AP Statistics **Name: _____ Period: ____**

Review Unit 1 – Designing Studies

Study your notes for the matching, fill in the blank, and multiple choice problems.
Reading Chapters 11-13 of your textbook may also be helpful. (Note: skip simulations in Chapter 11)

1. A group of nurses believes that ginseng tea has a positive effect on the mood of patients. To test this they serve ginseng tea to patients and have the patients rate their mood on a scale of 1 to 5 at randomly selected times throughout several days. Patients are divided into groups who receive varying amounts of tea as follows: Group 1 - 1 cup per day Group 2 - 3 cups per day Group 3 - 5 cups per day

   Identify the response variable and the explanatory variable in this study.

2. A track coach who also teaches physics knows that the velocity of his runners is related to moving mass over distance. He wonders if the weight of the runner has any effect his time in the 100 yard dash. To test this he weighs each candidate for his team and then has them run the 100 yard dash and records their times. What are the explanatory and response variables?

3. Two neighbors both planted vinca in their yards over the same weekend. One planted them in full sun while the other planted them in an area with partial shade. After two months, the neighbor who planted them in the partial shade had beautiful vinca with many flowers. The other neighbor had lost most of the plants and had few flowers. Is this good evidence that vinca should be planted in partial shade? Why or why not?

4. After a government test, Mr. Dingley averages the grades of his 3rd period class and finds the class mean to be 88. Curious about his other classes, he finds the mean of all students who took the test to be 79. Which of the following can be said about his test scores?

   a) 79 is a statistic
   b) 88 is a statistic
   c) 88 is a parameter
   d) 3rd period has smarter students
   e) Outliers caused the overall mean to be lower
   f) a, c, and e

5. When conducting a well-constructed survey, a researcher should use

   a) open-ended questions.
   b) questionnaires only.
   c) non-randomized presentation of questions.
   d) closed-ended questions.

6. Stratifying a survey sample will provide which of the following?

   a) reduced variation b) increased sample size c) biased results d) subject restriction

7. To study a cause-and-effect relationship between variables, which of the following methods of data collection should be used.

   a) observational study
   b) survey (presentation of questionnaire)
   c) survey (use of one-on-one interview)
   d) experiment

8. 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

9. 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.

10. 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 confounding 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 other choices gives the complete set of true responses.

11. Which of the following are true statements?

   I. If bias is present in a sampling procedure, it can be overcome by dramatically increasing the sample size.
   II. There is no such thing as a “bad sample.”
   III. Sampling techniques that use probability techniques effectively reduce bias.

   a) I only b) II only c) III only
   d) none of the statements are true
   e) none of the choices gives the complete set of true responses.

12. To find out the average occupancy size of student-rented apartments, a researcher picks a simple random sample of 100 such apartments. Even after one follow-up visit, the interviewer is unable to make contact with anyone in 27 of these apartments. Concerned about nonresponse bias, the researcher chooses another simple random sample and instructs the interviewer to continue this procedure until contact is made with someone in a total of 100 apartments. The average occupancy size in the final 100 apartment sample is 2.78. Is this estimate probably too low or too high?

    a) Too low, because of undercoverage bias.
    b) Too low, because convenience samples overestimate average results.
    c) Too high, because of undercoverage bias.
    d) Too high because convenience samples overestimate average results.
    e) Too high, because voluntary response samples overestimate average results.

13. What fault do all these sampling designs have in common?

    I. The Wall Street Journal plans to make a prediction for a presidential election based on a survey of its readers.
    II. A radio talk show asks people to phone in their views on whether the United States should pay off its huge debt to the United Nations.
    III. A police detective, interested in determining the extent of drug use by teenagers, randomly picks a sample of high school students and interviews each one about any illegal drug use by the student during the past year.

    a) All the designs make improper use of stratification.
    b) All the designs have errors that can lead to strong bias.
    c) All the designs confuse *association* with *cause and effect.*
    d) None of the designs satisfactorily controls for sampling error.
    e) None of the designs makes use of chance in selecting a sample.

14. In designing an experiment, blocking is used

    a) to reduce bias.
    b) as a substitute for a control group.
    c) to control the level of the experiment.
    d) to reduce variation.
    e) as a first step in randomization.

