Surveys are often conducted to gather data about a population. A **population** is the entire group of people or objects that you want information about. A **census** is a survey of an entire population. When it is too difficult, expensive, or time-consuming to conduct a census, a **sample**, or part of the population, is surveyed.

When every member of a population has an equal chance of being selected for a sample, the sample is called a **random sample**, or **probability sample**. Random samples are most likely to be representative of a population and are preferred over non-random samples such as **convenience samples** and **self-selected samples**.
A non-random sample can result in a **biased sample**. A biased sample is a sample that may not be representative of a population. In a biased sample, the population can be underrepresented or overrepresented.

**Underrepresented**  One or more of the parts of a population are left out when choosing the sample.

**Overrepresented**  A greater emphasis is placed on one or more of the parts of a population when choosing the sample.
Random samples are less likely to be biased, while nonrandom samples are more likely to be biased. Bias in a sample is not always obvious at first glance.

A **statistic** is a number that describes a sample. A **parameter** is a number that describes a population. You can use a statistic from a survey to estimate a parameter. In this way, surveys can be used to make predictions about a population.
Identify the population and the sample.

1. A car factory just manufactured a load of 6,000 cars. The quality control team randomly chooses 60 cars and tests the air conditioners. They discover that 2 of the air conditioners do not work.

*population: 6,000 total cars
*sample: 60 cars*
Example 2A: Identifying Potentially Biased Samples

Decide whether each sampling method could result in a biased sample. Explain your reasoning.

A. A survey of a city’s residents is conducted by asking 20 randomly selected people at a grocery store whether the city should impose a beverage tax.

Residents who do not shop at the store are underrepresented, so the sample is biased.
Example 2B: Identifying Potentially Biased Samples

B. A survey of students at a school is conducted by asking 30 randomly selected students in an all-school assembly whether they walk, drive, or take the bus to school.

No group is overrepresented or underrepresented, so the sample is not likely to be biased.
Check It Out! Example 2

Decide whether each sampling method could result in a biased sample. Explain your reasoning. An online news site asks readers to take a brief survey about whether they subscribe to a daily newspaper.

Yes; people visiting a news site online are more likely to be interested in news and subscribe to a daily newspaper.
Example 3: Analyzing a Survey

A car dealer wants to know what percentage of the population in the area is planning to buy a car in the next year. The dealer surveys the next 15 people who come to the car lot. Are the results of the survey likely to be representative of the population?

The sample chosen is a convenience sample, which is not likely to be representative of the population. People who come to a car lot are more likely to be planning to buy a car.
A restaurant owner wants to know how often families in his area go out for dinner. He surveys 25 families who eat at his restaurant on Tuesday night. Are his results likely to be representative of the population? Explain.

No; people in a restaurant on a Tuesday night are much more likely to eat out often.
Example 4: Making Predictions

In a survey of 40 employees at a company, 18 said they were unhappy with their pay. The company has 180 employees. Predict the number of employees who are unhappy with their pay.

\[
\frac{\text{unhappy employees in sample}}{\text{employees in sample}} = \frac{\text{unhappy employees in company}}{\text{employees in company}}
\]

\[
\frac{18}{40} = \frac{x}{180}
\]

\[
18 \cdot 180 = 40x
\]

\[
81 = x
\]

You can predict that about 81 employees are unhappy with their pay.
In a random sample of phone calls to a police station, 11 of the 25 calls were for emergencies. Suppose the police station receives 175 calls in one day. Predict the number of calls that will be for emergencies.

\[
\frac{\text{emergency calls in sample}}{\text{police station calls in sample}} = \frac{\text{emergency calls in one day}}{\text{police station calls in one day}}
\]

\[
\frac{11}{25} = \frac{x}{175}
\]

\[
11 \cdot 175 = 25x
\]

\[
77 = x
\]

You can predict 77 emergency phone calls in one day.
Example 5: Manufacturing

The manager of a store randomly surveys 20 customers. Of the 12 staff members, 3 had shifts on the day of the survey. Of the 20 people surveyed, 15 thought the staff was not attentive enough. The manager decides to close the store for a day and hire a consultant to come in and train the whole staff on customer service skills. Did the manager make a good decision? Why or why not?

The manager did not make a good decision. The sample was taken from customers who may only have had an experience with 3 of the 12 staff, so it is not representative of the entire staff.
Sampling Distributions

When a survey is used to gather data, it is important to consider how the sample is selected for the survey. If the sampling method is biased, the survey will not accurately reflect the population.

Most national polls that are reported in the news are conducted using careful sampling methods in order to minimize bias.
Other polls, such as those where people phone in to express their opinion, are not usually reliable as a reflection of the general population.

Remember that a random sample is one that involves chance. Six different types of samples are shown below.
### Sampling Distributions

#### Types of Samples

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Simple Random Sample</td>
<td>Members are chosen using a method that gives everyone an equally likely chance of being selected.</td>
</tr>
<tr>
<td>Systematic Sample</td>
<td>Members are chosen using a pattern, such as selecting every other person.</td>
</tr>
<tr>
<td>Stratified Sample</td>
<td>The population is first divided into groups. Then members are randomly chosen from each group.</td>
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</tbody>
</table>
Cluster Sample
The population is first divided into groups. A sample of the groups is randomly chosen. All members of the chosen groups are surveyed.

Convenience Sample
Members are chosen because they are easily accessible.

Self-Selected Sample
Members volunteer to participate.
Example 1: Classifying a Sample

The campaign staff for a state politician wants to know how voters in the state feel about a number of issues. Classify each sample.

A. They call every 50th person on a list of registered voters in the state.

This is a systematic sample as members are chosen using a pattern.

B. They randomly select 100 voters from each county to call.

This is a stratified sample as the county is chosen and then voters are selected at random.
**C.** They ask every person who comes to the next campaign rally to fill out a survey.

This is a convenience sample as the people at the rally are easily accessible.
Check It Out! Example 1

The editor of a snowboarding magazine wants to know the readers’ favorite places to snowboard. The latest issue of the magazine included a survey, and 238 readers completed and returned the survey. Classify the sample.

This is a self-selected example as readers volunteered to participate.