does not describe a potential form of bias?

   (A) The survey asks about teenagers' tendency to text and drive and is administered in front of the teenagers' parents.
   (B) A small portion of the administered surveys are returned for analysis.
   (C) A study is meant to describe the behavior of high school students in general, but it is only administered to girls.
   (D) The population of a high school is divided into nonhomogeneous groups, and ten surveys are administered to a random sample from each cluster.
   (E) A question in the survey states, "Most teenagers know texting while driving is bad. How often do you text and drive?"

5. Suzy and John each claim to make the best chicken enchiladas. To test their claims, they each prepare enchiladas and serve them to a random sample of friends. Those friends are then surveyed using the same questionnaire. Results are compared. Which of the following statements about the study is true? (Note: Suzy and John do not have the same friends in common.)

   (A) The results will generalize because the questionnaires were identical.
   (B) The samples were random so the results should not be biased.
   (C) The results of this study will definitively prove whose enchiladas are better.
   (D) There is a convenience sampling bias present for both Suzy and John.
   (E) The study was a single-blind design study.

6. A student is lobbying for a new robotics club to be established at her high school. The school newspaper conducts a survey of students to assess interest in such a club. What is the population of interest?

   (A) All faculty, staff, and students at the school
   (B) All students at the school
   (C) All high school students in the county
   (D) All students in the district
   (E) All freshman at the school

7. A study testing the effectiveness of a new antidepressant medication includes three groups: a group given the new antidepressant, a group given an antidepressant that has already been proven to be effective, and a group given an ineffective, non-medicated sugar pill. What is the best name for the group given the sugar pill?

   (A) placebo
   (B) control
   (C) experimental
   (D) treatment
   (E) block

8. Why is replication a good practice in experimental designs?

   (A) It "controls" the effects of known factors.
   (B) It eliminates chance variation.
   (C) It allows for causation to potentially be determined.
   (D) It makes a study random.
   (E) It allows for chance variation to be estimated.

9. What is an example of a non-biased sampling method?

   (A) A teacher selecting only students with last names starting with the letters P through Z to take a pop quiz
   (B) A teacher selecting only students with a current A or B grade in his class to take a pop quiz
   (C) A teacher picking 10 names out of a jar containing the names of all the students in his class to take a pop quiz
   (D) A teacher selecting only students wearing long sleeves to take a pop quiz
   (E) A teacher asking the students sitting on the right side of his classroom to take a pop quiz

Free-Response Questions

10. A scientist wants to determine which catalyst, A or B, will reduce the reaction times of three reactions (1, 2, and 3) most.

    a. Design an experiment to compare the effects of these catalysts.
    b. Is your experiment single-blind, double-blind, or neither?

11. A school psychologist is interested in showing whether or not stress about school can lead to poor grades in school. She interviews a random sample of 100 students from her district's schools (K–12) at the middle of the semester. She asks them how stressed they generally are on a scale from 1 to 10, 10 being the most stressed. Then, the psychologist compares the grades of these students at the end of the semester. After analyzing the data, she concludes that stress about school causes poor grades.

    a. Is this causal conclusion appropriate based on the design of the study? Why or why not?
    b. What are some flaws in the design? How are they flaws?
    c. Design an experiment that corrects these flaws.

CHAPTER 5 ANSWERS AND EXPLANATIONS

1. **D** Samples from a population should be randomly selected and representative of the population as a whole. The population is the interest rates on home loans nationally, so the sample should be nationally representative. Only (D) has a sample that is representative of the population.

2. **C** Volunteer samples are a form of biased samples since the subjects self-select their participation in the sample. The results can be biased as certain individuals can decide not to participate. The other options are all means of sampling a population randomly. For example, systematic sampling would be when a researcher selects every 5th name on a list for participation in a study. Stratified sampling would be dividing the population into strata or homogeneous groups (like boys and girls) and then randomly selecting participants from those groups. Proportional sampling would require the population to be divided into strata and the samples proportional to the size of the stratum size be selected (for example, 40% of the population is girls, so 40% of the sample is from the girls stratum). Finally, cluster sampling is when the population is divided into nonhomogeneous groups and then those clusters sampled (like when a teacher splits the classroom in half down the middle and randomly selects a sample from each half of the class—assuming the students are not seated to form strata.)

