

Introducing Statistics: Why Is My Sample Not Like Yours?

2. Which statement best describes sampling variability?

- A. Every random sample produces exactly the same results.
 - B. Different random samples from the same population can produce different results.
 - C. Random samples always represent the population perfectly.
 - D. Sampling variability occurs only when a sample is biased.
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3. Two students randomly select 30 students from the same school. One sample has a mean study time of 8 hours, while the other has a mean of 9 hours. What does this illustrate?

- A. Measurement error
 - B. Sampling bias
 - C. Sampling variability
 - D. Population change
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- **Population — 总体**
- **Sample — 样本**
- **Sampling variability — 抽样变异**
- **Bias — 偏差**
- **Representative sample — 代表性样本**

- Different samples come from the **same population**, but **random chance** makes them vary.
- **Sampling variability** means no two random samples are exactly the same.
 - Larger samples tend to be **more consistent** than smaller samples.
 - Random sampling reduces **bias**, but it does not eliminate **variation**.
- Statistics helps us **measure and explain this variation** to make conclusions about the population.

A school wants to estimate the average number of hours students sleep each night. Two students, Alice and Bob, each take a **random sample** of 5 students from the school. Alice finds an average of 7 hours, while Bob finds an average of 6 hours.

- (a) Explain why Alice's sample and Bob's sample might give different results.
- (b) Define what is meant by **sampling variability** in this context.
- (c) Identify one factor that could cause **bias** in a sample.
- (d) Explain why it is important for a sample to be **representative** of the population.

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| (a) | Different random samples contain different students, leading to different sample means. |
| (b) | Definition of sampling variability. |
| (c) | Identifies a valid source of bias. |
| (d) | Explains that a representative sample gives more accurate estimates of the population. |

1. The Mystery of Different Results

Two students survey 50 people each about their favourite social media platform. One finds that 60% prefer TikTok, while the other finds that only 40% do. Give three possible statistical reasons for the difference.

2. Small Sample vs Large Sample

A school has 1,200 students. Student A randomly samples 30 students and finds an average study time of 1.8 hours per day. Student B randomly samples 200 students and finds an average of 2.1 hours per day.

- Which result is likely to be more reliable?
- Explain why.

3. The Basketball Team Problem

A researcher wants to estimate the average height of all Grade 10 students. She measures only members of the basketball team.

- Is this a representative sample?
- How might this affect her conclusion?

4. Which Sample Is More Consistent?

Two random samples are taken from the same population. One sample has 20 individuals and the other has 500.

- Which sample would you expect to have less variability?
- Explain using statistical reasoning.

1. The Mystery of Different Results

Different samples, sample variability, or sampling bias.

2. Small Sample vs Large Sample

Student B; larger samples usually give more reliable estimates.

3. The Basketball Team Problem

No; it is likely biased because basketball players may be taller than average.

4. Which Sample Is More Consistent?

The sample of 500; larger samples generally have less sampling variability.

Sampling Methods & Bias — 5 Key Words

- 1. Population — 总体 —** The entire group being studied.
- 2. Sample — 样本 —** A smaller group selected from the population.
- 3. Random Sampling — 随机抽样 —** Selecting individuals using chance.
- 4. Bias — 偏差 —** A systematic tendency that leads to inaccurate results.
- 5. Sampling Variability — 抽样变异 —** Differences between results from different samples.

Sampling Methods & Bias — Key Points

- 1. Samples vary** — Different random samples can give different results due to sampling variability.
- 2. Random sampling reduces bias** — Chance-based selection helps produce representative samples.
- 3. Different methods have different strengths** — SRS, stratified, and cluster sampling are useful in different situations.
- 4. Watch for bias** — Convenience sampling, voluntary response, undercoverage, and nonresponse can distort results.
- 5. Good samples represent the population** — The goal is to use sample data to make reliable conclusions about the population.

Sampling Methods & Bias — FRQ

Question:

A school wants to estimate the average number of hours Grade 10 students spend studying each week. The school has 600 Grade 10 students.

- (a) Explain how the school could obtain a **simple random sample of 50 students**.
- (b) The school instead surveys the first 50 students who enter the library. Identify the sampling method and explain one potential source of **bias**.
- (c) Another student surveys 50 volunteers who respond to an online questionnaire. Explain why this method may produce a biased estimate.
- (d) Explain why two different random samples of 50 students might produce different estimates of the population mean.

- (a) Assign each student a number and use a random number generator to select 50 students.
- (b) **Convenience sampling**; students who enter the library may study more than typical Grade 10 students.
- (c) **Voluntary response bias**; students who choose to respond may have different study habits from nonrespondents.
- (d) **Sampling variability** — random samples naturally differ from one another.

TRUE or FALSE

- If two simple random samples from the same population produce different sample means, this is evidence that at least one sample was not randomly selected.

TRUE or FALSE

- When sampling variability is high, different random samples are more likely to produce different conclusions.

TRUE or FALSE

- A biased sampling method can sometimes produce a sample statistic very close to the true population parameter.