

*82. A marketing director for a major grocery store is conducting a survey to determine whether a salad bar should be added to the produce section of the store. Which of these random sampling methods would create the most accurate sample survey of the store's customers?

- A. asking customers who are shopping in the produce section
- B. asking customers who are shopping in the snack aisle
- C. asking customers as they enter the store
- D. asking people who do not shop at the store

*82b. A student interested in comparing the effect of different types of music on short-term memory is planning the following experiment: 80 volunteers will be assigned to one of two groups. The first group will be given five minutes to memorize a list of words while listening to rap music. The second group will be given the same task while listening to classical music. The number of words correctly recalled by each individual will then be measured, and the results for the two groups will be compared. Which of the following must be true to collect accurate data?

- A. participants should be given different lists to memorize
- B. participants should be screened to determine music preferences
- C. participants should be randomly assigned to be listening to rap or classical music
- D. participants should be allowed to choose which music to listen to during the experiment

*83. A student interested in comparing the effect of different types of music on short-term memory conducted the following study: 80 volunteers were randomly assigned to one of two groups. The first group was given five minutes to memorize a list of 20 words while listening to rap music. The second group was given the same task while listening to classical music. The number of words correctly recalled by each individual was then measured, and the results for the two groups were compared. The results are recorded below.

	Rap	Classical
Mean number of recalled words	9.8	12.2

Based on the table, which of these conclusions is **most likely** to be true about the study?

- A. more students listened to classical music
- B. students should not listen to music when studying
- C. the rap music was played louder than the classical music
- D. more words were memorized while listening to classical music

*83b Ten plants of the same variety are given a new plant food once a week in addition to regular watering. Ten other plants of the same variety are only watered regularly. The mean heights of the plants are compared after one month. The results are given below.

With Plant Food		Without Plant Food	
Mean height at beginning of study	3.2 cm	Mean height at beginning of study	2.8 cm
Mean height after one month	10.3 cm	Mean height after one month	10 cm

Based on the tables, which of these conclusions is **most likely** to be true about the study?

- A. The plant food causes significant increases in growth.
- B. The plant food does not cause significant increases in growth.
- C. The plant food causes significant increases in growth for all varieties of plants.
- D. The plant food does not cause significant increases in growth for all varieties of plants.

20. A local university has a drop-in center located near the Student Union where students can drop-in to speak to a counselor on any issue or concern whether personal or academic. A researcher stations herself at a receptionist's desk during a few random evenings to collect data on whether men or women are more likely to use this service and whether a particular class (freshman, sophomore, junior, senior) is more likely to drop-in.

What type of study is the researcher conducting?

- A. Census
- B. Experiment
- C. Observational study
- D. Sample survey

20b. A newspaper in New Jersey conducted a poll of its readers to obtain their opinions in whether Michael Jordan would return to basketball again in the NBA. 40% of the eligible readers participated.

What type of survey is the newspaper conducting?

- A. Census
- B. Experiment
- C. Observational study
- D. Sample survey

21. A sample for a local fast food restaurant survey is composed of people who were chosen randomly from shoppers at five different restaurants in the city. Which population can this group of people represent?

- A. residents of the city who live near the restaurants
- B. residents of the state who live near the restaurants
- C. residents of the city who like to eat at the restaurants
- D. residents of the state who like to eat at the restaurants

21b. A sample for a polling study is composed of people who were chosen randomly from voters at five polling stations in a city. Which population can this group of people represent?

- A. residents of the city who live near the polling station
- B. residents of the state who live near the polling station
- C. residents of the state who vote
- D. residents of the city who vote

*10. Which project would be best conducted using an observational study instead of a randomized experiment?

- A. Project I: Do cars get better mileage with a premium gasoline or with regular unleaded gasoline?
- B. Project II: Does using a particular fertilizer increase the yield of potatoes?
- C. Project III: Does using a certain brand of shampoo reduce hair loss?
- D. Project IV: Does the sun affect the growth of moss on trees?

*10b. The principal of an elementary school that has a total of 650 students wants to determine which cereal is preferred among the students. Which method of data collection will give the most accurate results?

- A. Assign a number to each student in the library and ask which cereal is preferred
- B. Assign a number to each student and ask every third grader with a number that is a multiple of 5 which cereal is preferred
- C. Assign a number to each classroom and ask all the students in 1 selected classroom per grade level which cereal is preferred.
- D. Assign a number to each classroom and ask the girls in 5 selected classrooms which cereal is preferred.

16. The federal government defines a 100-year flood as “a flood that has a 1% chance of being equaled or exceeded in any single year.” What should be the effect of the government’s definition if a 100-year flood were to occur 4 years in a row?

A. The definition should stay unchanged.

~~B. The definition should begin to describe a 25-year flood.~~

C. The amount of water expected in a 100-year flood should be increased.

~~D. The amount of water expected in a 100-year flood should be decreased.~~

Just because something happens that had a low probability of occurring does not change the theoretical probability of it occurring in the future.

