

You should be able to define the following:

Population vs. Sample

Sampling Designs:

1. Voluntary response sample
2. Convenience Sample
3. Simple Random Sample (SRS)
4. Stratified Random Sample
5. Cluster Sample

Cautions about Sample Surveys (bias)

1. Undercoverage
2. Nonresponse
3. Response Bias
4. Wording of Questions

Observational Study vs. Experiment

Experiments:

1. Experimental units/subjects
2. Factor(s)/Explanatory variable(s)
3. Treatments
 - a) placebo
4. Response variable

Experiments:

1. Randomized Comparative Experiments
 - a) Control group
 - b) Completely randomized
2. Double-blind Experiments
3. Matched pairs design
4. Block design

Cautions with Experiments:

1. Lack of realism

Multiple Choice Practice:

1. A farmer wishes to study the effect of three different fertilizers on crop yields. He takes a rectangular field and divides it into four plots of equal area. Then he randomly assigns the three different fertilizers to one of the four plots. One plot receives no fertilizer. The plots are harvested after a following statements **best** describes the design of the study?
 - I. This design has matched pairs.
 - II. This design has blocks.
 - III. This is a completely randomized design.

(A) I only (B) I and III only (C) I and II only (D) II only (E) III only
2. The purpose of doing an experiment is to:

(A) Determine cause and effect (C) Identify lurking variables (E) Find human error

(B) Identify confounding variables (D) Control participants
3. At a charter high school, administrators wish to collect a sample of 50 students. The proportions of the student body represented by each class are: 45% freshmen, 28% sophomores, 16% juniors, and 11% seniors. They decide to randomly sample 23 freshmen, 14 sophomores, eight juniors, and five seniors. Which of the following methods was used to select the probability sample?

(A) Random (B) Systematic (C) Stratified (D) Cluster (E) Simple Random
4. A charter school operator in Los Angeles wishes to gather information about student achievement. From the 73 small schools the operator manages, one school is selected by lottery and all students from that school are used in the sample. Which of the following methods was used to select the probability sample?

(A) Random (B) Systematic (C) Stratified (D) Cluster (E) Simple Random
5. Local schools wish to add a bond measure to the ballot. They survey the residents with the following question: "Will you support the bond measure if it will cost the taxpayers \$30 million in 30 years?" Three-fourths of respondents reply "No." Which type of sampling bias best describes the situation?

(A) Voluntary Response (C) Response (E) Undercoverage

(B) Non-response (D) Wording of question

6. Two antidepressants are to be compared in the treatment of elderly patients in a nursing home. Each patient has his or her own room, some with spectacular views of the ocean. The experimental design is to create homogeneous blocks with respect to window view. How should randomization be used for a *randomized block design*?

- A
- (A) Within each block, randomly pick half the patients to receive each antidepressant.
 - (B) Randomly pick half of all patients to receive each antidepressant, but then analyze the results separately by block.
 - (C) Randomly choose which blocks will receive which antidepressant.
 - (D) Randomly choose half the block to receive each antidepressant for a given time period; then for the same time period switch the medication in each block and compare the results.
 - (E) For ethical reasons, allow patients to choose which medication they prefer taking, but then randomly assign patients to the blocks.

7. Before taking an exam, students either went to bed at their normal times or were sleep deprived for 4 or 8 hours. Half of each group were given a caffeine pill before taking the exam. Determine the number of factors, levels for each, and number of treatments.

- D
- (A) One factor with two levels, five treatments
 - (B) Two factors, one with one and one with two levels, three treatments
 - (C) Two factors, one with two and one with three levels, five treatments
 - (D) Two factors, one with two and one with three levels, six treatments
 - (E) Three factors, each with two levels, six treatments

Answer key for Multiple choice: 1. E, 2. A, 3. C, 4. D, 5. D, 6. A, 7. D

8. A furniture maker buys hardwood in large batches. The supplier is supposed to dry the wood before shipping (wood that isn't dry won't hold its size and shape). The furniture maker chooses five pieces of wood from each batch and tests their moisture content. If any piece exceeds 12% moisture content, the entire batch is sent back.

(a) What is the population?

hardwood in a batch

(b) What is the sample?

the five pieces chosen and tested

(c) What variable will be measured?

moisture content

9. An educator wants to compare the effectiveness of computer software that teaches reading with that of a standard reading curriculum. She tests the reading ability of each student in a class of fourth graders, then divides them into two groups. One group uses the computer regularly, while the other studies a standard curriculum. At the end of the year, she retests all the students and compares the increase in reading ability in the two groups.

(a) Is this an experiment? Why or why not?

Yes. The teacher is imposing treatment (method of teaching) on the students.

(b) What are the explanatory and response variables?