3. **B** The number of values you multiply together is equal to the number of factors in a study. Here, we have three factors, so we must multiply __ × __ × __. The values that go into each slot represent the number of levels for each factor. In this case, 3 × 3 × 3 = 27.

4. **D** Choice (A) is an example of response bias; the students may not answer honestly in front of their parents. Choice (B) is an example of nonresponse bias; a portion of the population refused to answer. Choice (C) is an example of undercoverage bias; boys are completely left out of the sample! Choice (E) is an example of wording effect bias; students may feel obliged to respond in a way to make themselves look better, since they know the behavior is not favorable. Finally, (D) is a form of random sampling; it describes a cluster sampling procedure.

5. **D** Let's walk through each choice. Choice (A): The results will not generalize because the samples that tasted the two types of enchiladas were different. Choice (B): The samples were samples of convenience, which can be biased. Choice (C): The experiment cannot definitively prove anything for the reasons in (A), (B), and (E). Choice (E): Both the subjects and administrators knew who was in each group, so there was no blinding. Choice (D) is correct for the same reason (B) is incorrect; the samples were each individual's friends only.

6. **B** The club is for the students in the high school, so all of them would be potential participants, and thus the population of interest. The faculty and staff at the school will not be participants, so they are not part of the population of interest. Students anywhere else in the district or county are not important to this one high school's students' interest. Finally, freshman are not listed as the only potential participants in the club.

7.   A   A placebo group is a special form of a control group. It helps allow researchers to determine how effective a medication actually is versus the beneficial effects produced by simply taking a pill.

8.   E   Replication within a design is beneficial because it allows researchers to determine whether the results for one participant (or group) are due to the treatment or due to characteristics of that participant (or group) or other factors. When multiple participants (or groups) are given a treatment, the variation due to chance or factors out of the researchers' control can be estimated.

9.   C   A sample is considered non-biased if it is selected randomly, provides each individual with an equal chance of selection, and, therefore, represents the population. Choices (A), (B), and (D) can be eliminated because the teacher non-randomly selects students with particular characteristics: having a last name starting with a letter in the latter half of the alphabet, maintaining an A or B grade, or wearing long-sleeves in class. Eliminate (E) because the teacher non-randomly selects the right-side of the classroom to take the quiz. Therefore, the only answer that provides a scenario of random, non-biased sampling is (C), in which students are selected randomly from a jar.

10.   a.   Example: Prepare 20 samples of each reaction (1, 2, and 3). Randomly assign each Catalyst A and B to 10 different samples of each reaction. For example, mix up the samples for each reaction 1, 2, and 3 and number the samples 1–20. Assign every odd-numbered reaction to Catalyst A and every even-numbered reaction to Catalyst B. Allow a lab technician to run the reactions using the catalysts and record the reaction times. This lab technician should not be involved in the assignment of catalysts to reactions. Finally, compare the results of the reaction times for each reaction under each catalyst.

        b.   The experiment is single-blind because the lab technician who records the results is not aware of which catalyst was used with each reaction sample. It is not a double-blind study because the reaction samples are not people, so they wouldn't know what catalyst they were receiving regardless. If the reactions were people it would still be single-blind because the patients would know which catalyst they were receiving.

11.   a.   This causal conclusion is not appropriate because there are many factors that could have caused the poor grades in the students such as fatigue, not learning the material properly, missing class, etc. Also, this study was observational, not experimental, so causal conclusions cannot be drawn.

        b.   Here are a few examples:

           1.   The study is observational and not experimental, so causal conclusions cannot be drawn; all other potential causal factors were not controlled.

           2.   The sample is only drawn from the psychologist's district. This is a sample of convenience and cannot be generalized to students outside of the district.

3. There are different types of stress, and the psychologist didn't ask about them in her survey, so students may not be experiencing stress about school alone.

4. The psychologist is comparing students at multiple ages and grades against each other. These students are at different stages of development and may experience stress at varying rates due to age and workload.

5. She measures stress at the middle of the semester and grades at the end, but stress can change over time and a final grade is cumulative. So the time periods in question between the two variables are different.

6. Stress was measured in the middle of the semester, so it is possible that prior bad grades could have caused a high stress level, not the other way around.

c. There are potentially numerous ways of designing a more appropriate experiment to answer the psychologist's questions. The following are a couple of examples.

