

## Chapter 4 Test Review

## Multiple Choice Questions

1. Who makes more mistakes on their income tax forms: accountants or taxpayers who prepare the forms themselves? A random sample of income tax forms that were prepared by accountants was drawn from IRS records. An equal number of forms that were self-prepared by taxpayers was also drawn. The average number of errors per form was compared to determine if one group tends to make more mistakes than the other. What type of study is this?
  - A) Census
  - B) Experiment
  - C) Voluntary response survey
  - D) Observational study
  - E) Match-pair study
  
2. A dance club holds a raffle at the end of each dance. Five dancers are selected at random to each draw one numbered tag from a hat without replacement. There are 50 tags in the hat numbered from 1 to 50. Drawing a tag from 1 through 5 wins \$20, tags 6 through 25 wins \$10 and tags from 26 through 50 wins \$5. In order to determine the average amount of money paid out, a simulation will be conducted using a random number table. Which of the following assignments of random numbers to tag values is most appropriate for the simulation.
  - A) Using single-digit numbers, assign 0 to represent a \$20 prize, 1-4 to represent a \$10 prize and 5-9 to represent a \$5 prize.
  - B) Using single-digit numbers, assign 0 to represent a \$20 prize, 1 to represent a \$10 prize and 2 to represent a \$5 prize. Numbers 3-9 are ignored.
  - C) Using two-digit numbers, assign 20 to represent a \$20 prize, 10 to represent a \$10 prize and 05 to represent a \$5 prize. Numbers 00-04, 06-09, 11-19, 21-99 are ignored.
  - D) Using two-digit numbers, assign 01-05 to represent a \$20 prize, 06-25 to represent a \$10 prize and 26-50 to represent a \$5 prize. Numbers 51-99 and 00 are ignored.
  - E) Using two-digit numbers, assign 01-10 to represent a \$20 prize, 11-40 to represent a \$10 prize and 41-99 and 00 to represent a \$5 prize.
  
3. The student council wants to survey students at the school to see what brands of soda they want in the school machines. They randomly sampled 30 freshman, 30 sophomores, 30 juniors and 30 seniors. The sampling method they used is a
  - A) Simple random sample
  - B) Stratified random sample
  - C) Cluster sample
  - D) Systematic random sample
  - E) Convenience sample

4. A new medication has been developed to cure a certain disease. The disease progresses in three stages, stages I, II, and III, each progressively worse than the one before it. Ninety volunteers are gathered to test the new medications, 30 in each of the three stages of disease. The medication will be administered to subjects daily in one of three dosages: 100mg for each subject in stage I of the disease, 200mg to each subject in state II, and 400mg to each subject in stage III. After 8 weeks, the proportion of subjects cured of the disease will be recorded. Why is this NOT a good experimental design?

- I. Because experiments of this type should only use one dosage level of medication.
- II. Because disease stage is potentially confounded with dosage level.
- III. Because the experiment lacks a control group.

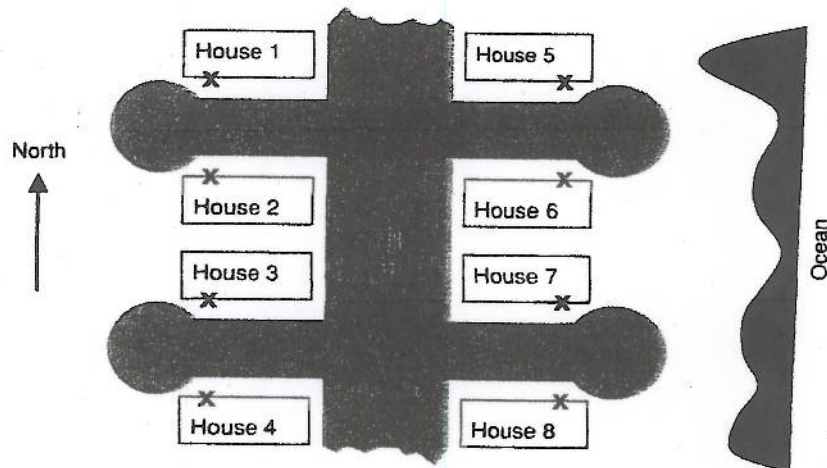
- A) I only
- B) II only
- C) I and II only
- D) II and III only
- E) I, II and III

5. A politician is considering running for public office. He wants to measure his name recognition by doing a survey of voters in his district. Which of the following survey methods would produce unbiased results.

