

17 Sampling, margin of error and causal claims

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

KEY WORDS random assignment • margin of error • inference

Objective

- Interpret a sample estimate and its stated margin of error
- Distinguish random sampling from random assignment
- Identify the population and causal scope supported by a study

Original public practice; marks below are classroom self-check points, not official criteria.

1 Key knowledge and worked examples

A sample statistic estimates a population quantity. A reported estimate of 58% with margin of error 4 percentage points gives an interval from 54% to 62% under the stated procedure. It does not mean 58% of respondents answered with an error of four percent, nor does it guarantee that every individual sample contains the true value.

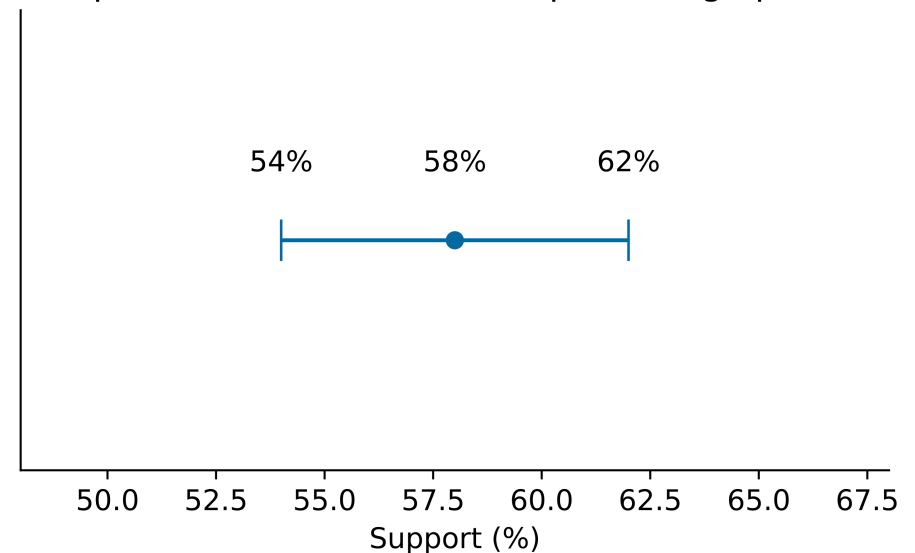
A representative random sample helps generalise to the population from which it was drawn. Convenience or voluntary-response samples can be biased even when large. Increasing a well-designed sample generally reduces sampling variability and margin of error at the same confidence level, but cannot automatically cure a systematically excluded group.

Random assignment distributes participants among treatment groups and supports causal inference by balancing competing factors on average. Random sampling selects who participates. A randomised experiment conducted only with volunteers may support a treatment effect for its participants without establishing that all people share the same effect.

An observational study measures existing differences without assigning treatment; association can reflect confounding. A comparison of students who choose extra tutoring against those who do not may mix tutoring with motivation or prior attainment. To judge a claim, identify selection, assignment, comparison, measured outcome and the exact population before accepting causation or broad generalisation.

A margin of error is added and subtracted in percentage points. Estimate 63% with margin 4 points gives 59%–67%. It is an interval from a procedure, not a guarantee that each person's response is near 63%. Random sampling supports population inference; random assignment addresses treatment comparisons.

Reported estimate: 58% $\pm$ 4 percentage points



A margin of error of 4 percentage points gives the interval 54% to 62%

Worked example. A random sample of 400 school students yields 58% support $\pm$ 4 percentage points: stated interval 54%–62%. This estimates the sampled school population, not all students worldwide. If volunteers are randomly assigned to two revision methods, a controlled outcome difference can support a causal comparison among participants; volunteer selection still limits wider generalisation.

2 Practice

2.1 Estimate 46% $\pm$ 3 percentage points gives:

[1]

- **A** 43%–49%
- **B** 45.97%–46.03%
- **C** 3%–46%

2.2 Which supports causal comparison?

[1]

- **A** Random assignment to treatments
- **B** An online volunteer poll alone
- **C** A large existing association alone

2.3 Estimate 71% with margin 5 points has upper endpoint ____%. [1]

2.4 A large convenience sample automatically eliminates selection bias. [1]

3 Exam-style questions

Use the data stated in each original task.

3.1 A random sample of 500 registered library members reports 62% support for a change, with stated margin 4 percentage points. State the interval and population. Does it establish support among every town resident? [3]

3.2 Forty volunteers are randomly assigned to old or new instructions, with the same task and conditions. The new group finishes faster. What causal and population claims are reasonable? [3]

3.3 A poll of 10000 website volunteers has a narrow reported margin. Explain why size alone cannot repair selection bias, and propose a better recruitment method. [3]
