SAMPLING BIAS

A sampling method is **biased** if every member of the population doesn't have equal likelihood of being in the sample.

There are many ways to sample a population, but there is one goal we need to keep in mind: we would like the sample to be **representative of the population**.

There are many ways to sample a population, but there is one goal we need to keep in mind: we would like the sample to be **representative of the population**.

One way to ensure that the sample has a reasonable chance of mirroring the population is to employ **randomness**.

The most basic random method is simple **random sampling**.

RANDOM SAMPLE

A **random sample** is one in which each member of the population has an equal probability of being chosen.
A simple random sample is one in which every member of the population and any group of members has an
equal probability of being chosen.

EXAMPLES OF RANDOM SAMPLING

We could write peoples' names on separate slips of paper. All slips are placed in a box and names are drawn from the box.

We can use assign a number to each person and use a random number generator to select people.

Even a random sample might end up not being totally representative of the population.

If we repeatedly take samples of 1000 people from a population, some of these samples might tend to have a slightly higher percentage of older people and some samples might include more younger people; some samples may have a larger percentage of women than the general population. In most cases, this **sampling variability** is not significant.

SAMPLING VARIABIALITY

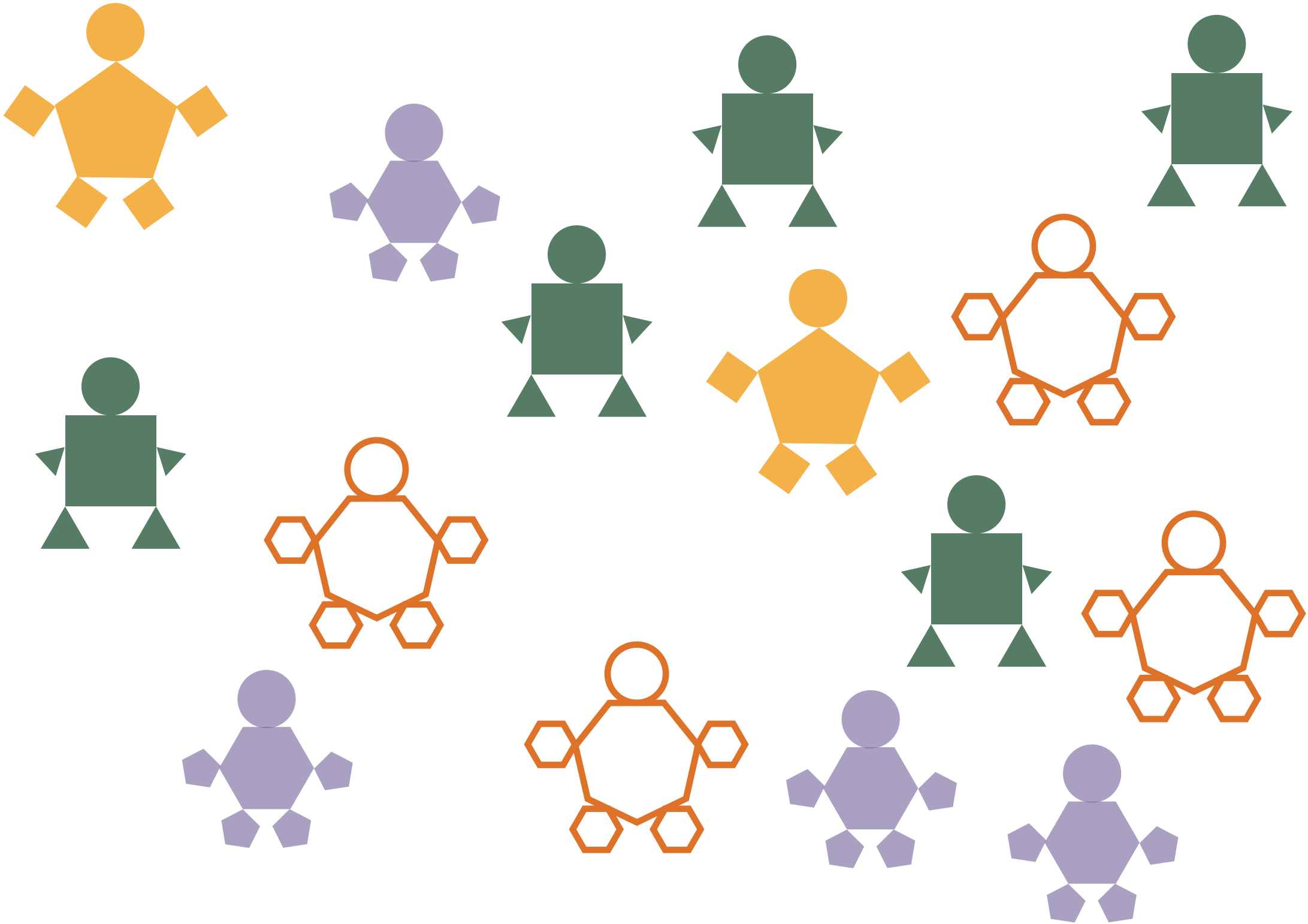
The natural variation of samples is called **sampling variability**.