First, the psychologist should utilize stratified random sampling based on grade level to ensure that all ages of students are represented in the sample. Using a more representative sample will improve the generalizability of the study. Another possible improvement would be to use a block design in which students are blocked by prior academic achievement. Depending on the number of participants, block 1 could be students with a GPA from 3.5-4.0, block 2 could be students with a GPA from 3.0-3.5, and so on. The psychologist could measure stress levels at the beginning of the school year and then examine grades after a semester or marking period is completed. Grades for high-stress students will be compared to grades for low-stress students within each block. This method would ensure that the primary difference between the students would be stress level and not pre-existing differences in academic ability.

Chapter 4 Multiple Choice Practice

Directions. *Identify the choice that best completes the statement or answers the question. Check your answers and note your performance when you are finished.*

1. A researcher is testing a company's new stain remover. He has contracted with 40 families who have agreed to test the product. He randomly assigns 20 families to the group that will use the new stain remover and 20 to the group that will use the company's current product. The most important reason for this random assignment is that
   A. randomization makes the analysis easier since the data can be collected and entered into the computer in any order.
   B. randomization eliminates the impact of any confounding variables.
   C. randomization is a good way to create two groups of 20 families that are as similar as possible, except for the treatments they receive.
   D. randomization ensures that the study is double-blind.
   E. randomization reduces the impact of outliers.

2. A researcher observes that, on average, the number of traffic violations in cities with Major League Baseball teams is larger than in cities without Major League Baseball teams. The most plausible explanation for this observed association is that the
   A. presence of a Major League Baseball team causes the number of traffic incidents to rise (perhaps due to the large number of people leaving the ballpark).
   B. high number of traffic incidents is responsible for the presence of Major League Baseball teams (more traffic incidents means more people have cars, making it easier for them to get to the ballpark).
   C. association is due to the presence of a lurking variable (Major League teams tend to be in large cities with more people, hence a greater number of traffic incidents).
   D. association makes no sense, since many people take public transit or walk to baseball games.
   E. observed association is purely coincidental. It is implausible to believe the observed association could be anything other than accidental.

3. A researcher is testing the effect of a new fertilizer on crop growth. He marks 30 plots in a field, splits the plots in half, and randomly assigns the new fertilizer to one half of the plot and the old fertilizer to the other half. After 4 weeks, he measures the crop yield and compares the effects of the two fertilizers. This design is an example of
   A. matched pairs experiment.
   B. completely randomized comparative experiment.
   C. cluster experiment.
   D. double-blind experiment.
   E. this is not an experiment.

4. A large suburban school wants to assess student attitudes towards their mathematics textbook. The administration randomly selects 15 mathematics classes and gives the survey to every student in the class. This is an example of a
   A. multistage sample.
   B. stratified sample.
   C. cluster sample.
   D. simple random sample.
   E. convenience sample.

5. Eighty volunteers who currently use a certain brand of medication to reduce blood pressure are recruited to try a new medication. The volunteers are randomly assigned to one of two groups. One group continues to take their current medication, the other group switches to the new experimental medication. Blood pressure is measured before, during, and after the study. Which of the following best describes a conclusion that can be drawn from this study?

A.   We can determine whether the new drug reduces blood pressure more than the old drug for anyone who suffers from high blood pressure.
B.   We can determine whether the new drug reduces blood pressure more than the old drug for individuals like the subjects in the study.
C.   We can determine whether the blood pressure improved more with the new drug than with the old drug, but we can't establish cause and effect.
D.   We cannot draw any conclusions, since the all the volunteers were already taking the old drug when the experiment started.
E.   We cannot draw any conclusions, because there was no control group.

6. To determine employee satisfaction at a large company, the management selects an SRS of 200 workers from the marketing department and a separate SRS of 50 workers from the sales department. This kind of sample is called a

A. s   imple random sample.
B.   simple random sample with blocking.
C. multistage   random sample.
D.   stratified random sample.
E.   random cluster sample.

7. For a certain experiment you have 8 subjects, of which 4 are female and 4 are male. The names of the subjects are listed below:
          Males: Atwater, Bacon, Chu, Diaz.   Females: Johnson, King, Liu, Moore
There are two treatments, A and B. If a randomized block design is used, with the subjects blocked by their gender, which of the following is *not* a possible group of subjects who receive treatment A?

