Chapter 4 Online Quiz

Chapter 4: Designing Studies

1. A professor decides to make his class notes available in electronic form on the Internet. At the end of the quarter, several students mention in the course evaluation that having the notes readily available helped them do well in the class. This is an example of
   A. an observational study.
   AR. Incorrect. These students represent individual cases that came to the professor’s attention. They are not necessarily representative of any group in particular. To be an observational study, the professor would need to compare the performance of students in years when the notes were available with student performance in years when they were not. Even then, confounding variables could still be a problem.
   B. an experiment.
   BR. Incorrect. To be an experiment, the treatments (availability or unavailability of notes on the Internet) would have to be imposed on the students by the professor, and an objective measure of how students performed in the course would have to be taken.
   C. neither of the above.
   CR. Correct. These are just several individual cases that came to the professor’s attention. They represent the personal experiences of several students and are not necessarily representative of any group in particular.

2. Researchers in Britain randomly divided a large number of pre-term babies into three groups. One received donated breast milk, one received infant formula made for pre-term babies, and the third received regular infant formula. Each diet was used for one month as a sole food or as a supplement to mother’s milk. Sixteen years later, the children returned and had their blood pressure measured. It was found that diastolic and systolic blood pressure both tended to be lower in the children who were fed breast milk than in the children who were fed formula. This study is an example of
   *A. an experiment.
   AR. Correct. Specific conditions (the types of diet) were imposed on the subjects (the pre-term babies) and the results (blood pressure) were measured and compared.
   B. an observational study.
   BR. Incorrect. The researchers did not merely observe. They actively imposed conditions (the types of diet) on the subjects (the pre-term babies).
   C. a census.
   CR. Incorrect. The study obviously does not look at all pre-term babies, and it is not an observational study because the researchers actively imposed conditions (the types of diet) on the subjects (the pre-term babies).

3. Suppose you would like to determine which age groups in the United States (18–29, 30–49, 50–64, 65 or older) currently identify watching television as their favorite way to spend an evening. The most appropriate statistical study to answer this question would be
   *A. a survey.
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AR. Correct. To get up-to-date information to answer this question, you would have to select an appropriate sample of Americans over 18 and determine the percentage of individuals in each age group who would say watching TV is their favorite evening pastime.

B. an observational study that is not a survey.

BR. Incorrect. You could try to use available data (for example, past survey results) to answer this question, but here we are interested in the current situation, so you would have to survey the current population.

C. an experiment.

CR. Incorrect. No treatment is being imposed on the subjects (Americans over 18) in this case. You are simply gathering information from them.

4. A researcher in early childhood education believes that kindergarten-age children are more receptive to help from a female teacher than from a male teacher. From a list of kindergarten teachers in the state, the researcher randomly samples four classes with male teachers and four classes with female teachers. The students in the classes are interviewed, and a measure of how receptive the students in each class are to help from the teacher is determined. This study is an example of

A. an experiment.

AR. Incorrect. For this study to be an experiment, teachers of both sexes would have to be assigned at random to the classes, which was not done here.

*B. an observational study.

BR. Correct. The researcher did not impose any treatment (male or female teacher) on each class. Note that confounding variables could be a problem as a result. In many schools, parents have some input in choosing their child’s teacher. When a choice of teacher is available, children might be put into a class with a teacher of the gender they would be more responsive to, which would tend to mask differences (if they existed).

C. a census.

CR. Incorrect. We are not surveying all kindergarten classes in the state. We are studying only a sample of such classes. Although this study is observational, it is not a census.

5. A study involving overweight, postmenopausal women aged 50 to 75 randomly assigned equal numbers of women to an exercise program (at least 45 minutes of moderate walking or riding an exercise bike five times a week) and to a stretching program (15 to 30 minutes of stretching three times a week, under the supervision of an exercise physiologist). It was found that a higher percentage of women in the exercise group reported improved sleep than did women in the stretching group. This study is an example of

*A. an experiment, but not a double-blind experiment.

AR. Correct. Treatments (the two programs) are being imposed on the subjects (the women) and their responses (quality of sleep) are being measured. The study is not double-blind because the women know which program they are following.