- A) The politician stands in front of a grocery store in his district on Saturday morning and asking each person entering the store if he or she recognizes the politician's name.
- B) Placing pollsters in front of every grocery store in his district on Saturday morning and asking each person entering the store if he or she recognizes the politician's name.
- C) Sending a survey card to all registered voters in the district asking them to call a phone number to state whether or not they recognize the politician's name.
- D) Calling people from his district listed in the phone book and asking each if he or she recognizes the politician's name.

E) None of these methods would produce unbiased results.

6. A garage door manufacturer has developed a new type of door for houses in the Southeastern part of the United States, especially the coastal area. Doors in this area of the country are particularly susceptible to damage from salty ocean spray and the sun's rays, which tend to shine mainly on the north side of the house. An experiment will test the new type of garage door against the existing type of door on 8 houses in a particular residential area. An overhead view of the area is shown below. The location of the garage door on each house is marked with an "X".



Which of the following blocking schemes is most appropriate to account for the variables in this study, other than the type of door?

- A) Form the houses into two blocks: {1, 2, 3, 4} and {5, 6, 7, 8}.
  - B) Form the houses into two blocks: {1, 3, 5, 7} and {2, 6, 4, 8}.
  - C) Form the houses into four blocks: {1,5}, {2,6}, {3,7}, and {4,8}.
  - D) Form the houses into four blocks: {1,3}, {2,4}, {5,7}, and {6,8}.
  - E) No blocking is necessary in this experiment.
7. A well-known diet doctor has developed a new formula for a drug that will suppress appetites. The Food and Drug Administration (FDA) wants this doctor to submit research to show that there is a significant difference in weight loss for patients using the new drug versus the old drug. Which of the following would be the best method to obtain results the FDA is requesting?
- A) The doctor should randomly choose patients and allow them to select which drug they want to use.
  - B) The doctor should randomly choose patients to take the new drug and ask patients using the old drug how much weight they have lost.
  - C) The doctor should randomly assign patients to two groups: one group takes the new drug and the other group takes the old drug.
  - D) The doctor should randomly assign the patients to two groups: one group takes the new drug and the other group takes a placebo.
  - E) The doctor assigns the new drug to patients who have more than 10 pounds to lose and the old drug to patients with less than 10 pounds to lose.



8. Which of the following allow inference about a population parameter?

- I. A randomized controlled experiment using volunteers
  - II. An observational study using volunteers
  - III. A survey of a random sample from the population
- A) I only
  - B) II only
  - C) III only
  - D) I and II only
  - E) I and III only

9. What is the major difference between an experiment and an observational study?

- A) A treatment is imposed in an experiment.
- B) An observational study can establish cause-effect relationships.
- C) There are two control groups instead of one in an experiment.
- D) Observational studies use only one population.
- E) Experiments are blinded.

10. Five homes from a subdivision will be randomly selected to receive 1 month of free cable TV. There are 80 homes in the subdivision. The homes are assigned numbers 01-80 and the random number table below is used to select the five homes. No home may receive more than one free month of service. Which of the following is a correct selection of the five homes?

|       |       |       |       |
|-------|-------|-------|-------|
| 99154 | 70392 | 23889 | 92335 |
| 92210 | 70439 | 08629 | 73299 |

- A) 9, 1, 5, 4, 7
- B) 15, 47, 03, 23, 23
- C) 15, 47, 03, 23, 35
- D) 99, 70, 23, 92, 08
- E) 99, 15, 47, 03, 92

11. The cafeteria manager at a university wants to conduct a survey of 10 students about the quality of food for the students that live in the dorms and use the cafeteria. Which of the following will give the best representation of all dorm students that use the cafeteria?

