1. An article in a women’s magazine says that women who choose to nurse their babies feel warmer and more receptive toward the infants than mothers who bottle-feed. The author concludes that nursing has desirable effects on the mother’s attitude toward the child. Explain why asserting a causal relationship based on this information is suspect, and give another plausible explanation for the association between the decision to bottle-feed or nurse and mothers’ attitudes toward their children.

2. A cookie manufacturer is trying to determine how long cookies stay fresh on store shelves, and the extent to which the type of packaging and the store’s temperature influences how long the cookies stay fresh. He designs a completely randomized experiment involving low (64 Fº) and high (75 Fº) temperatures and two types of packaging—plastic and waxed cardboard. List the experimental units, factors, and treatments in this experiment.

3. An experiment to investigate the effectiveness of white-willow-bark capsules as a remedy for back pain plans to compare the reduction in pain for people using this herbal remedy to a control group. Is it possible to conduct this experiment in a double-blind? Explain.
4. The Brigham Young University statistics department is conducting a series of randomized comparative experiments to compare teaching methods. Response variables include students’ final-exam scores and a measure of their attitude toward statistics. One study compares two levels of technology for large-group lectures: standard (overhead projectors and chalk) and multimedia. The experimental units in the study are the 8 lecture sections in a basic statistics course. There are four instructors, each of whom teaches two sections. Because the lecturers differ, their lectures form four blocks. Suppose the sections and lecturers are as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer</td>
<td>Hilton</td>
<td>Christensen</td>
<td>Hadfield</td>
<td>Hadfield</td>
<td>Tolley</td>
<td>Hilton</td>
<td>Tolley</td>
<td>Christensen</td>
</tr>
</tbody>
</table>

(a) Outline the design of an experiment using blocking to determine which lecture method is most effective. Be sure to explain how you will randomly assign the treatments, using the random digits table below.

71487 09984 29077 14863 61683 47052 62224 51025
13873 81598 95052 90908 73592 75186 87136 95761
54580 81507 27102 56027 55892 33063 41842 81868
71035 09001 43367 49497 72719 96758 27611 91596

(b) Explain why a randomized block design is better than a completely randomized design in this case.
1. For each study described below, comment on the extent to which inferences can be drawn about a larger population and whether cause and effect can be established.

   (a) A football coach thinks lessons in yoga will improve the flexibility of his players and thereby reduce injuries. To test his theory, he randomly divides the players on the team into two groups. One group has 45 minutes of yoga training each day. The players in the other group do the standard stretching routine the team has used in the past. He compares flexibility in the two groups at the end of the experiment.

   (b) Does lack of sleep affect your academic performance? A student explores this question by asking everyone in his statistics class to write down on a piece of paper his or her score on a recent test and total number of hours of sleep he or she got on the last three nights before taking the test.

   (c) Does “Cold-Cut,” a popular over-the-counter cold remedy that claims to reduce the length and severity of colds really work? A consumer advocacy group addresses this question by asking a random sample of 400 adults how many colds they’d had in the last six months, how long each cold lasted, and if they took “Cold-Cut” to treat the cold.

2. Preliminary observational studies have linked consumption of caffeine during pregnancy to a higher incidence of miscarriages. It would be unethical to run a controlled experiment to establish cause and effect in this situation. Describe two ways in which researchers can seek to establish cause and effect that do not involve experiments.
1. For each study described below, comment on the extent to which inferences can be drawn about a larger population and whether cause and effect can be established.

   (a) A teacher wants to decide if handing out a topic outline before the final exam improves the exam scores of calculus students. He has two sections of calculus this term. His gives one class a topic outline and tell the other class to generate their own topic outline. He then compares the two sections’ scores on the final exam.

   (b) Does blood type determine your personality? In a study aimed at answering this question, a random sample of 100 adults were given a personality test, and a comparison was made between the scores on the introversion/extroversion scale and blood type (A, B, AB, O).

   (c) Does using a calculator improve understanding of mathematical concepts? All 200 fifth-graders at a school are randomly assigned to one of two groups. One group studies addition of fractions with the aid of a calculator, the other studies the same topic without a calculator. Scores on a fractions test are compared after two weeks.

2. A few studies have suggested that people who live within a few hundred yards of high-voltage power lines are more likely to get certain forms of cancer. It would be both unethical and impractical to conduct a controlled experiment to establish cause and effect in this situation. Describe two ways in which researchers can seek to establish cause and effect that do not involve experiments.
1. For each study describe below, comment briefly on the extent to which results can be
generalized to some larger population, and the extent to which cause and effect has been
established.

(a) A marketing executive who wants to gauge reactions to a new packaging design for a
popular brand of cookie places the new packages in 45 randomly-selected grocery stores
in a large city and compares sales of the cookies to sales of the same cookie (with the old
packaging) in the previous month.

(b) A consumer advocacy organization wants to determine if using premium gasoline in the
engines of cars improves gas mileage. They randomly select 40 makes and models of new
cars and acquire two of each. They run each car on a track for 1000 miles, one with
regular gasoline, one with premium. (Which car within each pair gets the premium gas is
determined by coin flip). After driving each car, they determine the difference in fuel
consumption within each pair of cars.

(c) A high school student thinks that the longer a student has been at the school, the less they
like the food in the cafeteria. To test this theory, she gives a two-question survey to the
first 100 people who enter the cafeteria on a certain day. The first question is, “How long
have you attended school here?” The second question asks the student to rate the food in
the cafeteria on a 1 to 5 scale.

