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

Down
1. groups of similar individuals in a population [STRATA]
2. a group of experimental units that are similar in some way that may affect the response to the treatments [BLOCK]
3. the rule used to assign experimental units to treatments is _____ assignment [RANDOM]
5. smaller groups of individuals who mirror the population [CLUSTERS]
6. this occurs when an individual chosen for the sample can't be contacted or refuses to participate [NONRESPONSE]
7. an observed effect that is too large to have occurred by chance alone [SIGNIFICANT]
9. a lack of _____ in an experiment can prevent us from generalizing the results [REALISM]
10. a sample in which we choose individuals who are easiest to reach [CONVENIENCE]
12. a _____ response sample consists of people who choose themselves by responding to a general appeal [VOLUNTARY]
13. neither the subjects nor those measuring the response know which treatment a subject received (two words) [DOUBLEBLIND]
14. when units are humans, they are called [SUBJECTS]
17. the part of the population from which we actually collect information [SAMPLE]
18. another name for treatments [LEVELS]
19. the individuals on which an experiment is done are experimental _____ [UNITS]
Chapter 4: Solutions

Section 4.1 Concept 1:

I can identify the population and sample in a sampling situation.

The population is all sentences and words used in the popular Algebra 1 textbooks. The sample consists of the sentences and words in the 10 randomly selected paragraphs.

Section 4.1 Concept 2:

I can describe how to use a table of random numbers or a random number generator to select a simple random sample.

Assign each student a two-digit label 01-23. Read two-digit blocks across the random number table until 4 of the labels are selected, ignoring repeats and labels from 24-00. The four selected are 19: Rohnkol, 22: Wilcock, 05: Buckley, 13: Lacey

Section 4.2 Concept 1:

I can explain the concept of confounding

1. This is an observational study since no treatment was imposed on the subjects. Test scores and shoe size were observed. No effort was made to influence either variable.
2. The explanatory variable would be the shoe size and response would be test score.
3. One possible confounding variable could be age of the students. Older students would have bigger feet, on average, and would most likely have higher test scores.

Section 4.2 Concept 2:

I can identify experimental units, explanatory variables, treatments, and response variables in an experiment

I can describe a completely randomized design for an experiment

1. Experimental units: Mr. Tyson's students Explanatory variable: listening to classical music (yes or no) Response variable: test scores
2. A potential lurking variable could be an existing musical preference based on test score. Perhaps higher performing students prefer listening classical music. Maybe students who listen to classical music have more resources/opportunities to score well than those who don't.
3. The 150 students should be randomly assigned to two groups. This could be accomplished by drawing names from a hat until 75 are in one group and 75 are in another. Both groups will receive the same instruction from Mr. Tyson. However, one group will be assigned to listen to classical music while studying and the other group will study in silence. All students will take the same assessment and their average results will be compared.

Section 4.2 Concept 3:

I can distinguish between completely randomized designs and block designs

(example) Suppose Mr. Tyson suspects students enrolled in a music class may have higher scores than those who don't. In order to ensure not all students enrolled in a music class are assigned to listen to classical music (which could happen through random assignment), he should block by enrollment. He should block all students enrolled in a music class together and all students who are not enrolled in music should be blocked separately. Then, he should randomly assign half of the students in each block to listen to classical music while studying and the other half should study in silence. Then all students should take the same assessment and the results within each block should be compared.

258
RAPPY! 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.

Statement 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

<table>
<thead>
<tr>
<th>My Score:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I did well:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>What I could improve:</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>What I should remember if I see a problem like this on the AP Exam:</td>
</tr>
</tbody>
</table>