- A) Survey every eighth student that arrives in the cafeteria.
- B) Survey the first 100 students that arrive at the cafeteria at dinner time.
- C) Select a simple random sample of dorm students that use the cafeteria.
- D) Hand out a survey to any student who will take the time to answer the questions.
- E) Put surveys in the dormitory mailbox of students on the cafeteria plan.

12. The school Parent-Teacher Association (PTA) wants to sample parents about the type of school lunches they prefer for their children. At a recent Open House parent night, the volunteer conducting the survey decided to hand the questions out to every 10<sup>th</sup> parent that came to the Open House. This sampling method is called a

- A) Convenience sample
- B) Multistage sample
- C) Cluster sample
- D) Stratified random sample
- E) Simple random sample

13. The manufacturer of an automobile battery claims that the battery provides at least 900 cold cranking amps (CCA) of current to a car's starter. To maintain this claim, a quality control inspector takes every 15<sup>th</sup> battery off the assembly line and measures the CCA put out by each battery. This sampling method is called a

- A) Cluster sample
- B) Convenience sample
- C) Simple random sample
- D) Stratified random sample
- E) Systematic sample

14. A botanist is studying the killing of trees by pine beetles in a small square-shaped region of a national forest. Using an aerial photograph of the region, the botanist divides the area into a grid 20 units long by 20 units wide. Forty of the four hundred squares on the grid are selected at random, and all trees within those squares are sampled. What type of sampling procedure is this?

- A) Cluster sample
- B) Convenience sample
- C) Simple random sample
- D) Stratified random sample
- E) Systematic sample

15. The maker of a popular pain reliever conducted an experiment to see if there were benefits from adding calcium to their formula. Five hundred people who experience regular headaches took part in the experiment. Two groups were randomly formed; one group took the pain reliever with the added calcium while the other group took the original formulation. The people in the group that took the new formula with calcium reported a shorter average waiting time for pain relief than the people with the original formulation. Which of the following is (are) true concerning the results of this experiment?
- I. We cannot conclude a cause-effect relationship between the presence of calcium and waiting time for pain relief.
  - II. The addition of calcium to pain relievers may reduce the time to experience pain relief.
  - III. There were not enough subjects in the experiment to draw a conclusion.
- A) I only
  - B) II only
  - C) III only
  - D) I and II only
  - E) I and III only
16. The only way to ensure a cause-effect relationship between two variables is to
- A) Conduct an observational study
  - B) Conduct a census
  - C) Conduct a study with volunteers
  - D) Conduct a survey
  - E) Conduct an experiment
17. It is thought that 40% of all students that take Physics also take Chemistry at some point in their high school careers. A simulation is designed to estimate the probability that 10 randomly selected students who take Physics will take Chemistry. The digits 0 through 9 will be used for the simulation. Which of the following assignments of digits would best model this simulation?
- A) Assign "1, 2, 3, and 4" as taking Chemistry and "5, 6, 7, 8, and 9" as not taking Chemistry
  - B) Assign "0, 1, 2, 3, and 4" as taking Chemistry and "5, 6, 7, 8, and 9" as not taking Chemistry
  - C) Assign "0, 1, 2, and 3" as taking Chemistry and "4, 5, 6, 7, 8, and 9" as not taking Chemistry
  - D) Assign "4" as taking Chemistry and "1, 2, and 3" as not taking Chemistry
  - E) Assign "4" as taking Chemistry and "0, 1, 2, 3, 5, 6, 7, 8, and 9" as not taking Chemistry
18. A telephone survey of households will be conducted to determine how many vehicles residents of each household own. Which is NOT a possible source of bias for this survey technique?
- A) Households with unlisted phone numbers may not be called.
  - B) Households with a single resident most likely have only one car.
  - C) Households whose residents who have caller ID may not answer the phone.
  - D) Households without phones will not be called.
  - E) Households with residents who only have cell phones may not be called.