B. a double-blind experiment.

BR. Incorrect. The study is not double-blind because the subjects (women) know which treatment (program) they are following.

C. a matched-pairs experiment.
CR. Incorrect. A matched-pairs experiment would require that we pair subjects (women) who are similar (by age, lifestyle, and so on) and then assign one woman at random to the exercise program and the other woman to the stretching program. The study was not designed this way.

6. An agricultural researcher wants to compare the effect on yield of three different methods of growing blueberries. To control for variables such as soil condition and location, he plants 30 plots on each of six different farms. On each farm, 10 of the 30 plots are assigned to each of the three treatments (growing methods). The researcher measures and compares the marketable yield of blueberries produced by each plot. Which of the following best describes the design of this experiment?

A. a completely randomized design with three treatments
AR. Incorrect. This is a randomized block design, because before we randomly assign the units (the plots) to the treatments (the growing methods), we divide the units into blocks (the farms).

*B. a randomized block design with six blocks and three treatments
BR. Correct. The blocks are the farms. Within each block, we assign 10 plots to each of the three treatments (the growing methods). There are three treatments in all because there are three different distinct conditions being imposed on the units (the plots).

C. a randomized block design with three blocks and six treatments
CR. Incorrect. You have interchanged the number of blocks (the farms) and the number of treatments (the growing methods).

7. Which of the following best describes replication in an experimental design?

A. increasing the number of treatments used
AR. Incorrect. Increasing the number of treatments will result in less replication, unless you increase the number of subjects or units being used.

B. applying the treatments to each subject or unit in a random order
BR. Incorrect. This addresses the issue of randomization, rather than replication.

*C. doubling the number of subjects or units in each treatment group
CR. Correct. Replication involves increasing the number of subjects or units in each treatment group. This will increase the precision and reliability of the results.

8. Twelve people who suffer from chronic fatigue syndrome volunteer to take part in an experiment to see if shark-fin extract will increase energy level. Eight of the volunteers are men, and four are women. Half of the volunteers are to be given shark-fin extract twice a day and the other half a placebo twice a day. We want to make sure that four men and two women are assigned to each treatment, so we decide to use a block design, with the men forming one block and the women the other. The names of the men and women are given in the chart, and each name is given the indicated single-digit numerical label.

<table>
<thead>
<tr>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Adams</td>
<td>5. Lewis</td>
</tr>
<tr>
<td>3. Gregg</td>
<td>7. Simpson</td>
</tr>
<tr>
<td>4. Howard</td>
<td>8. Taylor</td>
</tr>
</tbody>
</table>

1. Braun
2. Davies
3. Miller
4. Warner
Use the list of random digits to assign four men and two women to the shark-fin treatment group. Read the table, starting at the beginning of the first line, from left to right, first selecting the four men and then the two women. According to this scheme, the subjects assigned to the shark-fin treatment are

A. Lewis, Simpson, Howard, Adams, Warner, and Davies.
AR. Incorrect. You moved to the second line of the table to choose the women after choosing the four men. Once you have chosen the men, you should stay on the first line to choose the women.

B. Lewis, Simpson, Howard, Adams, Gregg, and Taylor.
BR. Incorrect. You chose all subjects from the list of men, resulting in six men rather than four men and two women.

*C. Lewis, Simpson, Howard, Adams, Braun, and Miller.
CR. Correct. The correct digits would be 5, 7, 4, 1 (men) and 1, 3 (women), which corresponds to Lewis, Simpson, Howard, and Adams among the men and Braun and Miller among the women.

9. A biologist is studying the effect of different nutrients and different levels of salinity (salt) in water on the growth of a certain species of fish. Ten fish are to be assigned at random to each of 12 similar tanks in a controlled environment. The biologist wants to use combinations of 4 different nutrients and 3 different salinity levels as treatments. In this experimental design, how many units (fish) are being assigned to each treatment group?

A. 12
AR. Incorrect. You have counted the total number of treatments, rather than the total number of units assigned to each treatment group.

*B. 10
BR. Correct. There are $(4)(3) = 12$ treatments in all, each of which will be applied to a single tank. Because 10 fish are put into each tank, there are 10 units per treatment group.

