

Populations, Samples, and Generalizing from a

Sample to a Population

What is the difference between a population characteristic and a sample statistic? Give an example to support your answer. Clearly identify the population and sample in your example.

1. The lunch program at Blake Middle School is being revised to align with the new nutritional standards that reduce calories and increase servings of fruits and vegetables. The administration decided to do a census of all students at Blake Middle School by giving a survey to all students about the school lunches.

<http://frac.org/federal-foodnutrition-programs/school-breakfast-program/school-meal-nutrition-standards>

- a. Name some questions that you would include in the survey. Explain why you think those questions would be important to ask.
- b. Read through the paragraph below that describes some of the survey results. Then, identify the population characteristics and the sample statistics.

About $\frac{3}{4}$ of the students surveyed eat the school lunch regularly. The median number of days per month that students at Blake Middle School ate a school lunch was 18 days. 36% of students responded that their favorite fruit is bananas. The survey results for Tanya's seventh-grade homeroom showed that the median number of days per month that her classmates ate lunch at school was 22, and only 20% liked bananas. The fiesta salad was approved by 78% of the group of students who tried it, but when it was put on the lunch menu, only 40% of the students liked it. Of the seventh graders as a whole, 73% liked spicy jicama strips, but only 2 out of 5 of all the middle school students liked them.

2. For each of the following questions: (1) describe how you would collect data to answer the question, and (2) describe whether it would result in a sample statistic or a population characteristic.
 - a. Where should the eighth-grade class go for their class trip?
 - b. What is the average number of pets per family for families that live in your town?
 - c. If people tried a new diet, what percentage would have an improvement in cholesterol reading?
 - d. What is the average grade point of students who got accepted to a particular state university?
 - e. What is a typical number of home runs hit in a particular season for major league baseball players?

3. Identify a question that would lead to collecting data from the given set as a population, and one where the data could be a sample from a larger population.
- All students in your school
 - Your state
4. Suppose that researchers sampled attendees of a certain movie and found that the mean age was 17 years old. Based on this observation, which of the following would be most likely.
- The mean ages of all of the people who went to see the movie was 17 years old.
 - About a fourth of the people who went to see the movie were older than 51.
 - The mean age of all people who went to see the movie would probably be in an interval around 17 years of age, i.e., between 15 and 19.
 - The median age of those who attended the movie was 17 years old as well.
5. The headlines proclaimed: "Education Impacts Work-Life Earnings Five Times More Than Other Demographic Factors, Census Bureau Reports." According to a U.S. Census Bureau study, education levels had more effect on earnings over a 40-year span in the workforce than any other demographic factor. www.census.gov/newsroom/releases/archives/education/cb11-153.html
- The article stated that the estimated impact on annual earnings between a professional degree and an eighth-grade education was roughly five times the impact of gender, which was \$13,000. What would the difference in annual earnings be with a professional degree and with an eighth-grade education?
 - Explain whether you think the data are from a population or a sample, and identify either the population characteristic or the sample statistic.

The History of the United States Census

The word *census* is Latin in origin and means to *tax*. The first U.S. census took place over 200 years ago, but the United States is certainly not the first country to implement a census. Based on archaeological records, it appears that the ancient Egyptians conducted a census as early as 3000 B.C.

The U.S. census is mandated by the U.S. Constitution in Article I, Section 2, which states, in part, “Representatives and direct Taxes shall be apportioned among the several States . . . according to their respective Numbers The Number of Representatives shall not exceed one for every thirty thousand, but each State shall have at Least one Representative” The Constitution then specifies how to calculate the number of people in each state and how often the census should take place.

The U.S. census has been conducted every ten years since 1790, but as time has passed, our census has evolved. Not only have the types of questions changed but also the manner in which the data are collected and tabulated. Originally, the census had only a few questions, the purpose of which was to discern the number of people in each household and their ages. Presumably, this data was used to determine the number of men in each state who were available to go to war. Federal marshals were charged with the task of conducting this first census. After collecting data from their respective jurisdictions, the marshals sent the data to President Washington.

As time has passed, more questions have been added to the U.S. census. Today, the census includes questions designed to collect data in various fields such as manufacturing, commerce, and transportation to name a few. Data that were once manually tabulated are now processed by computers. Home visits by census officials were once the norm, but now the census is conducted primarily through the U.S. Postal Service. Each household in the U.S. receives in the mail a copy of the census questionnaire to be completed by its head of household who then mails it back to the Census Bureau. Home visits are paid only to those individuals who do not return the questionnaire by the specified deadline.

The census is an important part of our Constitution. Today, the census not only tells us the population of each state, thereby determining the number of representatives that each state will have in the House of Representatives, but it also provides the U.S. government with very useful data that paint a picture of the current state of our population and how it has changed over the decades.

“U.S. Census History,” *essortment*, accessed November 4, 2014, <http://www.essortment.com/census-history-20901.html>.

What is the difference between a population characteristic and a sample statistic? Give an example to support your answer. Clearly identify the population and sample in your example.