A.   Atwater, Chu, King, Liu
B.   Bacon, Chu, Liu, Moore
C.   Atwater, Diaz, Liu, King
D.   Atwater, Bacon, Chu, Johnson
E.   Atwater, Bacon, Johnson, King

8. An article in the student newspaper of a large university had the headline "A's swapped for evaluations?" Results showed that higher grades directly corresponded to a more positive evaluation. Which of the following would be a valid conclusion to draw from the study?

A.   A teacher can improve his or her teaching evaluations by giving good grades.
B.   A good teacher, as measured by teaching evaluations, helps students learn better, resulting in higher grades.
C.   Teachers of courses in which the mean grade is higher apparently tend to have above-average teaching evaluations.
D.   Teaching evaluations should be conducted before grades are awarded.
E.   All of the above

9. A new cough medicine was given to a group of 25 subjects who had a cough due to the common cold. 30 minutes after taking the new medicine, 20 of the subjects reported that their coughs had disappeared. From this information you conclude

A.   that the remedy is effective for the treatment of coughs.
B.   nothing, because the sample size is too small.
C.   nothing, because there is no control group for comparison.
D.   that the new treatment is better than the old medicine.
E.   that the remedy is not effective for the treatment of coughs.

10. 100 volunteers who suffer from anxiety take part in a study. 50 are selected at random and assigned to receive a new drug that is thought to be extremely effective in reducing anxiety. The other 50 are given an existing anti-anxiety drug. A doctor evaluates anxiety levels after two months of treatment to determine if there has been a larger reduction in the anxiety levels of those who take the new drug. This would be double blind if

A.   both drugs looked the same.
B.   neither the subjects nor the doctor knew which treatment any subject had received.
C.   the doctor couldn't see the subjects and the subjects couldn't see the doctor .
D.   there was a third group that received a placebo.
E.   all of the above.

Multiple Choice Answers

Problem	Answer	Concept	Right	Wrong	Simple Mistake?	Need to Study More
1	C	Why We Randomize				
2	C	Confounding				
3	A	Matched Pairs				
4	C	Cluster Sampling				
5	B	Inference About the Population				
6	D	Stratified Random Sampling				
7	D	Blocking				
8	C	Surveys vs. Experiments				
9	C	Lurking Variables				
10	B	Definition of Experiments				

FRAPPY! Free Response AP Problem, Yay!

The following problem is modeled after actual Advanced Placement Statistics free response questions. Your task is to generate a complete, concise response in 15 minutes. After you generate your response, view two example solutions and determine whether you feel they are "complete," "substantial," "developing," or "minimal." If they are not "complete," what would you suggest to the student who wrote them to increase their score? Finally, you will be provided with a rubric. Score your response and note what, if anything, you would do differently to increase your own score.

A large school district is interested in determining student attitudes about their co-curricular offerings such as athletics and fine arts. The district consists of students attending 4 elementary schools (2000 students total), 1 middle school (1000 students total), and 2 high schools (2000 students total).

The administration is considering two sampling plans. The first consists of taking a simple random sample of students in the district and surveying them. The second consists of taking a stratified random sample of students and surveying them.

(a) Describe how you would select a simple random sample of 200 students in the district.

(b) Describe how you would select a stratified random sample consisting of 200 students.

(c) Describe the statistical advantage of using a stratified random sample over the simple random sample in this study.

Student Response 1:

a) Write the names of all 5,000 students on separate slips of paper. Place the slips into a large bin and mix them well. Draw slips of paper until you have 200.

b) Separate the students by level—elementary, middle, and high school. Label the students at each level and randomly select 66 elementary students, 66 middle school students, and 68 high school students.

c) By stratifying, we avoid surveying only elementary students or only high school students. This is important because student attitudes might be different at each level.

How would you score this response? Is it substantial? Complete? Developing? Minimal? Is there anything this student could do to earn a better score?

Student Response 2:

a) Label each student with a number from 0001 to 5000. Use your calculator to generate 200 random numbers. These numbers correspond to the individuals who will be surveyed.

b) Randomly select 1 elementary school, 1 middle school, and 1 high school. Randomly select 200 students from each school.

c) Stratifying is easier because we don't have to sample the entire population. It is less time consuming and gives better results.

How would you score this response? Is it substantial? Complete? Developing? Minimal? Is there anything this student could do to earn a better score?

Scoring Rubric

Use the following rubric to score your response. Each part receives a score of "Essentially Correct," "Partially Correct," or "Incorrect." When you have scored your response, reflect on your understanding of the concepts addressed in this problem. If necessary, note what you would do differently on future questions like this to increase your score.