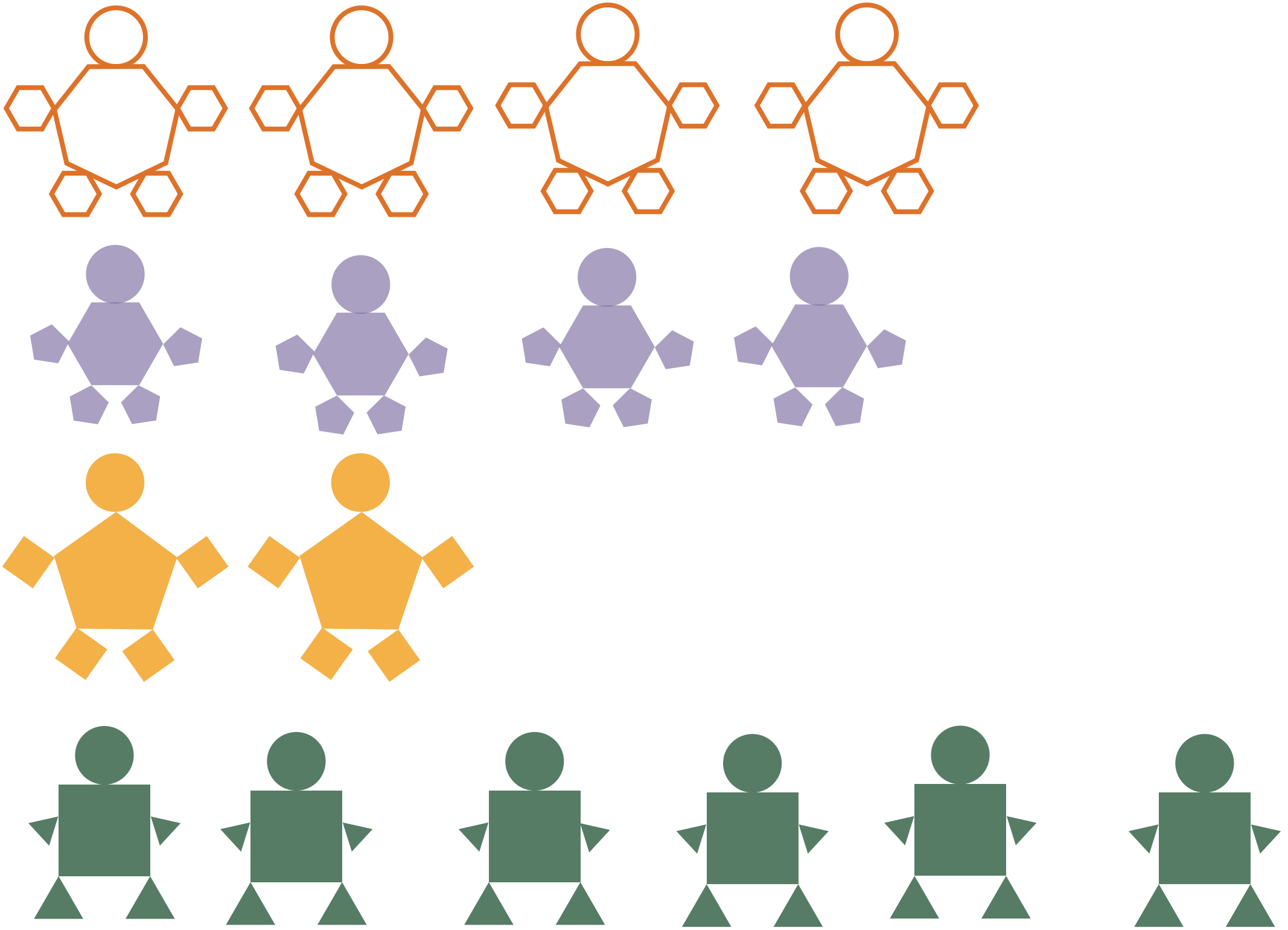
This is unavoidable and expected in random sampling, and in most cases is not an issue.

