

AP Statistics | Unit 03 – Sampling & Study Design ReviewMultiple Choice

1. What is *bias* in conducting surveys?
 - (a) An example of sampling error
 - (b) Lack of a control group
 - (c) Confounding variables
 - (d) Difficulty in concluding cause and effect
 - (e) A tendency to favor the selection of certain members of a population

2. Which of the following is **incorrect**?
 - (a) Blocking is to experiment design as stratification is to sampling design
 - (b) By controlling certain variables, blocking can make conclusions more specific
 - (c) The matched-pair design is a special case of blocking
 - (d) Blocking results in increased accuracy because the blocks have smaller size than the original group
 - (e) In a randomized block design, the randomization occurs within the blocks

3. Consider the following studies being run by three different nursing home establishments.
 - I. One nursing home has pets brought in for an hour every day to see if patient morale is improved
 - II. One nursing home allows hourly visits everyday by kindergarten children to see if patient morale is improved
 - III. One nursing home administers antidepressants to all patients to see if patient morale is improved

Which of the following is true?

 - (a) None of these studies uses randomization
 - (b) None of these studies uses control groups
 - (c) None of these studies uses blinding
 - (d) Important information can be obtained from all these studies, but none will be able to establish causal relationships
 - (e) All of the above

4. Which of the following is **not** important in the design of experiments?
 - (a) Control of confounding variables
 - (b) Randomization in assigning subjects to different treatments
 - (c) Replication of the experiment using sufficient numbers of subjects
 - (d) Observing without imposing change
 - (e) Isolating variability due to differences between blocks

5. Some researchers believe that too much iron in the blood can raise the level of cholesterol. The iron level in the blood can be lowered by making periodic blood donations. A study is performed by randomly selecting half of a group of volunteers to give periodic blood donations while the rest do not. Is this an experiment or an observational study?
 - (a) An experiment with a single factor
 - (b) An experiment with control group and blinding
 - (c) An experiment with blocking
 - (d) An observational study with comparison and randomization
 - (e) An observational study with little if any bias

6. Which of the following is a true statement about the design of matched-pair experiments?
- (a) Each subject may receive both treatments
 - (b) Each pair of subjects receives the identical treatment, and differences in their responses are noted.
 - (c) Blocking is one form of matched-pair design
 - (d) Stratification into two equal sized strata is an example of matched pairs
 - (e) Randomization is unnecessary in true matched pair designs
7. A town has one high school, which buses students from urban, suburban, and rural communities. Which of the following sampling techniques is most recommended in studying attitudes toward military enlistment after high school graduation?
- (a) Cluster sample
 - (b) Simple random sample
 - (c) Stratified sample
 - (d) Systematic sample
 - (e) Voluntary response sample
8. A large suburban school wants to assess student attitudes towards their mathematics textbook. The administration randomly selects 15 mathematics classes and gives the survey to every student in the class. This is an example of a
- (a) Multistage sample
 - (b) Stratified sample
 - (c) Cluster sample
 - (d) Simple random sample
 - (e) Convenience sample
9. A new cough medicine was given to a group of 25 students who had a cough due to the common cold. 30 minutes after taking the medicine, 20 students reported that their coughs had disappeared. From this information you conclude
- (a) That the remedy is effective for the treatment of the coughs
 - (b) Nothing, because the sample size is too small
 - (c) Nothing, because there is no control group for the comparison
 - (d) That the new treatment is better than the old medicine
 - (e) That the remedy is not effective for the treatment of coughs
10. 100 volunteers who suffer from anxiety take part in a study. 50 are selected at random and assigned to receive a new drug that is thought to be extremely effective in reducing anxiety. The other 50 are given an existing anti-anxiety drug. A doctor evaluates anxiety levels after two months of treatment to determine if there has been a larger reduction in the anxiety levels of those who take the new drug. This would be double blind if
- (a) Both drugs looked the same
 - (b) Neither the subject nor the doctor knew which treatment the subject had received
 - (c) The doctor couldn't see the subjects and the subjects couldn't see the doctor
 - (d) There was a third group that received the placebo
 - (e) All of the above

Free Response

11. A biologist is interested in studying the effect of growth-enhancing nutrients and different salinity (salt) levels in water on the growth of shrimp. The biologist has ordered a shipment of young tiger shrimp from a supply house for use in the study. The experiment is to be conducted in a laboratory where 20 tiger shrimp are placed randomly into each of 6 similar tanks in a controlled environment. The biologist is planning to use three 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 for the experiment.

b) Using the treatments listed in part a, describe a completely randomized design that will allow the biologists to compare the shrimp's growth after 3 weeks. Include a diagram.

c) Give one statistical advantage to having only tiger shrimp in the study. Explain why this is an advantage.

d) Give one statistical disadvantage to having only tiger shrimp in the study. Explain why this is a disadvantage.

12. A maker of fabric for clothing is setting up a new line to “finish” the raw fabric. The line will use either metal rollers or natural-bristle rollers to raise the surface of the fabric; a dyeing-cycle time of either 30 or 40 minutes; and a temperature of either 150 degrees or 175 degrees C. An experiment will compare all combinations of these choices. Three specimens of fabric will be subjected to each treatment and scored for quality.

Identify the following items (if possible). If you can't tell, then say so – this often happens when we read about a survey.

a) The population

b) The sample (experimental units/subjects)

c) The sampling method (indicate whether or not randomization was employed)

d) The factors and response variable

e) The treatments or levels if applicable

f) Any potential sources of bias you can detect and any problems you see in generalizing to the population of interest

14. 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.

15. A manufacturer of boots plans to conduct an experiment to compare a new method of waterproofing to the current method. The appearance of the boots is not changed by either method. The company recruits 100 volunteers in Seattle, where it rains frequently, to wear the boots as they normally would for 6 months. At the end of the 6 months, the boots will be returned to the company to be evaluated for water damage.

a) Describe a design for this experiment that uses the 100 volunteers. Include a few sentences on how it would be implemented.

b) Could your design be double blind? Explain.

16. High cholesterol level in people can be reduced by exercise or by drug treatment. A pharmaceutical company has developed a new cholesterol-reducing drug. Researchers would like to compare its effects to the effects of the cholesterol-reducing drug that is currently available on the market. Volunteers who have a history of high cholesterol and who are currently not on medication will be recruited to participate in a study.

a) Explain how you would carry out a completely randomized experiment for the study.

b) Describe an experimental design that would improve the design in (a) by incorporating blocking.