Intent of the Question

The goal of this question is to determine your ability to describe sampling methods and explain the advantages of stratifying over simple random sampling

Solution

(a) Write each student's name on a slip of paper. Place the slips of paper in a hat and mix well. Select 200 slips of paper and note the students in the sample. OR Label each student with a number from 0001 to 5000. Use a random number table or technology to produce random 4 digit numbers, ignoring repeats, until 200 are determined. These 200 numbers correspond to the individuals who will be surveyed.

(b) Because student attitudes may differ by level of school (elementary, middle, or high school), we should stratify by level. Label students at each level and randomly select 80 elementary students, 40 middle school students, and 80 high school students. This ensures each level is represented in the same proportion as the overall student enrollments

(c) Stratifying ensures no level is over or under represented in the sample. It is possible to select very few (or even no!) students from one level in a simple random sample. The opinions of students at one level may not reflect the opinions of all students in the district. Stratifying ensures each level is fairly represented.

Scoring:

Parts (a), (b), and (c) are scored as essentially correct (E), partially correct (P), or incorrect (I).

Part (a) is essentially correct if the response describes an appropriate method of selecting a simple random sample. This method should include labeling the individuals and employing a sufficient means of random selection that could be replicated by someone knowledgeable in statistics.
Part (a) is partially correct if random selection is used correctly, but the description does not provide sufficient detail for implementation.

Part (b) is essentially correct if the response describes selecting strata based on a reasonable variable (such as school level) and indicates randomly selecting individuals from each stratum to be a part of the survey. The method can result in an equal number of students from each level OR proportional representation based on the strata.

Part (b) is partially correct if a reasonable variable is identified, but the method is unclear or does not ensure proportional representation.

Part (c) is essentially correct if the response provides a reasonable statistical advantage of stratified random sampling based on the effects of an identified variable on the results in the context of the problem.
Part (c) is partially correct if the response provides a reasonable statistical advantage, but the communication is not clear or lacks context.

4   Complete Response
   All three parts essentially correct

3   Substantial Response
   Two parts essentially correct and one part partially correct

2   Developing Response
   Two parts essentially correct and no parts partially correct
   One part essentially correct and two parts partially correct
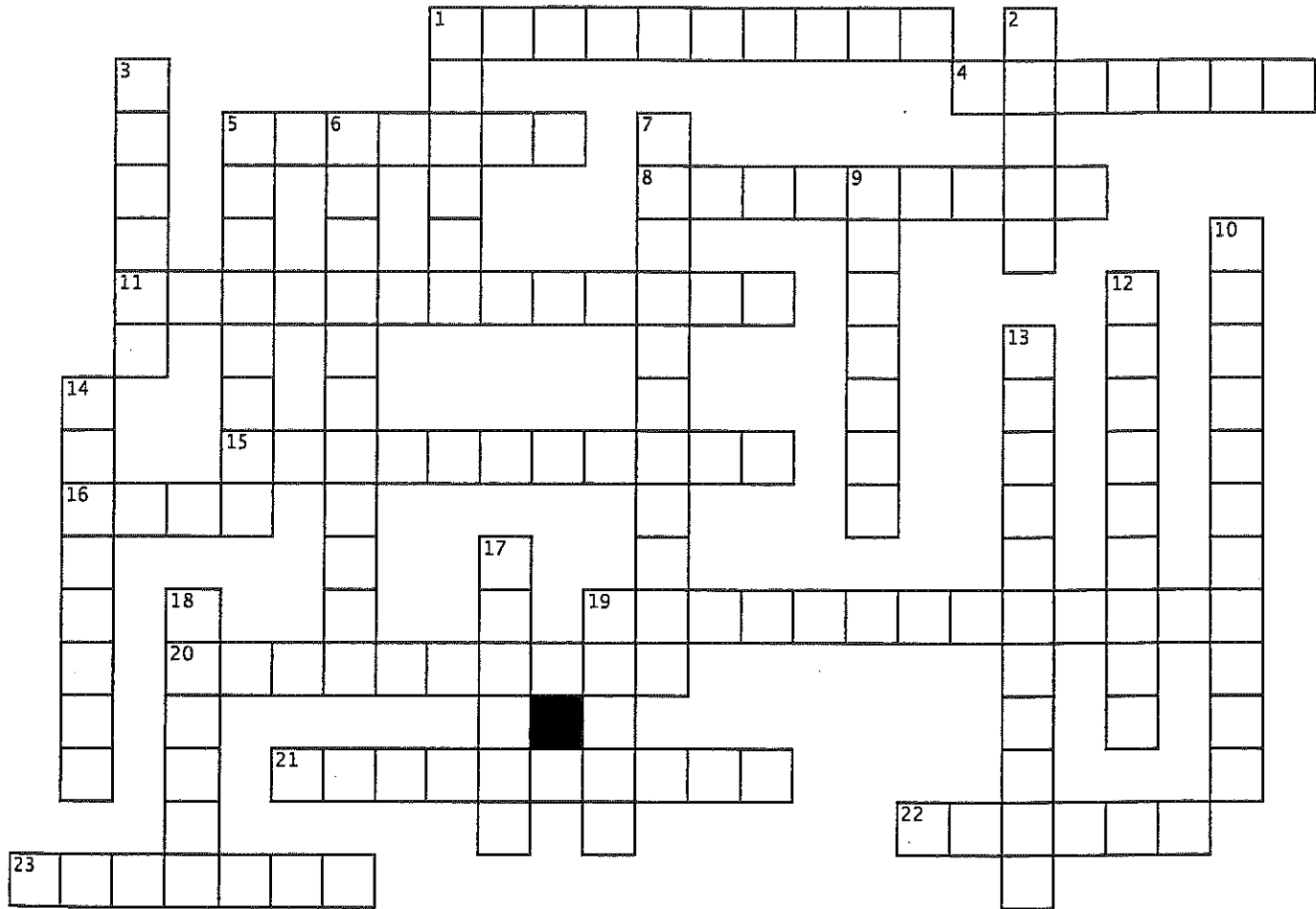   Three parts partially correct