16b. The federal government defines a 100-year flood as “a flood that has a 1% chance of being equaled or exceeded in any single year.” What should be the effect of the government’s definition if a 100-year flood were to occur 5 years in a row?

A. The definition should stay unchanged.

B. The definition should begin to describe a 20-year flood.

C. The amount of water expected in a 100-year flood should be increased.

D. The amount of water expected in a 100-year flood should be decreased.

Lesson 12: Types of Statistical Studies

Classwork

Opening Exercise

You want to know what proportion of the population likes rock music. You carefully consider three ways to conduct a study. What are the similarities and differences between the following three alternatives? Do any display clear advantages or disadvantages over the others?

- a. You could pick a random sample of people and ask them the question, "Do you like rock music?" and record their answers.
- b. You could pick a random sample of people and follow them for a period of time, noting their music purchases, both in stores and online.
- c. You could pick a random sample of people, separate them into groups, and have each group listen to a different genre of music. You would collect data on the people who display an emotional response to the rock music.

A statistical study begins by asking a question that can be answered with data. The next steps are to collect appropriate data, organize and analyze it, and arrive at a conclusion in the context of the original question. This lesson focuses on the three main types of statistical studies: observational studies, surveys, and experiments. The objective of an observational study and a survey is to learn about characteristics of some population, so the data should be collected in a way that would result in a representative sample. This speaks to the importance of random selection of subjects for the study. The objective of an experiment is to answer such questions as, "What is the effect of treatments on a response variable?" Data in an experiment need to be collected in a way that does not favor one treatment over another. This demonstrates the importance of random assignment of subjects in the study to the treatments.

Opening Exercise

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- You could pick a random sample of people and ask them the question, "Do you like rock music?" and record their answers. **survey - determines the proportion of the population likes rock music**
- You could pick a random sample of people and follow them for a period of time, noting their music purchases, both in stores and online. **observational study - mildly creepy in this case - too invasive**
- You could pick a random sample of people, separate them into groups, and have each group listen to a different genre of music. You would collect data on the people who display an emotional response to the rock music. **experiment - determines what types of music (treatment) gives people emotional reactions (response)**

A statistical study begins by asking a question that can be answered with data. The next steps are to collect appropriate data, organize and analyze it, and arrive at a conclusion in the context of the original question. This lesson focuses on the three main types of statistical studies: observational studies, surveys, and experiments. **The objective of an observational study and a survey is to learn about characteristics of some population, so the data should be collected in a way that would result in a representative sample. This speaks to the importance of random selection of subjects for the study. The objective of an experiment is to answer such questions as, "What is the effect of treatments on a response variable?" Data in an experiment need to be collected in a way that does not favor one treatment over another. This demonstrates the importance of random assignment of subjects in the study to the treatments.**

An observational study is one in which the values of one or more variables are observed with no attempt to affect the outcomes. One kind of observational study is a survey. A survey requires asking a group of people to respond to one or more questions. (A poll is one example of a survey.) An experiment differs from an observational study. **In an experiment, subjects are assigned to treatments for the purpose of seeing what effect the treatment has on some response while an observational study makes no attempt to affect the outcomes, i.e., no treatment is given.** Note that subjects could be people, animals, or any set of items that produce variability in their responses. Here is an example of an observational study: In a random sample of students, it was observed that those students who played a musical instrument had better grades than those who did not play a musical instrument. In an experiment, a group of students who do not currently play a musical instrument would be assigned at random to having to play a musical instrument or not having to play a musical instrument for a certain period of time. Then, at the end of the period of time we would compare academic performance.

Classify each of the three study methods about rock music as an observational study, a survey, or an experiment.

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Example 3: Experiment

a. An experiment imposes treatments to see the effect of the treatments on some response. Suppose that an observational study indicated that a certain type of tree did not have as much termite damage as other trees. Researchers wondered if resin from the tree was toxic to termites. They decided to do an experiment where they exposed some termites to the resin and others to plain water and recorded whether the termites survived. The explanatory variable (treatment variable) is the exposure type (resin, plain water), and the response variable is whether or not the termites survived. We know this is an experiment because the researchers imposed a treatment (exposure type) on the subjects (termites).

Is the following an observational study or an experiment? Why? If it is an experiment, identify the treatment variable and the response variable. If it is an observational study, identify the population of interest.

A study was done to answer the question, "What is the effect of different durations of light and dark on the growth of radish seedlings?" Three similar growth chambers (plastic bags) were created in which 30 seeds randomly chosen from a package were placed in each chamber. One chamber was randomly selected and placed in 24 hours of light, another for 12 hours of light and 12 hours of darkness, and a third for 24 hours of darkness. After three days, researchers measured and recorded the lengths of radish seedlings for the germinating seeds.

treatment (independent variable) = amount of light

response (dependent variable) = growth of radishes

b. In an experiment, random assignment of subjects to treatments is done to create comparable treatment groups. For example, a university biologist wants to compare the effects of two weed killers on pansies. She chooses 24 plants. If she applies weed killer A to the 12 healthiest plants and B to the remaining 12 plants, she will not know which plants died due to the type of weed killer used and which plants subjected to weed

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