Explanatory - Teaching method
Response - increase in reading ability

10. A high school offers two precalculus courses, one that uses a traditional lecture and drill method, and a second that divides students into small groups to work on open-ended problems. To compare the effectiveness of the two methods, the administration proposes to compare average SAT scores for the students in the two courses.

(a) What is wrong with the administration's proposal?

They do not account for confounding variables such as the motivation of the student.

(b) Suppose a group of 50 students are willing to take either course. Explain how you would use a random number table to set up an experiment comparing the effectiveness of the two courses.

Label the students 01-50. Using a random line on the random number table, I would look at two digits at a time. I would ignore numbers not on my list and repeats. I would continue this process until I had 25 students.

(c) Apply your setup procedure to the given random number table:

17, 31, 50, 14, 35,	84177	06757	17613	15582	51506	81435	41050	92031	06449
41, 05, 09, 20, 06,	05059	59884	31180	53115	84469	94868	57967	05811	84514
44, 43, 11, 18, 45,	75011	13006	63395	55041	15866	06589	13119	71020	85940
01, 30, 39, 15, 13,	91932	06488	74987	54355	52704	90359	02649	47496	71567
10, 19, 32, 48, 49	94268	08844	26294	64759	08989	57024	97284	00637	89283
	03514	59195	07635	03309	72605	29357	23737	57881	03668
	33876	35841	52869	23114	15864	38942			

They would be assigned to one method and the remaining 25 would be assigned to the second method.

(d) Discuss any variables that your setup doesn't consider.

My setup does not consider what students are doing outside of class to prepare or how students have done in the past in their math courses.

When using the Random Digit Table, be careful of:

Numbers not on your list and duplicates.

11. Comment on each of the following as a potential sample survey question. Is the question clear? Is it slanted toward a desired purpose?

a) "Some cell phone users have developed brain cancer. Should all cell phones come with a warning label explaining the danger of cell phones?"

This example leads people to believe cell phones are bad because they could "cause" brain cancer - leads people to want the label.

b) "Do you agree that a national system of health insurance should be favored because it would provide health insurance for everyone and would reduce administrative costs?"

Favors the national system of health insurance - leads people to agree.

c) "In view of escalating environmental degradation and incipient resource depletion, would you favor economic incentives for recycling of resource-intensive consumer goods?"

Favors the recycling program - leads people to favor it as well because of "environmental degradation."

12. A university has 2000 male and 500 female faculty members. The university president wants to poll the opinions of a random sample of faculty members.

In order to give adequate attention to female faculty opinion, the president decides to choose a **stratified random sample** of 200 males and 200 females.

- What is the chance that any one of the 2000 males will be in your sample? $\frac{200}{2000} = \frac{1}{10}$
- What is the chance that any one of the 500 females will be in your sample? $\frac{200}{500} = \frac{2}{5}$

Each member of the sample is asked, "In your opinion, are female faculty members in general paid less than males with similar positions and qualifications?"

180 of the 200 females (90%) say "Yes."
60 of the 200 males (30%) say "Yes."

- In all, 240 of the sample of 400 (60%) answered "Yes." The president therefore reports: "Based on a sample, we can conclude that 60% of the total faculty feels that female members are underpaid relative to males." **Explain why this conclusion is wrong.**

Both groups were not represented equally, therefore, this is not a good representation of the faculty.

- If we took a stratified random sample of 200 male and 50 female faculty members at this university, each member of the faculty would have the same chance of being chosen. What is that chance? Explain why this sample is *not* an SRS.

$\frac{200}{2000} = \frac{1}{10}$ $\frac{50}{500} = \frac{1}{10}$
This is not an SRS because each group of 250 does not have an equal chance of being chosen.

13. New varieties of corn with altered amino acid content may have higher nutritional value than standard corn, which is low in the amino acid lysine. An experiment compares two new varieties, called opaque-2 and floury-2, with normal corn. The researchers mix corn-soybean meal diets using each type of corn at each of three protein levels, 12% protein, 16% protein, and 20% protein. They feed each diet to 10 one-day old chicks and record their weight gains after 21 days. The weight gain of the chicks is a measure of the nutritional value of their diet.

- What are the experimental units and the response variable in this experiment?
Experimental units - 10 ~~days~~ one-day old chicks.
Response - weight gain.
- How many factors are there? How many treatments? How many experimental units does this experiment require?

2 factors: Corn variety and protein levels
6 treatments: (2 corn varieties x 3 protein levels). We will need 60 experimental units (6 treatments x 10 chicks)

14. You have been asked to select 20 subjects for a drug trial that compares two different treatments (the drug and a placebo) for migraine headaches. The researchers have requested a block design (male/female) with control groups for each block. You have been given a list of people willing to participate in the trial, numbered from 1 to 87. The first 42 people are female; the rest are male. Sketch a diagram for the design of this experiment.

