Name: _____

STATISTICS

PART 3 PRACTICE EXAM 1

Time – 1 hour and 30 minutes

Number of multiple choice questions – 20

Number of free response questions - 3

1. 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 experienced 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 formulations. 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 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.

2. 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

3. 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.

4.

A school committee member is lobbying for an increase in the gasoline tax to support the county school system. The local newspaper conducted a survey of county residents to assess their support for such an increase. What is the population of interest here?

(A) All school-aged children
(B) All county residents
(C) All county residents with school-aged children
(D) All county residents with children in the county school system
(E) All county school system teachers

5.

A manufacturer of ready-bake cake mixes is interested in designing a study to test the effects of 4 different temperature levels (300°, 325°, 350°, and 375° F), 2 different types of pans (glass and metal), and 3 different types of ovens (gas, electric, and microwave) on the texture of its cakes. How many different treatment combinations are to be used in this study?

(A) 3
(B) 9
(C) 18
(D) 20
(E) 24

6.

After a frost warning was issued, the owner of a large orange grove asked his workers to spray all his trees with water. The water was supposed to freeze and form a protective covering of ice around the orange blossom. Nevertheless, the owner suspected that some trees suffered considerable damage due to the frost. To estimate the proportion of trees that suffered more than 50 percent damage due to the frost, he took a random sample of 100 trees from his grove. What constitutes an observation (measurement) in this experiment?

(A) The proportion of trees that suffered more than 50 percent damage due to frost.
(B) The number of trees affected by the frost.
(C) The number of trees sampled from the grove.
(D) For each sampled tree, whether it was sprayed with water or not sprayed with water.
(E) For each sampled tree, whether it suffered more than 50 percent damage or at most 50 percent damage.

7.

A manufacturer of motor oil is interested in testing the effects of a newly developed additive on the lifespan of an engine. Twenty-five different engine types are selected at random and each one is tested using oil with the additive and oil without the additive. What type of analysis will yield the most useful information?

(A) Matched pairs comparison of population proportions.

(B) Matched pairs comparison of population means.

(C) Independent samples comparison of population proportions.

(D) Independent samples comparison of population means.

(E) *Chi-square* test of homogeneity.

8.

An insurance agent is successful in selling a life insurance policy to 20 percent of the customers he contacts. He decides to construct a simulation to estimate the mean number of customers he needs to contact before being able to sell a policy. Which of the following schemes should he use to do the simulation?

(A) Assign numbers "0, 1" to successfully selling a policy to a customer and numbers "2, 3, 4, 5, 6, 7, 8, 9" to failing to sell a policy to a customer.

(B) Assign numbers "0, 1" to successfully selling a policy to a customer and numbers "2, 3, 4" to failing to sell a policy to a customer.

(C) Assign number "0" to successfully selling a policy to a customer and number "1" to failing to sell a policy to a customer.

(D) Assign numbers "0, 1, 2, 3, 4" to successfully selling a policy to a customer and numbers "5, 6, 7, 8, 9" to failing to sell a policy to a customer.

(E) Assign number "20" to successfully selling a policy to a customer and numbers "1, 3, 5, 7, 9, 11, 13, 15, 17, 19" to failing to sell a policy to a customer.

9.

In a clinical trial, 30 sickle cell anemia patients are randomly assigned to two groups. One group receives the currently marketed medicine, and the other group receives an experimental medicine. Each week patients report to the clinic where blood tests are conducted. The lab technician is un-aware of the kind of medicine the patient is taking. This design can be described as

(A) a completely randomized design, with the currently marketed medicine and the experimental medicine as 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 two blocks

(D) a randomized block design, with the currently marketed medicine and the experimental medicine as two treatments

(E) a stratified design with two strata, patients with sickle cell disease forming one stratum and those without sickle cell disease forming the other stratum

10.

A newspaper reporter examined police reports of accidents during the past 12 months to collect data about the speed of a car and its stopping distance. The reporter then constructed a scatterplot and computed a correlation coefficient to show the relation between a car's speed and its stopping distance. This is an example of

(A) a double-blind study
(B) a single-blind study
(C) a study involving no blinding at all
(D) an observational study
(E) a well-designed experiment

11.

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 played soft music 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, because 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 to be blindfolded.
(E) This experiment cannot be a double blind experiment, because patients will know which treatment they are receiving, although the examining doctor might not.