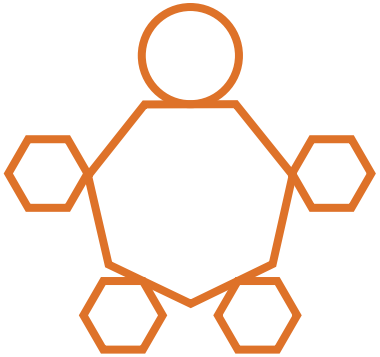
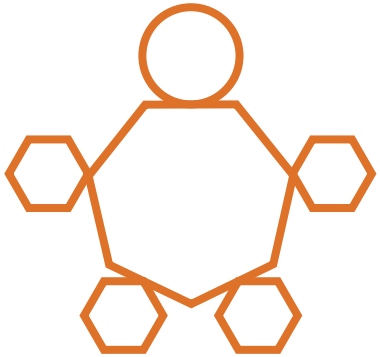
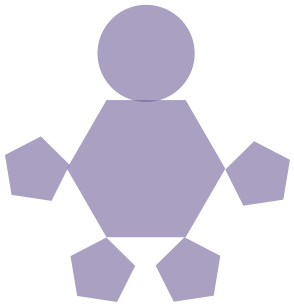
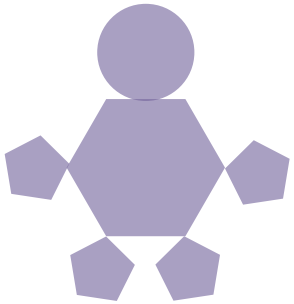
To help account for variability, pollsters might instead use a **stratified sample**.

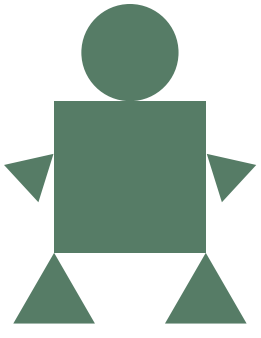
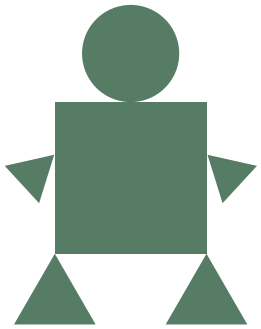
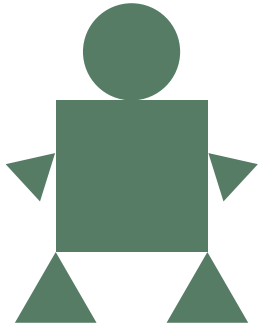
STRATIFIED SAMPLING

In **stratified sampling**, a population is divided into a number of subgroups (or strata). Random samples are then taken from each subgroup with sample sizes proportional to the size of the subgroup in the population.