15. Which of the following are true statements?

    I. In general, strong association implies causation.
    II. In well-designed, well-conducted experiments, strong association implies causation.
    III. Causation and association are unrelated concepts.

    a) I only b) II only c) III only d) I and II e) I, II, and III

16. A nutritionist believes that having each player take a vitamin pill before a game enhances the performance of the football team. During the course of one season, each player takes a vitamin pill before each game, and the team achieves a winning season for the first time in several years. Is this an experiment or an observational study?

    a) An experiment, but with no reasonable conclusion possible about cause and effect.
    b) An experiment, thus making cause and effect a reasonable conclusion.
    c) An observational study, because there was no use of a control group.
    d) An observational study, but a poorly designed one because randomization was not used.
    e) An observational study, thus allowing reasonable conclusion of association but not of cause and effect.

17. A newspaper wants to know public opinion of a town regarding the construction of a new library in a downtown location. It is decided that 48 people will be surveyed using a simple random sample. Which of the following will produce a simple random sample?

    A) Randomly select 12 people from each of the northwest, northeast, southwest, and southeast sections of the city.
    B) Survey every fourth person who enters the current library until 48 people have responded.
    C) Randomly select 48 people from the city phone directory.
    D) Number the residents using the census data. Use a random number generator to pick 48 people.
    E) Record the opinions of the first 48 people who visit the newspaper's web site.

18. Which of the following statements is true? (Pearson pg 224)

    A) A census is an experiment that involves the entire population.
    B) A parameter is a value used to describe a sample.
    C) A sample is the entire group of individuals we want information about.
    D) In stratified random sampling, every individual has the same probability of being chosen.
    E) Voluntary samples never introduce bias.

19. Patients afflicted with a debilitating disease took part in a study to measure the effectiveness of a new drug in controlling the progress of the disease. The patients were divided into two groups, an experimental group who received the drug, and a control group who received a placebo. The results of the experimental group were so positive that the study was stopped early. This was most likely because

    A) The researchers stopped getting useful information.
    B) The researchers realized that their subjects were poorly chosen.
    C) The researchers felt that it was too expensive to continue the study.
    D) The researchers felt it was unethical to use only patients who had the disease in the study.
    E) The researchers felt it was unethical to withhold an effective treatment from the placebo group.

FREE RESPONSE & SHORT ANSWER QUESTIONS

20. Identify which type of sampling is used in each of the following.

    a) a farmer selects every third row of corn for a new fertilizer
    b) a game show host rolls two die to select which two of six players will be in the bonus round
    c) a counselor selects 2 males and 2 females from each of the four grade levels to ride the float
    d) student council selects one representative from each homeroom for the meeting

21. In a test of the effects of persistent pesticides, rats are to be fed a diet contaminated with DDT for sixty days after weaning. Then a certain measurement will be made on their nerve responses. You have 20 newly weaned male rats available to be assigned at random to the two diets with 10 rats in each group. Use the random digit table on page A-77 of your text starting at **line 9** to carry out the randomization.

22. Texas A & M wants to study the effects of a new pesticide on the growth and absorption level of both corn and green beans. To study this, the researchers have located eight farmers in Texas who grow both corn and beans. The last names of the farmers are listed below. Diagram a design for this study. Explain exactly how you would conduct the study and carry out the randomization.

    Farmers: Katterjohn, Merkling, Callen, Seay, Brenaman, Jones, Richards, Doerksen

23. The cross country coach believes that a new type of shoe will help his team run faster. He buys the entire team the new shoes for their first home meet and is delighted when they do indeed finish the race with better times than they had the at the away meet the previous week.

    a) Is this and observational study or an experiment? Explain.

    b) Describe a possible confounding variable. Clearly explain how this may be confounding in the context of this study.