2. The gas mileage experiment in part (b) of the previous question is criticized by an oil
company as suffering from lack of realism. Explain what this means in the context of the
experiment.
Test 4A  AP Statistics  Name:

Part 1: Multiple Choice. Circle the letter corresponding to the best answer.

1. A new headache remedy was given to a group of 25 subjects who had headaches. Four hours after taking the new remedy, 20 of the subjects reported that their headaches had disappeared. From this information you conclude
(a) that the remedy is effective for the treatment of headaches.
(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 aspirin.
(e) that the remedy is not effective for the treatment of headaches.

2. We wish to draw a sample of 5 without replacement from a population of 50 households. Suppose the households are numbered 01, 02, . . . , 50, and suppose that the relevant line of the random number table is 11362 35692 96237 90842 46843 62719 64049 17823. Then the households selected are
(a) households 11 13 36 62 73
(b) households 11 36 23 08 42
(c) households 11 36 23 23 08
(d) households 11 36 23 56 92
(e) households 11 35 96 90 46

3. A maple sugar manufacturer wants to estimate the average trunk diameter of Sugar Maples trees in a large forest. There are too many trees to list them all and take a SRS, so he divides the forest into several hundred 10 meter by 10 meter plots, selects 25 plots at random, and measures the diameter of every Sugar Maple in each one. This is an example of a
(a) multistage sample.
(b) stratified sample.
(c) simple random sample.
(d) cluster sample.
(e) convenience sample.

4. A researcher for a consumer products company is field testing a new formula for laundry detergent. He has contracted with 60 families, each with two children, who have agreed to test the product. He randomly assigns 30 families to the group that will use the new formula and 30 to the group that will use the company’s current detergent formula. 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 30 families that are as similar as possible, so that comparisons can be made between the two groups.
(d) randomization ensures that the study is double-blind.
(e) randomization reduces the impact of outliers.
5. To test the effect of music on productivity, a group of assembly line workers are given portable mp3 players to play whatever music they choose while working for one month. For another month, they work without music. The order of the two treatments for each worker is determined randomly. This is
(a) an observational study.
(b) a matched pairs experiment.
(c) a completely randomized experiment.
(d) a block design, but not a matched pairs experiment.
(e) impossible to classify unless more details of the study are provided.

6. A survey was done in the town of Mechanicsville to estimate the proportion of cars that are red and made by companies based in Japan. A random sample of 25 cars from a student parking lot at Lee-Davis High School was taken. Which of the following statements is not correct?
(a) This sample may not be representative of the cars in Mechanicsville because mainly students park at Lee-Davis High School.
(b) If the particular parking space is vacant, we can simply select another parking space at random because it is unlikely that a space being vacant is related to the color or manufacturer of the car.
(c) It would an error to simply select the first 25 parking spaces in the lot closest to the auditorium because there are a number of parking spaces there reserved for Drivers Ed vehicles, whose primary color is white.
(d) A different team doing the sampling independently would obtain different answers for their sample proportions.
(e) The results will be the same regardless of the time of day that the sample is taken.

7. A nutritionist wants to study the effect of storage time (6, 12, and 18 months) on the amount of vitamin C present in freeze dried fruit when stored for these lengths of time. Vitamin C is measured in milligrams per 100 milligrams of fruit. Six fruit packs were randomly assigned to each of the three storage times. The treatment, experimental unit, and response are respectively:
(a) A specific storage time, amount of vitamin C, a fruit pack
(b) A fruit pack, amount of vitamin C, a specific storage time
(c) Random assignment, a fruit pack, amount of vitamin C
(d) A specific storage time, a fruit pack, amount of vitamin C
(e) A specific storage time, the nutritionist, amount of vitamin C

8. A researcher observes that, on average, the number of divorces 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 divorces to rise (perhaps husbands are spending too much time at the ballpark).
(b) high number of divorces is responsible for the presence of Major League Baseball teams (more single men means potentially more fans at the ballpark, making it attractive for an owner to relocate to such cities).
(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 divorces).
(d) association makes no sense, since many married couples go to the ballpark together.
(e) observed association is purely coincidental. It is implausible to believe the observed association could be anything other than accidental.

9. Control groups are used in experiments in order to
   (a) control the effects of outside variables on the outcome.
   (b) control the subjects of a study to ensure that all participate equally.
   (c) guarantee that someone other than the investigators, who have a vested interest in the outcome, controls how the experiment is conducted.
   (d) achieve a proper and uniform level of randomization.
   (e) reduce the variability in results.

10. A survey is to be administered to recent graduates of a certain nursing school in order to compare the starting salaries of women and men. For a random sample of graduates, three variables are to be recorded: sex, starting salary, and area of specialization. Which of the follow best describes a conclusion that can be drawn from this study?
   (a) Whether being female causes graduates of this nursing school to have lower (or higher) starting salaries than males.
   (b) Whether being female causes graduates in this sample to have lower (or higher) starting salaries than males.
   (c) Whether choosing certain area of specialization causes females graduates of this nursing school to have lower (or higher) starting salaries than males.
   (d) Whether there is an association between sex and starting salary among graduates of this nursing school.
   (e) Whether there is an association between sex and starting salary at all nursing schools similar to this one.