1   Minimal Response
   One part essentially correct and one part partially correct
   One part essentially correct and no parts partially correct
   No parts essentially correct and two parts partially correct

Chapter 4: Designing Studies

Across

1. a _____ random sample consists of separate simple random samples drawn from groups of similar individuals
4. a "fake" treatment that is sometimes used in experiments
5. the effort to minimize variability in the way experimental units are obtained and treated
8. the process of drawing a conclusion about the population based on a sample
11. this type of student can not be used to establish cause-effect relationships
15. the practice of using enough subjects in an experiment to reduce chance variation
16. a study that systematically favors certain outcomes shows this
19. this occurs when some groups in the population are left out of the process of choosing the sample
20. a study in which a treatment is imposed in order to observe a reasponse
21. the entire group of individuals about which we want information
22. a simple _____ sample consists of individuals from the population, each of which has an equally likely chance of being chosen
23. a _____ sample consists of a simple random sample of small groups from a population

Down

1. groups of similar individuals in a population
2. a group of experimental units that are similar in some way that may affect the response to the treatments
3. the rule used to assign experimental units to treatments is _____ assignment
5. smaller groups of individuals who mirror the population
6. this occurs when an individual chosen for the sample can't be contacted or refuses to participate
7. an observed effect that is too large to have occurred by chance alone
9. a lack of _____ in an experiment can prevent us from generalizing the results
10. a sample in which we choose individuals who are easiest to reach
12. a _____ response sample consists of people who choose themselves by responding to a general appeal
13. neither the subjects nor those measuring the response know which treatment a subject received (two words)
14. when units are humans, they are called
17. the part of the population from which we actually collect information
18. another name for treatments
19. the individuals on which an experiement is done are experimental _____

Questions on Topic Six: Overview of Methods of Data Collection

Multiple-Choice
Questions

Directions: The questions or incomplete statements that follow are each followed by five suggested answers or completions. Choose the response that best answers the question or completes the statement.

1. When travelers change airlines during connecting flights, each airline receives a portion of the fare. Several years ago, the major airlines used a sample trial period to determine what percentage of certain fares each should collect. Using these statistical results to determine fare splits, the airlines now claim huge savings over previous clerical costs. Which of the following is true?

   I. The airlines ran an experiment using a trial period for the control group.
   II. The airlines ran an observational study using the calculations from a trial period as a sample.
   III. The airlines feel that any monetary error in fare splitting resulting from using a statistical sample is smaller than the previous clerical costs necessary to calculate exact fare splits.