A population characteristic is a summary measure that describes some feature of population, the entire set of things or objects from which data might be collected. A sample statistic is a summary measure that describes a feature of some subset of the population. For example, the population could be all of the students in school, and a population characteristic could be the month in which most of the students were born. A sample of students could be those that had mathematics during the fifth block in their schedule, and a sample statistic could be their grade-point average.

The Problem Set is intended to support students' emerging understanding of the difference between a population and a sample and summary measures for each. Students should do at least Problems 1, 3, and 4 of the set below.

1. The lunch program at Blake Middle School is being revised to align with the new nutritional standards that reduce calories and increase servings of fruits and vegetables. The administration decided to do a census of all students at Blake Middle School by giving a survey to all students about the school lunches.

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- a. Name some questions that you would include in the survey. Explain why you think those questions would be important to ask.

Answers will vary. Possibilities include: How often do you eat the school lunch? Do you ever bring your lunch from home? What is your favorite food? Would you eat salads if they were served? What do you drink with your lunch? What do you like about our lunches now? What would you change? Explanations would vary but might include the need to find out how many students actually eat school lunch and if the lunches were different, would more students eat school lunch? What types of food should be served so more people will eat it?

- b. Read through the paragraph below that describes some of the survey results. Then, identify the population characteristics and the sample statistics.

About $\frac{3}{4}$ of the students surveyed eat the school lunch regularly. The median number of days per month that students at Blake Middle School ate a school lunch was 18 days. 36% of students responded that their favorite fruit is bananas. The survey results for Tanya's seventh-grade homeroom showed that the median number of days per month that her classmates ate lunch at school was 22, and only 20% liked bananas. The fiesta salad was approved by 78% of the group of students who tried it, but when it was put on the lunch menu, only 40% of the students liked it. Of the seventh graders as a whole, 73% liked spicy jicama strips, but only 2 out of 5 of all the middle school students liked them.

Population characteristics: $\frac{3}{4}$ eat school lunch; median number of days is 18; 36% like bananas; 40% liked fiesta salad; 2 out of 5 liked jicama strips.

Sample statistics: Tanya's homeroom median number of days 22; 20% liked bananas; 78% liked fiesta salad in trial; 73% of seventh graders liked spicy jicama strips.

2. For each of the following questions: (1) Describe how you would collect data to answer the question, and (2) describe whether it would result in a sample statistic or a population characteristic.
- a. Where should the eighth-grade class go for their class trip?
- All eighth-grade students would be surveyed. The result would be a population characteristic.*
- Possibly only students in a certain classroom or students of a particular teacher would be surveyed. The students surveyed would be a sample, and the result would be a sample statistic.*
- b. What is the average number of pets per family for families that live in your town?
- Data collected from families responding to a survey at a local food store. Data would be a sample, and the result would be a sample statistic.*
- It is possible that a town is small enough to survey each family that owns a pet. If this is the case, the people surveyed would be the population, and the result would be a population characteristic.*
- c. If people tried a new diet, what percentage would have an improvement in cholesterol reading?
- Data collected from people at a local health center. The people surveyed using the new diet would be a sample, and the result would be a sample statistic.*
- It is possible that all people involved with this new diet were identified and agreed to complete the survey. The people surveyed would then be the population, and the result would be a population characteristic.*
- d. What is the average grade point of students who got accepted to a particular state university?
- The data would typically come from the grade-point averages of all entering freshmen. The result would be a population characteristic.*
- It may have been possible to survey only a limited number of students who registered or applied. The students responding to the survey would be a sample, and the result would be a sample statistic.*
- e. What is a typical number of home runs hit in a particular season for major league baseball players?
- This answer would come from examining the population of all major league hitters for that season; it would be a population characteristic.*
3. Identify a question that would lead to collecting data from the given set as a population, and one where the data could be a sample from a larger population.
- a. All students in your school
- The school might be the population when considering what to serve for school lunch or what kind of speaker to bring for an all-school assembly.*
- The school might be a sample when considering how students in the state did on the algebra portion of the state assessment or what percent of students engage in extracurricular activities.*
- b. Your state
- The percent of students who drop out of school would be calculated from data for the population of all students in schools; how people were likely to vote in the coming election could use the state as a sample of an area of the country.*

4. Suppose that researchers sampled attendees of a certain movie and found that the mean age was 17 years old. Based on this observation, which of the following would be most likely?
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 - About a fourth of the people who went to see the movie were older than 51.
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Answer (c) would be most likely because the sample would not give an exact value for the whole population.

5. The headlines proclaimed: "Education Impacts Work-Life Earnings Five Times More Than Other Demographic Factors, Census Bureau Reports." According to a U.S. Census Bureau study, education levels had more effect on earnings over a 40-year span in the workforce than any other demographic factor. www.census.gov/newsroom/releases/archives/education/cb11-153.html
- The article stated that the estimated impact on annual earnings between a professional degree and an eighth-grade education was roughly five times the impact of gender, which was \$13,000. What would the difference in annual earnings be with a professional degree and with an eighth-grade education?

About \$65,000 a year.

- Explain whether you think the data are from a population or a sample, and identify either the population characteristic or the sample statistic.

The data probably came from a sample since the report was a study and not just about the population, so the numbers are probably sample statistics.

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