EXAMPLES OF STRATIFIED SAMPLING

A company has 500 employees. The company has three departments:

40% of the employees work in the **Sales**
35% work **engineering**
25% work in **marketing**.
The company wants to conduct a survey by sampling **200 employees**. To ensure that the survey accurately reflects the composition of the company, they could use stratified sampling.
From the Sales department **40% of 200=80 employees** should be selected.
From the Engineering department **35% of 200=70 employees** should be selected.
From the Marketing department (**25% of 500**), **50 employees** should be selected.
So, out of the 200 people sampled:
80 employees will come from Sales
70 from Engineering
50 from Marketing

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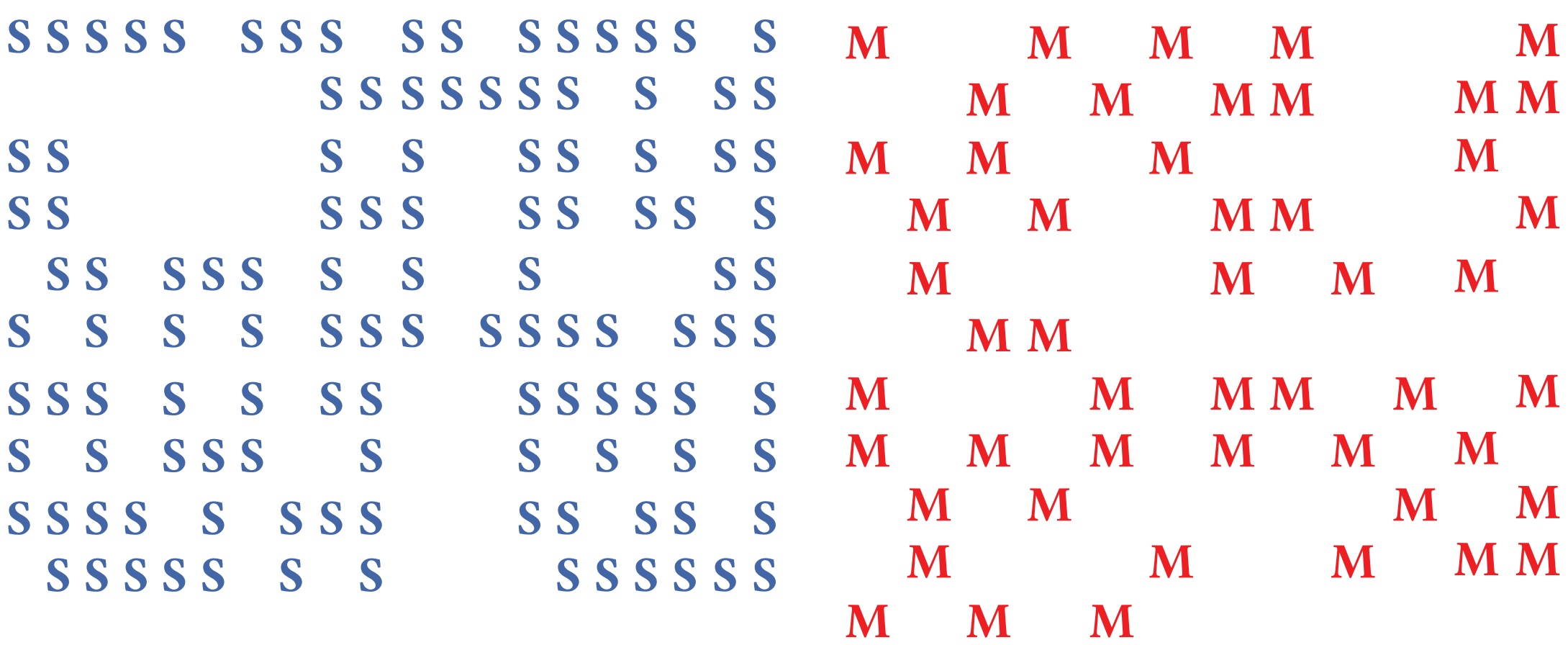
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QUOTA SAMPLING

Quota sampling is a variation on stratified sampling, wherein samples are collected in each subgroup until the desired quota is met.

