

Algebra 2 - Sampling, Surveys and Experiments - Answer Key

Common Core S-IC.A.1, S-IC.A.2, S-IC.B.3, S-IC.B.4, S-IC.B.5, S-IC.B.6 · maths-pdf.fr/en/

Every worksheet problem on sampling, surveys, and experiments is solved here, one step at a time. Compare your method as well as your final answer, because the steps show where confusing an observational study with an experiment can go wrong. Final answers appear in bold so you can find them quickly when you only need a check.

Algebra 2 · Common Core State Standards: **S-IC.A.1, S-IC.A.2, S-IC.B.3, S-IC.B.4, S-IC.B.5, S-IC.B.6**

Exercise 1 - Population and sample

The population is all 1,200 students. The sample is the 120 students asked.

Population: 1,200 students; sample: 120 students

Exercise 2 - Spot the bias

People at a rock concert are more likely to prefer rock, so they do not represent all teens. The sample was chosen for convenience.

Biased: the sample overrepresents rock fans

Exercise 3 - Which is random?

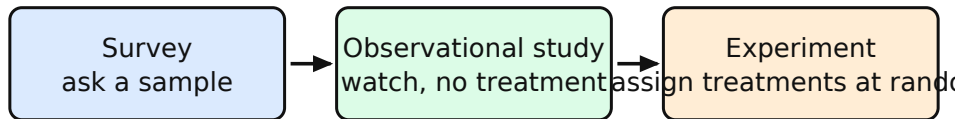
Method	Random?	Why
A	No	Lunch line is a convenience sample
B	Yes	Every student has an equal chance
C	No	Volunteers from one club

Method B is random.

Only method B gives every student an equal chance of selection.

Method B

Exercise 4 - Classify the study



Only an experiment with random assignment can show cause and effect.

(a) Residents are asked: survey. (b) The groups choose themselves and nothing is assigned: observational study. (c) Treatments are assigned at random: experiment.

(a) survey; (b) observational study; (c) experiment

Exercise 5 - Why randomize?

Random assignment tends to make the groups similar in every other way, such as age and health. Then a difference in results is likely caused by the treatment and not by something else.

To balance other variables and allow cause-and-effect conclusions

Exercise 6 - Estimate a population

$$\frac{45}{150} = 0.30. \quad 0.30 \cdot 2400 = 720.$$

30%, about 720 students

Exercise 7 - Margin of error

$$\frac{1}{\sqrt{100}} = 0.10 \text{ and } \frac{1}{\sqrt{400}} = 0.05.$$

10 percentage points and 5 percentage points

Exercise 8 - Interval estimate

$$\frac{1}{\sqrt{625}} = \frac{1}{25} = 0.04.$$

$62\% \pm 4\%$ gives 58% to 66%.

About 58% to 66%

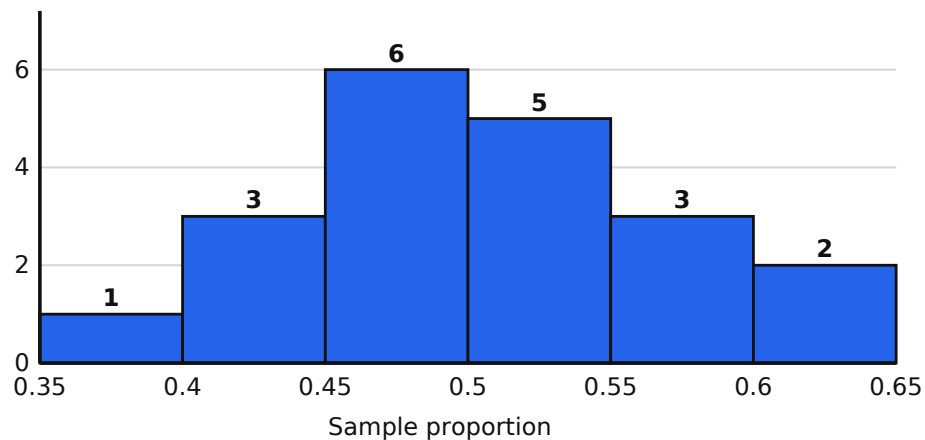
Exercise 9 - Run a simulation

Let digits 0, 1, 2, 3 stand for rain (4 of 10 digits is 40%) and 4 to 9 stand for no rain.

Generate 7 random digits for one week, count the digits from 0 to 3, and repeat many times.

0-3 = rain, 4-9 = dry; 7 digits per week

Exercise 10 - Read a simulation



The bar from 0.60 to 0.65 has 2 samples.