24. Because of concerns about employee stress, a large company is conducting a study to compare two programs (tai chi or yoga) that may help employees reduce their stress levels. Tai chi is a 1,200 year-old practice, originating in China, that consists of slow, fluid movements. Yoga is a practice, originating in India, which consists of breathing exercises and movements designed to stretch and relax muscles. The company has assembled a group of volunteer employees to participate in the study during the first half of their lunch hour each day for a 10-week period. Each volunteer will be assigned at random to one of the two programs. Volunteers will have their stress levels measured just before beginning the program and 10 weeks later at the completion of it.

    a) A group of volunteers who work together ask to be assigned to the same program so that they can participate in the program together. Give an example of a problem that might arise if this is permitted. Explain to the volunteer group why random assignment to the two programs will address this problem.

    b) Someone proposes that a control group be included in the design as well. The stress level would be measured for each volunteer assigned to the control group at the start of the study and again 10 weeks later. What additional information, if any, would this provide about the effectiveness of the two programs?

    c) Is it reasonable to generalize the findings of this study to all employees of this company? Explain.

ANSWERS

1. explanatory variable: the amount of tea; response variable: mood rating

2. explanatory variable: weight; response variable: time

3. No. The evidence is anecdotal. Many other variables confound the situation such as amount of water and type of soil.

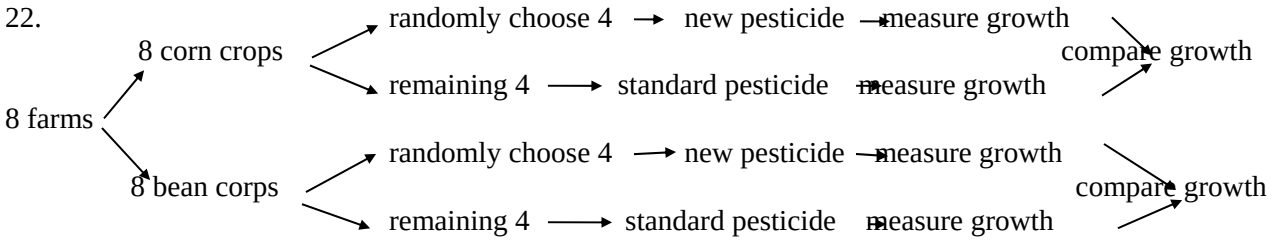
4. b 5.d 6.a 7.d 8.e 9.a 10.a 11.d* (see below) 12.c 13.b 14.d 15.b 16.a 17. d 18.a 19.a

*(#11)If there is bias, taking a larger sample just magnifies the bias on a larger scale. If there is enough bias, the sample can be worthless. Even when the subjects are chosen randomly, there can be bias due, for example, to non-response or to the wording of the questions.

20. a. systematic random sample b. simple random sample c. stratified random sample
    d. stratified random sample

21. If we label the rats from 01 to 20 and use two digits, the following rats are selected for the first group:
    3, 7, 6, 13, 2, 12, 15, 4, 11, 9. The remaining rats are assigned to the second group.

22.



The randomization for the corn crops was completed by writing the 8 farmers names on slips of paper, putting them in a brown lunch bag and drawing out 4 names to receive the new pesticide. The remaining 4 farmers used the old pesticide. The same procedure was repeated for the bean crops.

23. a) This is an experiment, although not a very good one. The treatment is the new shoes but there are many possible confounding variables.

b) There are several correct answers for this. To properly describe a confounding variable first name it and then explain how the confounding variable could be the cause of the results rather than the treatment.
Example: A possible confounding variable could be the home crowd advantage. Maybe the cheering of family and friends at the home game inspired the team to run faster rather than the new shoes. Due to fewer supporting fans cheering at the away meet, the team was less inspired to run their best resulting in slower times.

24. Of course, your answer may be different but should contain the same principals as the College Board example that follows.

a) For example, a deadline in the department where the group of volunteers works has been moved back, lowering the stress levels for those working in the department. If the volunteers from this department were all in the same treatment group, this change in stress level could mistakenly be attributed to the treatment.

Without random assignment of volunteers to the two programs, it is possible that the two treatment groups could differ in some way that affects the outcome of ;the experiment. Randomization “evens out” the possible effects of potentially confounding variables.

b) Without the control group, the company could compare the two treatments, but would not be able to say whether the observed reduction in stress was attributable to participation in the programs. For example, a change in the work environment during this period might have reduced the stress level of all employees. The addition of a control group would enable the company to assess the magnitude of the mean reduction attributable to each treatment, as opposed to just determining if the two programs differ.

c) It is not reasonable to generalize the findings of this study to all employees, because,

> the participants in this experiment were volunteers and volunteers may not be representative of the population
> OR
> the participants were not randomly selected from the company employees.