19. Which of the following statements is NOT true about the design of an experiment?

- A) A purpose of blocking is to test the effect of outside variables.
- B) A purpose of blocking is to reduce undesired variability.
- C) A purpose of control groups is to provide a basis for comparison with other treatments.
- D) A purpose of randomization is to even out variability due to lurking variables.
- E) A purpose of randomization is to reduce bias due to confounding variables.

20. A large telecommunications company wants to improve employee productivity. Studies have shown that exercise could help. The company decides to offer two different types of programs during the workday. One program is an aerobics class for 30 minutes; the other is a weight room session for 30 minutes. Employees can choose the program in which they want to participate. If the company truly wants to find out if exercise during the day improves worker productivity, what else is needed in the study?

- I. A third type of exercise, as more treatments will yield more reliable information.
- II. A control group that does not exercise in order to determine if an increase in productivity was actually due to one of the treatments.
- III. Random assignment of employees to treatment groups, instead of allowing employees to choose.

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

21. A pharmacist wants to study the effect of temperature ( $0^{\circ}$ ,  $30^{\circ}$ ,  $60^{\circ}$ , and  $90^{\circ}F$ ) on the potency of a headache pain reliever when it is stored for extended periods of time. Thirty pills were randomly assigned to each of the temperatures for a specified storage time. The time it took to gain relief from a headache was measured for each pill. Which of the following is the correct description of the treatment, experimental unit, and the response, respectively?

- A) Specific temperature, pill, relief time
- B) Specific temperature, the pharmacist, relief time
- C) Pill, relief time, specific temperature
- D) Random assignment, pill, relief time
- E) Specific temperature, relief time, pill

22. In a clinical trial, 30 sickle-cell patients are randomly assigned to two groups. One group is then randomly assigned the currently marketed medicine, and the other group receives the experimental medicine. Each week patients report to the clinic where blood tests are conducted. The lab technician is unaware of the kind of medicine the patient is taking and the patient is also unaware which medicine he/she has been given. This design can be described as

- A) A completely randomized design, with the currently marketed medicine and the experimental medicine as the two treatments.
- B) A matched-pairs design, with the currently marketed medicine and the experimental medicine forming a pair
- C) A randomized block design, with the currently marketed medicine and the experimental medicine as the two blocks.
- D) A randomized block design, with the currently marketed medicine and the experimental medicine as the two treatments
- E) A randomized block design, in which blinding occurs.

23. In a clinic, 50 patients with sleep disorders are randomly assigned to one of two different groups. Patients in one group are given medication before bedtime. Patients in the other group are given blindfolds and soft music is played at bedtime. Each patient is attached to a machine that records breathing patterns. From the patterns, it is possible to determine if the patient is awake or asleep. The data will be used to decide which method is more effective in helping patients with sleep disorders. Which of the following statements is correct in the context of this experiment?

- A) This is a single blind experiment, since only one group uses blindfolds
- B) This is a single blind experiment, because only patients and not doctors use blindfolds
- C) This is a double-blind experiment since patients are blindfolded and the doctor does not know which patient receives which treatment
- D) This experiment cannot be a single blind experiment, because many patients do not like being blindfolded
- E) This experiment cannot be a double blinded, because patients will know which treatment they are receiving, although the examining doctor will not.




### Free Response Questions

1. A dentist has just returned from a dental convention where a new formula of toothpaste with additional fluoride was announced. The maker of the toothpaste claims a reduction in cavities over the existing formula. Before recommending this new toothpaste to her patients, the dentist decided to conduct an experiment of her own. She asks 80 patients to volunteer to be part of the experiment. The experiment will last for 1 year.

- A) Design an experiment that will allow the dentist to determine if the new formula reduces cavities as compared to the old formula.

The dentist wants to determine if the new formula of toothpaste will show fewer cavities than the old formula. The 80 volunteers will be randomly assigned to two groups of 40. One group will use the old toothpaste and the other group will use the new toothpaste. After 1 year, the volunteers will be checked and new cavities will be counted. Then the number of new cavities for each of the two groups will be compared.