C. 120
CR. Incorrect. You have counted the total number of units in the entire experiment, rather than the total number of units assigned to each treatment group.

10. You want to know the opinions of American high-school teachers on the issue of establishing a national proficiency test as a prerequisite for graduation from high school. You obtain a list of all high-school teachers belonging to the National Education Association (the country’s largest teachers’ union) and mail a survey to a random sample of 2500 teachers. In all, 1347 of the teachers return the survey. Which of the following statements about this situation is true?

*A. The sampling frame is the set of all high-school teachers who are members of the NEA.
AR. Correct. The sampling frame is defined as the set of individuals from which the sample is actually selected. It may be identical to the population, or, as in this case, it may be a subset of the population. We are using the NEA teachers as a matter of convenience, but we suspect that
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the NEA teachers will be a reasonably good cross section of the population of all high-school teachers, since the NEA is the largest teachers’ union.

B. The population is the set of all high-school teachers who are members of the NEA.
BR. Incorrect. In this case, the population—the set of all individuals of interest in the study—is the set of all high-school teachers, not just teachers who belong to the NEA. You are merely using the set of NEA teachers as an aid in selecting the sample.

C. The sample is the set of 2500 teachers to whom you send the survey.
CR. Incorrect. To be counted as part of the survey, a teacher would have to send the survey back to you. Therefore, the sample is the set of 1347 teachers who returned the survey.

11. A sociologist wants to study the attitudes of American male college students toward marriage and husband–wife relations. She gives a questionnaire to 25 of the men enrolled in Sociology 101 at her college. All 25 men complete and return the questionnaire. The sample in this situation is
A. all men taking a comparable sociology class.
AR. Incorrect. This phrase does not describe a sample at all but rather a set of subjects similar to the population of interest.
*B. the 25 men who received and returned the questionnaire.
BR. Correct. The sample is the part of the population we actually observe.
C. all men in the Sociology 101 class.
CR. Incorrect. This is the population from which we are drawing, not the sample.

12. A researcher is interested in the cholesterol levels of adults in the city she lives in. A cholesterol-screening program is set up in the downtown area during the lunch hour. Individuals can walk in and have their cholesterol measured for no charge. In one lunch hour, 173 people use the service, and their average cholesterol level is 217.8. The sample obtained here is an example of
A. a simple random sample, since the experimenter did not know beforehand which individuals would come to the screening.
AR. Incorrect. A simple random sample requires that all samples of a certain size drawn from the population have the same chance of being selected, clearly not the case here.
*B. a stratified sample of high- and low-cholesterol individuals.
BR. Incorrect. A stratified sample of these individuals would require a list of individuals in these two categories. Then a simple random sample would have to be taken from each list. The sample was not selected this way.
*C. a sample probably containing bias and undercoverage.
CR. Correct. Individuals “volunteered” for the screening. Individuals who knew their cholesterol level was fine may not have bothered to have it checked, which would cause the average from the screening to be too high. The downtown area is not equally accessible to all adults in the population. Those who work downtown are more likely to be in the sample. Other groups may not have known about the screening or may have been unable to reach the screening center, which would lead to undercoverage.

13. You would like to compare the level of mathematical knowledge among 15-year-olds in the United States and Japan. To do this, you plan to give a mathematics achievement test to random
samples of 1000 15-year-olds in each of the two countries. To ensure that the samples will include individuals from all different socioeconomic groups and educational backgrounds, you will randomly select 200 students from low-income families, 400 students from middle-income families, and 400 students from high-income families in each country. The sampling procedure being used here is
A. simple random sampling.
AR. Incorrect. This cannot be a simple random sample because there are certain possible samples of size 1000 that have no chance whatsoever of being chosen. For example, it would be impossible to select a sample of size 1000 containing more than 200 students from low-income families, because under the stated conditions of the sampling procedure, no more than 200 such students could be in the final sample.
B. voluntary response sampling.
BR. Incorrect. You are using random selection to choose the different components of the sample. A voluntary response sampling procedure allows the members of the sample to choose themselves.
*C. stratified sampling.
CR. Correct. In this case, the strata are the different socioeconomic groups. You take random samples of the stated sizes from each of the groups and combine the samples to form the final sample of size 1000. Stratified sampling is useful when we wish to take a representative sample from a population that may contain subgroups that differ fundamentally in ways that may affect their responses. Socioeconomic status certainly plays a role in educational development.