   (A) I only
   (B) II only
   (C) III only
   (D) I and III
   (E) II and III

2. Which of the following are true statements?

   I. In an experiment some treatment is intentionally forced on one group to note the response.
   II. In an observational study information is gathered on an already existing situation.
   III. Sample surveys are observational studies, not experiments.

   (A) I and II
   (B) I and III
   (C) II and III
   (D) I, II, and III
   (E) None of the above gives the complete set of true responses.

3. Which of the following are true statements?

   I. In an experiment researchers decide how people are placed in different groups.
   II. In an observational study, the people themselves select which group they are in.
   III. A control group is most often a self-selected grouping in an experiment.

(A) I and II
(B) I and III
(C) II and III
(D) I, II, and III
(E) None of the above gives the complete set of true responses.

4. In one study on the effect of niacin on cholesterol level, 100 subjects who acknowledged being long-time niacin takers had their cholesterol levels compared with those of 100 people who had never taken niacin. In a second study, 50 subjects were randomly chosen to receive niacin and 50 were chosen to receive a placebo.

(A) The first study was a controlled experiment, while the second was an observational study.
(B) The first study was an observational study, while the second was a controlled experiment.
(C) Both studies were controlled experiments.
(D) Both studies were observational studies.
(E) Each study was part controlled experiment and part observational study.

5. In one study subjects were randomly given either 500 or 1000 milligrams of vitamin C daily, and the number of colds they came down with during a winter season was noted. In a second study people responded to a questionnaire asking about the average number of hours they sleep per night and the number of colds they came down with during a winter season.

(A) The first study was an experiment without a control group, while the second was an observational study.
(B) The first study was an observational study, while the second was a controlled experiment.
(C) Both studies were controlled experiments.
(D) Both studies were observational studies.
(E) None of the above is a correct statement.

6. In a 1992 London study, 12 out of 20 migraine sufferers were given chocolate whose flavor was masked by peppermint, while the remaining eight sufferers received a similar-looking, similar-tasting tablet that had no chocolate. Within 1 day, five of those receiving chocolate complained of migraines, while no complaints were made by any of those who did not receive chocolate. Which of the following is a true statement?

(A) This study was an observational study of 20 migraine sufferers in which it was noted how many came down with migraines after eating chocolate.
(B) This study was a sample survey in which 12 out of 20 migraine sufferers were picked to receive peppermint-flavored chocolate.
(C) A census of 20 migraine sufferers was taken, noting how many were given chocolate and how many developed migraines.
(D) A study was performed using chocolate as a placebo to study one cause of migraines.
(E) An experiment was performed comparing a treatment group that was given chocolate to a control group that was not.

7. Suppose you wish to compare the average class size of mathematics classes to the average class size of English classes in your high school. Which is the most appropriate technique for gathering the needed data?

   (A) Census
   (B) Sample survey
   (C) Experiment
   (D) Observational study
   (E) None of these methods is appropriate.

8. Which of the following are true statements?

   I. Based on careful use of control groups, experiments can often indicate cause-and-effect relationships.
   II. While observational studies may suggest relationships, great care must be taken in concluding that there is cause and effect because of the lack of control over lurking variables.
   III. A complete census is the only way to establish a cause-and-effect relationship absolutely.

   (A) I and II
   (B) I and III
   (C) II and III
   (D) I, II, and III
   (E) None of the above gives the complete set of true responses.

9. Two studies are run to compare the experiences of families living in high-rise public housing to those of families living in townhouse subsidized rentals. The first study interviews 25 families who have been in each government program for at least 1 year, while the second randomly assigns 25 families to each program and interviews them after 1 year. Which of the following is a true statement?

   (A) Both studies are observational studies because of the time period involved.
   (B) Both studies are observational studies because there are no control groups.
   (C) The first study is an observational study, while the second is an experiment.
   (D) The first study is an experiment, while the second is an observational study.
   (E) Both studies are experiments.

10. Two studies are run to determine the effect of low levels of wine consumption on cholesterol level. The first study measures the cholesterol levels of 100 volunteers who have not consumed alcohol in the past year and compares these values with their cholesterol levels after 1 year, during which time each volunteer drinks one glass of wine daily. The second study measures the cholesterol levels of 100 volunteers who have not consumed alcohol in the past year, randomly picks half the group to drink one glass of wine daily for a year while the others drink no alcohol for the year, and finally measures their levels again. Which of the following is a true statement?