Example

A university wants to conduct a survey on campus facilities satisfaction among its students. They decide to use quota sampling to ensure that their sample includes students from different academic years. They set quotas to include 100 students from each of the following categories:

Freshmen (1st year)
Sophomores (2nd year)
Juniors (3rd year)
Seniors (4th year)

Once they have filled the quota for a particular year (e.g., 100 Freshmen), they no longer include students from that year in the sample. They continue to gather responses from students in the remaining years until all quotas are met.

CLUSTER SAMPLING

In **cluster sampling**, the population is divided into subgroups (clusters), and a set of subgroups are selected to be in the sample.

Example

A city wants to survey public library usage. They randomly select 5 out of 20 library branches. They then survey all patrons who visit those 5 branches during a specific week.

This approach ensures that each academic year is represented in the sample, but it may not be fully random since the selection is based on meeting specific quotas rather than being entirely random.

Example

A national park wants to assess visitor experiences. They randomly select 5 out of 30 park campgrounds. They then survey all campers staying at those 5 campgrounds during a particular weekend.

SYSTEMATIC SAMPLING

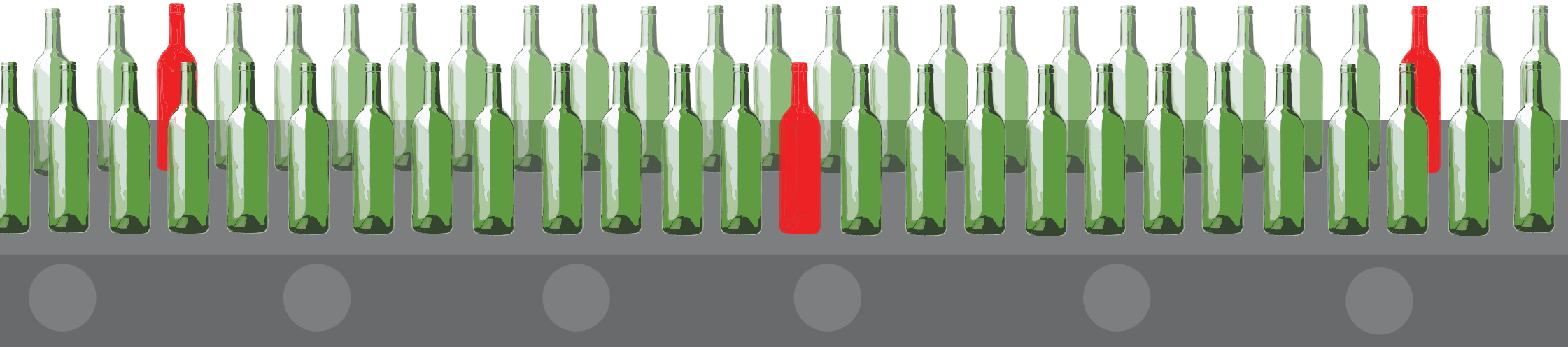
In **systematic sampling**, every nth member of the population is selected to be in the sample.

Example

A factory wants to inspect the quality of products on the assembly line. They use systematic sampling by checking every 50th item produced during a shift for quality control.

Example

A factory wants to inspect the quality of products on the assembly line. They use systematic sampling by checking every 20th item produced during a shift for quality control.



Example

A supermarket wants to assess the freshness of its produce. They use systematic sampling by inspecting every 40th item of fruit delivered each day.

The Worst Way to Sample

Perhaps the worst types of sampling methods are convenience samples and voluntary response samples.

CONVENIENCE & VOLUNTARY SAMPLING

Convenience sampling is the practice of samples chosen by selecting whoever is convenient.

Voluntary response sampling is allowing the sample to volunteer.

Question

A journalist interviews the first 20 people who enter a community center for a public event.

Which sampling method is represented by this scenario?

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Convenience sampling

Question

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Convenience sampling

Question

A local community center posts a suggestion box for residents to express their opinions on new community programs.