12. Which of the following is the best description of a systematic random sample?
(A) A sample chosen is such a way that every possible sample of a given size has an equal change to be the sample.
(B) After a population is separated into district groups, one or more of these groups are randomly selected in their entirety to be the sample.
(C) A value is randomly selected from an ordered list and then every nth value in the list after the first value is selected for the sample.
(D) Select a sample in such a way that the proportion of some variables thought to impact the response is approximately the same in the sample as in the population.
(E) A sample in which the respondents volunteer their response.

13. In the famous study from the late 1920s, the Western Electric Company wanted to study the effect of lightling on productivity. They discovered that worker productivity increased with each change of lighting, whether the lighting was increased or decreased. The worders were aware that a study was in

progress. What is the most likely cause of this phenomenon? (This effect is known as the Hawthorne Effect.)
   (A) Response bias
   (B) Absence of a control group
   (C) Lack of randomization
   (D) Sampling variability
   (E) Undercoverage

14. A study is to be conducted on a new weather proofing product for outdoor decks. Four houses with outdoor decks in one suburban neighborhood are selected for the study. Each deck is to be divided into two halves, one half receiving the new product and the other half receiving the product the company currently has on market. Each of the four decks is divided into North/South sections. Either the new or the old product is randomly assigned the North side of each of the decks and the other product is assigned to the South side. The major reason for doing this is that
   (A) the study is much too mall to avoid using randomization
   (B) there are only two treatments being studied.
   (C) this controls for known differences in the effect of the sun on the North and South sides of decks.
   (D) randomization is necessary elements of any experiment.
   (E) this controls for the unknown differential effects of the weather on the North and South sides of decks in this neighborhood.

15. Which of the following best describes a cluster sample size 20 from a population of size 320?
   (A) All 320 names are written on slops of paper and the slops are put into a box. Twenty slops are selected at random from the box.
   (B) The 320 names are put into an alphabetical list. One of the first 6 names on the list is selected at random as part of the sample. Every 16th name on the list is then selected for the sample.
   (C) The sample will consist of the first 20 people who volunteer to be part of the sample
   (D) Each of the 320 people is assigned a number. Twenty numbers are randomly selected by a computer and the people corresponding to these 20 numbers are the sample.
   (E) The 320 names are put into an alphabetical list and the list numbered from 1 to 320. A number between 1 and 304 (inclusive) is selected at random. The person corresponding to that number and the ext 19 people on the list are selected for the sample.

16. You are going to conduct an experiment to determine which of four different brands of cat food promotes growth best for kittens ages 4 months to 1 year. You are concerned that the effect might vary by the breed of the cat, so you divide the cats into three different categories by breed. This gives you eight kittens in each category. You randomly assign two of the kittens in each category to one of the four foods. The design of this study is best described as:
   (A) randomized block, blocked by breed of cat and type of cat food.
   (B) randomized block, blocked by type of cat food.
   (C) matched pairs where each two cats are considered a pair.
   (D) a controlled design in which the various breeds of cats are the controls.
   (E) randomized block, blocked by breed of cat.

17. You want to conduct a survey to determine the types of exercise equipment most used by people at your health club. You plan to base your results on a random sample of 40 members. Which of the following methods will generate a simple random sample of 40 members?
   (A) Mail out surveys to every member and use the first 40 that are returned as your sample.
   (B) Randomly pick a morning and survey the first 40 people who come in the door that day.
   (C) Divide the number of members by 40 to get a value k. Choose one of the first kth names on the list using a random number generator. Then choose every kth name on the list after that name.
   (D) Put each member's name on a slip of paper and randomly select 40 slips.
   (E) Get the sign-in lists for each day of the week, Monday through Friday. Randomly choose 8 names from each day for the survey.

18. An advice columnist asks readers tow rite in about how happy they are in their marriages. The results indicate that 79% of those responding would not marry the same partner of they had to do it all over again. Which of the following statements is most correct?
   (A) It's likely that this result is an accurate reflection of the population.
   (B) It's likely that this result is higher than the true population proportion because persons unhappy in their marriages are most likely to respond.
   (C) It's likely that this result is lower than the true population proportion because persons unhappy in their marriages are unlikely to respond.
   (D) It's likely that the results are not accurate because people tend to lie in voluntary response surveys.
   (E) There is really no way of predicting whether the results are biased or not.