- B) Explain "blinding" in the context of this situation and why it is important for the experiment.

This experiment can be blind if the volunteers do not know whether they are using the old formula of toothpaste or the new. Blinding can be important in eliminating potentially confounding variables. If the group using the new formula knew they had the new formula, they might eat healthier or brush more carefully to show that the formula works. Then the researchers would not know if fewer cavities were caused by the toothpaste or by this other behavior. This experiment could be double-blind if the dentist also did not know which patients had which toothpaste during the experiment.

2. The administrators in a high school are thinking of changing the school's parking policy effective 3 weeks after school begins. The administration has asked the student council to conduct a survey during the first week of school to determine what students who own cars think about the proposal.

The student body has the following distribution. The number of students who own cars is also provided.

| Grade      | Freshmen | Sophomores | Juniors | Seniors |
|------------|----------|------------|---------|---------|
| Population | 500      | 550        | 500     | 450     |
| Own Cars   | 0        | 180        | 315     | 405     |

The student council has decided to survey 100 students. The student body president wants to conduct a simple random sample to obtain the names of 100 students to be surveyed. The student body secretary wants to use a stratified random sample to obtain the names of the 100 students.

- A) If the student body president's plan is chosen, describe the procedure used to select the 100 students.

The population of interest is those students who own cars, not the entire student body. Therefore, the student president should consider only those 900 students who own cars to be the sampling frame. Each of the 900 students should be assigned a three digit number from 001 to 900. Then 3 digits are taken from a random digit table (ignoring 901-999, 000 and repeats) until 100 students are chosen. This will yield an SRS of students who own cars.

- B) If the student body secretary's plan is chosen, describe the procedure used to select the 100 students.

The sample should be divided proportionally between sophomores, juniors and seniors. Sophomores are 20% of the students who own cars, juniors are 35% and seniors are 45%. Therefore, a sample of 100 students should include 20 sophomores, 35 juniors and 45 seniors. For the 180 sophomore with cars, assign each a number from 001 to 180 and select 20 numbers at random without replacement. For the juniors, assign numbers 001 to 315 and select 35 numbers at random. For the seniors, assign the numbers 001 to 405 and select 45 numbers at random. The stratified sample consists of 3 smaller SRS's.

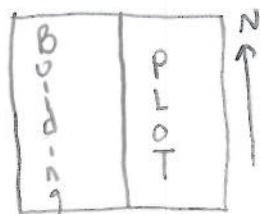
- C) What are the advantages and disadvantages of each sampling method?

Both methods give good, unbiased results. The president's SRS is a little easier to implement, requiring only one assignment of numbers. The secretary's stratified random sample requires doing this three times. The advantages of the secretary's plan is that stratification will prevent a disproportionate number of one grade from being sampled. The SRS does not guarantee proportional representation.

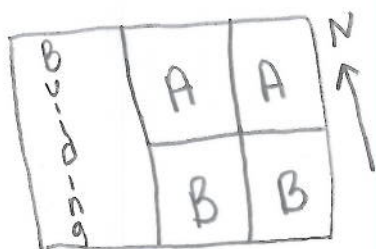


3. A nursery grows rose bushes. A new fertilizer is on the market and the gardener in charge of the roses want to determine if the roses will have more bloom than with the fertilizer he has be using. The rose bushes are planted in a rectangular plot along the east side of the nursery building; the south end of the plot receives more sunlight than the north end. Design an experiment using both brands of fertilizer that takes into account the variation in sunlight.

The diagram below shows the situation.



The south side of the plot will potentially get more sunlight than the north end. The plot will get the morning sun but the building will block the evening sun on the north end. As the plants grow, those on the northern end will be shaded by those in the south. The plot should be divided into blocks in order to take into account these effects.



One example would be to divide the large plot into two blocks, A and B, of two plots each. The new fertilizer will be randomly assigned to one of the plots in block A and the other plot in block A receives the old fertilizer. This process is repeated for block B. The average number of blooms would be compared between the two fertilizers.