Which sampling method is represented?

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Which sampling method is represented?

This is a self-selected sample, or voluntary response sample, where residents choose to participate by submitting their suggestions.

Question

What sampling method was used?

Every 6th customer entering a store was selected for a feedback survey.
survey.

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Systematic sampling

Question

What sampling method was used?

A sample was chosen to include 40 teenagers and 60 adults.

Question

What sampling method was used?

A sample was chosen to include 40 teenagers and 60 adults.

Stratified or Quota

Question

What sampling method was used?

Subscribers to a magazine are invited to share their opinions on a new feature through an email survey.

Question

What sampling method was used?

Subscribers to a magazine are invited to share their opinions on a new feature through an email survey.

Voluntary response

Question

What sampling method was used?

A company uses a random number generator to select 100 employees from their entire staff list for a satisfaction survey.

Question

What sampling method was used?

A company uses a random number generator to select 100 employees from their entire staff list for a satisfaction survey.

Simple random

Question

What sampling method was used?

To study public opinion on a new park, a research firm randomly selects 5 out of 20 neighborhoods and surveys all residents in those neighborhoods.

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To study public opinion on a new park, a research firm randomly selects 5 out of 20 neighborhoods and surveys all residents in those neighborhoods.

Cluster

SOURCES OF BIAS

There are number of ways that a study can be ruined before you even start collecting data.

Sampling bias – when the sample is not representative of the population

Voluntary response bias – the sampling bias that often occurs when the sample is volunteers

Self-interest study – bias that can occur when the researchers have an interest in the outcome

Response bias – when the responder gives inaccurate responses for any reason

Perceived lack of anonymity – when the responder fears giving an honest answer might negatively affect them

Loaded questions – when the question wording influences the responses

Non-response bias – when people refusing to participate in the study can influence the validity of the outcome

Question

Identify the type of bias.

Consider a recent study that found eating a certain brand of cereal improves athletic performance in high school students. This study was funded by the cereal company itself. Identify the type of sampling bias found in this example.

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Consider a recent study that found eating a certain brand of cereal improves athletic performance in high school students. This study was funded by the cereal company itself. Identify the type of sampling bias found in this example.

Solution: This is an example of a **self-interest study**; the researchers have a vested interest in a positive outcome. This suggests that the study should be examined with caution for potential bias.

Question

Identify the type of bias.

A survey asks participants, “How often do you exercise each week?” What type of sampling bias might this lead to?

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Identify the type of bias.

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Solution: This might suffer from **response bias**, as participants might overestimate their exercise frequency to appear more health-conscious.

Question

Identify the type of bias.

An organization conducts a survey asking employees if they feel they receive adequate support for their work. Which sampling bias may occur in this scenario?

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Solution: This survey may be affected by **perceived lack of anonymity**, as employees might fear that their responses could impact their job security or relationships with management, leading to less honest answers.

Question

Identify the type of bias.

A health survey asks, “How often do you visit your doctor for routine check-ups?” and 35% of people refuse to participate. Which sampling bias is represented?

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Solution: This is an example of **non-response bias**, as the high refusal rate may skew the results, making them less representative of the overall population.

Question

Identify the type of bias.

A university sends an email survey to alumni asking for feedback on their education experience. What type of sampling method is used, and what bias might occur?

Question

Identify the type of bias.

A university sends an email survey to alumni asking for feedback on their education experience. What type of sampling method is used, and what bias might occur?

Solution: This is a self-selected sample. It might introduce **voluntary response bias**, as alumni who choose to respond might have stronger opinions about their education, either positive or negative, which may not represent the entire alumni population.

Question

Identify the type of bias.

A political campaign conducts a survey by calling people who have previously donated to their party. What type of sampling bias might this lead to?

Question

Identify the type of bias.

A political campaign conducts a survey by calling people who have previously donated to their party. What type of sampling bias might this lead to?

Solution: This introduces sampling bias, as it only includes individuals who have previously supported the party financially, which may not represent the views of the general population.