

Algebra 2 • Unit 8 • Assessment Guide

Statistical Inferences

For the Parent or Teacher — What to look for

Unit 8 develops statistical inference and is heavy on language precision. Most diagnostic errors occur when students conflate CORRELATION with CAUSATION, or misinterpret what 'random' actually accomplishes in a study.

Problem 1 — Study type classification

- (a) EXPERIMENTAL — random assignment to treatment.
- (b) OBSERVATIONAL — no random assignment; just records pre-existing behavior.
- (c) SURVEY — collecting self-reported preferences.
- (d) ★ Only EXPERIMENTAL studies (with random assignment) can establish CAUSATION. Observational studies can show correlation but cannot rule out confounders.
- Strong: mentions that random assignment makes the groups equivalent on average, so any difference in outcomes is attributable to the treatment.

Problem 2 — Sampling bias

- Method A is BIASED: students walking into the gym are likely athletes, so the estimate of sport participation will be inflated.
- Method B (random sampling) gives an unbiased estimate.
- ★ Strong: "Random sampling ensures every student has equal chance of being selected, so the sample's proportion is representative of the population's proportion (on average)."

Problem 3 — Normal distribution + 68/95/99.7 rule

- (a) 18.5 to $21.5 = \mu \pm \sigma$. About 68%.
- (b) 17 to $23 = \mu \pm 2\sigma$. About 95%.
- (c) 15.5 to $24.5 = \mu \pm 3\sigma$. About 99.7%.
- (d) Strong: "In a normal distribution, about 68% of data falls within 1 SD of the mean, 95% within 2 SD, and 99.7% within 3 SD."
- ★ This rule is the single most useful tool in Unit 8 — be sure students have it memorized AND understand it.

Problem 4 — Margin of error

- (a) Interval: 47% to 57%.
- (b) Cannot confidently claim A is winning — the interval includes values below 50%. A could actually be losing.
- (c) Larger sample $\Rightarrow$ smaller margin of error. Roughly margin scales as $1/\sqrt{n}$.
- ★ The most common Unit 8 misconception: '52% means A is winning.' The margin of error makes this borderline.

Problem 5 — Sample variability

- (a) Expected proportion $\approx 30\%$ (≈ 7.5 of 25).
- (b) NO — samples vary because of randomness. Some have 6, some have 9 red.

- (c) $12/25 = 0.48$ — about 18 percentage points above the expected 30%. With $n=25$, this is roughly 2 standard deviations away from the expected (rough estimate $\sigma \approx \sqrt{p(1-p)/n} \approx 0.09$). So 0.48 IS notably unusual but not impossible.
- ★ Strong: discusses sampling variability rigorously. Weak: 'no the bag is wrong' without quantitative reasoning.

Problem 6 — Significance via randomization distribution

- (a) $5 / 2 = 2.5$ standard deviations.
- (b) Yes — 2.5 SD is outside the 95% interval ($\mu \pm 2\sigma$). Only about 5% of trials under the no-effect assumption would land that far out.
- (c) STRONG: "There is evidence that the fertilizer has an effect." CAREFUL: NOT "we have proven fertilizer works" — only that the observed difference is unlikely under the no-effect assumption.
- ★ This phrasing matters per the unit narrative.

Problem 7 — Bias identification

- (a) Voluntary response bias — only readers who feel strongly will respond. Fix: random sample of all subscribers.
- (b) Brand-suggestion bias — perceptions of a known brand affect taste judgment. Fix: blind taste test.
- (c) Selection bias — sports website visitors are not representative of the general population. Fix: random national sample.
- ★ Strong students name the SPECIFIC kind of bias (voluntary response, selection, response bias).

Problem 8 — Correlation vs. causation

- NO — the study likely is OBSERVATIONAL. Chocolate eaters might be healthier in other ways (wealthier, lower stress, more exercise). These are CONFOUNDERS.
- Strong: identifies that observational studies CANNOT establish causation; need an experimental study with random assignment.
- ★ THE most important Unit 8 lesson. Watch for students who say 'yes because the study showed it.' That's a comprehension red flag.

Problem 9 — Confidence interval interpretation

- Technically NOT quite right. The 95% refers to the METHOD: if we repeated the sampling and interval construction many times, 95% of the resulting intervals would contain the true value. The true value is fixed; the interval is random.
- ★ This is a subtle but important distinction in statistics. Strong students articulate that 'the parameter is not random; the interval is.' Many adults — and statisticians — also get this wrong colloquially.
- Weak: agrees without scrutiny.

Problem 10 — Designing a study

- (a) EXPERIMENTAL — to establish that the app's recommendations CAUSE the change.
- (b) Random assignment to two groups: one gets app recommendations, the other gets random playlist.
- (c) Some measurable enjoyment metric: rating per song, total listening time, skip rate.
- (d) Threats: participants may know which group they're in (placebo effect), small sample, music taste varies wildly so noise is high, time-of-day or mood confounders, etc.
- ★ Strong students design with awareness of bias and threats. This is the unit's culminating skill.