19. You are interested in determining which of two brands of tires (call them Brand G and Brand F) last longer under differing conditions of use. Fifty Toyota Camry's are fitted with Brand G tires and 50 Honda Accords are fitted with Brand F tires. Each tire is driven 20,000 miles, and tread wear is measured for each tire, and the average tread wear for the two brands is compared. What is wrong with this experimental design?
   (A) The type of car is a confounding variable
   (B) Average tread wear is not a proper measure for comparison.
   (C) The experiment should have been conducted on more than two brands of cars.
   (D) Not enough of each type of tire was used in the study.
   (E) Nothing is wrong with this design – it should work quite well to compare the two brands of tires.

20. A psychiatrist is studying the effects of regular exercise on stress reduction. She identifies 40 people who exercise regularly and 40 who do not. Each of the 80 people is given a questionnaire designed to determine stress levels. None of the 80 people who participated in the study knew that they were part of a study. Which of the following statement is true?
   (A) This is an observational study.
   (B) This is a randomized comparative experiment.
   (C) This is a double-blind study.
   (D) This is a matched-pairs design.
   (E) This is an experiment in which exercise level is a blocking variable.

FREE RESPONSE

Questions 1-3

Spend about 45 minutes on this part of the exam.

2006 Form A Question 5
1.

A biologist is interested in studying the effect of growth-enhancing nutrients and different salinity (salt) levels in water on the growth of shrimps. The biologist has ordered a large shipment of young tiger shrimps from a supply house for use in the study. The experiment is to be conducted in a laboratory where 10 tiger shrimps are placed randomly into each of 12 similar tanks in a controlled environment. The biologist is planning to use 3 different growth-enhancing nutrients (A, B, and C) and two different salinity levels (low and high).

(a) List the treatments that the biologist plans to use in this experiment.

(b) Using the treatments listed in part (a), describe a completely randomized design that will allow the biologist to compare the shrimps' growth after 3 weeks.

(c) Give one <u>statistical</u> advantage to having only tiger shrimps in the experiment. Explain why this is an advantage.

(d) Give one <u>statistical</u> disadvantage to having only tiger shrimps in the experiment. Explain why this is a disadvantage.

2010 form B Q2

2.

In response to nutrition concerns raised last year about food served in school cafeterias, the Smallville School District entered into a one-year contract with the Healthy Alternative Meals (HAM) company. Under this contract, the company plans and prepares meals for 2,500 elementary, middle, and high school students, with a focus on good nutrition. The school administration would like to survey the students in the district to estimate the proportion of students who are satisfied with the food under this contract.

Two sampling plans for selecting the students to be surveyed are under consideration by the administration. One plan is to take a simple random sample of students in the district and then survey those students. The other plan is to take a stratified random sample of students in the district and then survey those students.

(a) Describe a simple random sampling procedure that the administrators could use to select 200 students from the 2,500 students in the district.

(b) If a stratified random sampling procedure is used, give one example of an effective variable on which to stratify in this survey. Explain your reasoning.

(c) Describe one statistical advantage of using a stratified random sample over a simple random sample in the context of this study.

3.

Researchers who are studying a new shampoo formula plan to compare the condition of hair for people who use the new formula with the condition of hair for people who use the current formula. Twelve volunteers are available to participate in this study. Information on these volunteers (numbered 1 through 12) is shown in the table below.

Volunteer	Gender	Age
1	Male	21
2	Female	20
3	Male	47
4	Female	60
5	Female	62
6	Male	61
7	Male	58
8	Female	44
9	Male	44
10	Female	24
11	Male	23
12	Female	46

(a) These researchers want to conduct an experiment involving the two formulas (new and current) of shampoo. They believe that the condition of hair changes with age but not gender. Because researchers want the size of the blocks in an experiment to be equal to the number of treatments, they will use blocks of size 2 in their experiment. Identify the volunteers (by number) that would be included in each of the six blocks and give the criteria you used to form the blocks.

(b) Other researchers believe that hair condition differs with both age and gender. These researchers will also use blocks of size 2 in their experiment. Identify the volunteers (by number) that would be included in each of the six blocks and give the criteria you used to form the blocks.

(c) The researchers in part (b) decide to select three of the six blocks to receive the new formula and to give the other three blocks the current formula. Is this an appropriate way to assign treatments? If so, describe a method for selecting the three blocks to receive the new formula. If not, describe an appropriate method for assigning treatments.