14. A poll of American adults’ opinions about efforts to reform Social Security was conducted in 2004–2005 by the AARP, the nation’s largest organization for retired people. The poll results were criticized in some quarters because they included no respondents under the age of 30, even though voters aged 18 to 29 made up 17% of the 2004 electorate. By contrast, respondents aged 60 and above made up 34% of the sample but were only 24% of the electorate. This poll is most likely subject to which of the following types of bias?
*A. undercoverage
AR. Correct. The poll does not include the opinions of a sizable segment of the electorate. Those aged 18 to 29 did not get a chance to participate.
B. nonresponse
BR. Incorrect. No specific information was given about the response rate of the poll. However, there is clearly a problem with undercoverage. Certain groups were excluded from participation in the poll. This is not the same as nonresponse, when subjects either cannot be contacted or do not choose to participate.
C. response bias
CR. Incorrect. It is possible that conditions under which the subjects were interviewed influenced the answers they gave. However, undercoverage is a much more obvious problem in this case.

15. A study using data from 41 states found a positive correlation between per capita beer consumption and death rates from cancer of the large intestine and rectum. The states with the highest rectal cancer death rates were Rhode Island and New York. The beer consumption in those states was 80 quarts per capita, per year. In South Carolina, Alabama, and Arkansas, by...
contrast, the beer consumption was only 26 quarts per capita, and rectal cancer death rates were less than one-third those in Rhode Island and New York. The best explanation for the observed association between beer consumption and rectal cancer death rate is

A. causation—heavier beer drinking causes a higher rate of cancer.

AR. Incorrect. This assertion is unjustified. Might there be other factors aside from beer drinking that affect rectal cancer death rate? Hint: Look at the states listed as high in both beer consumption and cancer death rate, then look at the states listed as low in both.

B. common response—both beer consumption and rectal cancer death rate are responding to changes in some third variable.

BR. Incorrect. It is rather difficult to devise a third variable that would influence both beer consumption and rectal cancer death rate. Many factors could play a role in beer consumption, such as climate (warm versus cold). Many factors could affect rectal cancer death rate, such as genetic predisposition toward cancer or lifestyle habits. Can one variable be said to affect both at the same time? Try thinking of other variables besides beer consumption that might be playing a role in the observed rectal cancer death rates.

C. confounding—the effects of beer drinking are mixed up with the effects of other environmental factors that affect rectal cancer death rate.

CR. Correct. States with high concentrations of industry, such as Rhode Island and New York, have environmental problems that contribute to the development of cancer that more rural states, such as South Carolina, Alabama, and Arkansas, do not possess. Any of these additional factors could be contributing to the higher death rates in the industrialized states. It would be a mistake to attribute the higher death rates solely to beer consumption.

16. A study covering many countries found a strong positive correlation between the life expectancy in a country and the percentage of households in the country with telephones. The best explanation of this observed correlation is that

*A. both life expectancy and telephone ownership are exhibiting a common response to the lurking variable of the country’s socioeconomic condition.

AR. Correct. Countries with poor socioeconomic conditions would tend to be low in both life expectancy and telephone ownership, while countries with good conditions would tend to be high in both categories.

B. telephone ownership and use is a major contributing cause of longer life.

BR. Incorrect. There is no plausible reason to believe that owning and using a telephone would be a cause of increased life expectancy, even though the variables are positively correlated. There are other, more reasonable explanations for the observed strong correlation.

C. in countries where life expectancy is high, the rate of telephone ownership tends to be low, and in countries where life expectancy is low, the rate of telephone ownership tends to be high.

CR. Incorrect. By the definition of positive correlation, the variables of life expectancy and telephone ownership tend to be either both high or both low. Having values of opposite size would be evidence of a negative correlation.