The bars are for 0.35, 0.40, 0.45, 0.50, 0.55, and 0.60 as left edges, with counts 1, 3, 6, 5, 3, 2.

Samples of 0.60 or more: the last bar, 2 samples. $\frac{2}{20} = 0.10$.

10%

Exercise 11 - An unusual result

A result that occurs in only 1% of random samples is unlikely to be due to chance if the population proportion were 0.5.

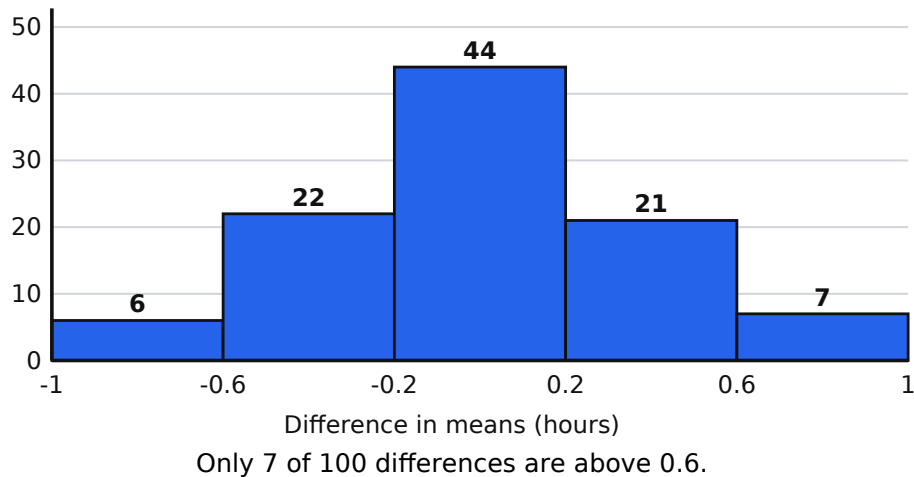
The population proportion is probably greater than 0.5

Exercise 12 - Is the coin fair?

$\frac{2}{200} = 0.01$: such a result occurs about 1% of the time with a fair coin.

Probably not fair

Exercise 13 - Compare treatments



Differences of 0.6 or more occurred in the last bar only: 7 of 100. A difference as large as 0.8 is even rarer, so it is below 7%.

A difference this large rarely happens by chance alone.

Unusual: the app probably improved sleep

Exercise 14 - Margin of error from a simulation

The interval is centered at 0.52 with half-width $\frac{0.58-0.46}{2} = 0.06$.

About 0.06, or 6 percentage points

Exercise 15 - Evaluate a report

$\frac{1}{\sqrt{10}} \approx 0.32$, so the true value could be anywhere from about 58% to 100%.

The sample is too small, and the method of choosing the dentists is unknown.

Margin of error about 32 percentage points; weak evidence

Exercise 16 - Sampling method

This is a stratified random sample: the population is split into groups (grades) and a random sample is taken from each.

It guarantees every grade is represented.

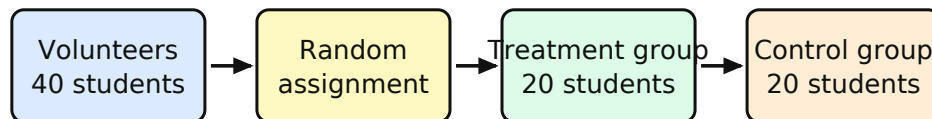
Stratified random sample

Exercise 17 - Confounding

People chose whether to drink coffee, so the study is observational. Other variables, such as exercise or income, may differ between the groups and explain the result.

Observational: confounding variables are possible

Exercise 18 - Design an experiment



A randomized experiment compares a treatment group with a control group.

Randomly assign 20 volunteers to eat the energy bar (treatment) and 20 to eat a plain bar (control). Time everyone's 100-meter sprint.

The response variable is the sprint time; compare the group averages.

Random assignment, 20 vs 20, response: sprint time

Exercise 19 - Effect of sample size

$\frac{1}{\sqrt{n}} = 0.05$ gives $\sqrt{n} = 20$, so $n = 400$.

400 people, four times as many

Exercise 20 - Find the error

The margin of error depends on the sample size, not on the population size. Samples of the same size give about the same margin of error.

No; the same sample size gives the same margin of error

Exercise 21 - Estimate a mean

$$2 \cdot \frac{6}{3} = 2 \text{ cm.}$$

24 ± 2 gives 22 to 26.

About 22 cm to 26 cm