Evaluating Statistical Reports

Name: _____	Date: _____	Score: _____ / 33

Quick Review

Real-world statistical claims come with marketing, headlines, and missing context. Your job, every time you read one, is to slow down and ask a small list of questions.

1. Where did the data come from? A random sample of a clearly defined population is strong. A convenience sample, a voluntary online poll, or an unspecified "recent study" is weak.

2. Observational or experimental? An observational study can show association but cannot establish causation. Watch for headlines that say "X causes Y" based on observational evidence – that's an overreach.

3. What's the sample size, and what's the margin of error? "A new poll shows 52% support for the bill" without a margin of error is suspicious. A MOE of $\pm 4\%$ means 52% could plausibly be anywhere from 48% to 56%.

4. Is the graphical display honest? A truncated y-axis (e.g., starting at 98 instead of 0) makes tiny differences look huge. Cherry-picked time ranges show only the part of the data that supports the claim.

5. Is there a confounder? Two variables that move together don't necessarily cause each other. Ice-cream sales and shark attacks both rise in summer – the lurking variable is temperature.

6. Generalization. A study on 200 college freshmen probably doesn't apply to retirees. A drug tested on adults may not be safe for children.

Common traps to watch for. Sample bias (mall surveys, online polls). Misleading axes. Correlation framed as causation. Statistical-significance language used as if it meant practical importance. "Up to $\$X$ savings" phrasings that report the best case, not the typical.

PRACTICE

For each scenario, identify the flaw or critique the reasoning.

1. A study finds students who drink more coffee score higher on exams and claims coffee causes the higher scores. Critique. _____
2. A pollster surveys at a shopping mall during business hours. Main bias? _____
3. A bar graph's y-axis starts at 98 and ends at 102. Issue? _____
4. Ice-cream sales and shark attacks are strongly positively correlated. Confounder? _____
5. A study on 200 college freshmen finds a result. Can we generalize to retirees? _____
6. A drug commercial says: "In a study, 80% of users reported improvement." Missing context? _____
7. An online poll on a fan-site asks readers to vote. Main bias? _____
8. A graph shows revenue "up 30%" but it goes from $\$100$ to $\$130$. Misleading? _____
9. A randomized clinical trial finds a 4% recovery improvement, $p = 0.001$. Can we claim causation? _____
10. From the poll summary in the table, can we say candidate A is ahead? _____

Estimate $\hat{p}$	MOE	Confidence
0.52	$\pm 4\%$	95%

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11. The study summarized in the table is “statistically significant.” Comment on its practical importance. _____

Sample size	Effect size	p-value
$100{,}000$	0.3 pts on a 100 scale	0.001

12. An ad summarizes its evidence in the table below. What’s the main critique? _____

Claim	Dentists recommending	Total asked
Brand X is best	9	10

13. A study reports “in our sample, exercise reduced anxiety by 40%.” What’s missing? _____
14. A line graph shows global temperatures from 2014–2018 flat. Can we conclude no warming? _____
15. A school principal reports: “Our new program raised test scores from 74 to 76.” What else do we need? _____
16. What is a confounding variable? _____
17. What does it mean if a study is “observational”? _____
18. True or false: a p-value below 0.05 proves the effect is large. _____
19. An ad says “up to 50% off!” What’s the trick? _____
20. A bar chart uses a 3-D effect that exaggerates one bar. Issue? _____

♦ Word Problems

21. A headline reads: “People who eat blueberries daily live longer” – based on an observational study of $1{,}000$ adults. List two reasons why the headline overreaches and what study design would justify a causal claim. _____
22. A poll reports that 58% of likely voters support a new bill, with a margin of error of $\pm 4\%$ at 95% confidence. The newspaper’s headline is “Majority Now Backs Bill.” Is the headline justified by the data? _____
23. A weight-loss ad displays a graph with the y-axis starting at 185 pounds and ending at 200 pounds, showing weight dropping from 195 to 189 over six months. The graph makes the drop look enormous. What’s misleading, and what would an honest version look like? _____
24. A study with $n = 50{,}000$ finds a “statistically significant” difference between two cereal brands: brand A increases morning alertness scores by 0.4 points on a 100-point scale, $p = 0.001$. Does this mean people should switch cereals? _____

Additional Practice

25. Find the mean of $4, 6, 8, 10$. _____
26. Find the median of $3, 9, 4, 10, 7$. _____
27. Find the range of $12, 5, 9, 20$. _____
28. Find the mode of $2, 3, 3, 5, 8$. _____
29. Find z for $x = 72$, mean 60, standard deviation 6. _____
30. Interpret $z = -1.5$. _____
31. Predicted y for $\hat{y} = 2x + 5$ at $x = 6$. _____
32. Residual if actual $= 20$ and predicted $= 17$. _____
33. Positive association: slope sign? _____

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Answer Keys

1. observational; possible confounders
2. convenience sample; not representative
3. truncated axis exaggerates differences
4. temperature (warm weather)
5. No – different population
6. study design, sample size, control group
7. voluntary-response (self-selection)
8. Not necessarily misleading; depends on the visual scale
9. Yes – random assignment supports causal inference
10. Not statistically significant; could be tied
11. Possibly negligible
12. Sampling unclear; how were the dentists chosen?
13. control group, baseline, sample size, randomization
14. No – cherry-picked time range
15. control group, sample size, statistical significance
16. a lurking variable affecting both groups
17. no random assignment of treatments
18. False
19. "up to" covers any value $\leq 50\%$
20. visual distortion
21. observational; need a randomized experiment
22. Yes – the entire 95% CI (54% to 62%) is above 50%
23. truncated y-axis; honest version starts at 0
24. Probably not – effect size is tiny

Additional Practice Answers

25. 7
26. 7
27. 15
28. 3
29. 2
30. 1.5 SD below mean
31. 17
32. 3
33. positive

Additional Practice: Answers for all numbered items, including the added practice, are shown in the grid above.

Step-by-Step Explanations

1. Observational $\Rightarrow$ no causal conclusion. Confounders: students who drink more coffee may study more, sleep less, or be under more academic pressure (which itself forces more studying).
2. Mall shoppers at midday are biased toward retirees, the unemployed, and stay-at-home parents – not the general voting public.
3. Small differences in the data look dramatic when the axis is zoomed in. Honest axes usually start at 0 unless there's a good reason otherwise.
4. Both rise in summer. The hot weather drives both – a classic lurking variable.
5. The sample frame was college freshmen. Retirees differ in age, health, lifestyle, and just about everything else.
6. Was it randomized? How many people? Was there a placebo group, and did they report 80% improvement too? Without these, the claim is hot air.
7. Only motivated readers vote. The result reflects the site's user base, not the general public.
8. Start with the key idea: 30% is the correct relative change. Whether the graph is misleading depends on how the y-axis is drawn (truncated? zero-based?). The number itself is fine. That gives a quick check on the answer.
9. Randomized experiments are the gold standard for causation. The small p adds evidence the effect isn't noise.
10. The 95% CI is $52\% \pm 4\% = [48\%, 56\%]$. It includes 50%, so we can't confidently say A is ahead.
11. A huge n makes even a tiny 0.3-point effect statistically significant. Always ask whether the effect size is big enough to matter in real life – here it likely isn't.
12. Only 10 dentists – not a random national sample. The company might have hand-picked dentists known to favor the brand. We need the sampling details before trusting "9 out of 10."
13. Without a comparison group and baseline measurements, we can't tell if the 40% drop is from exercise or from time passing, expectations, or natural variation.
14. Five years is too short to draw climate conclusions. The trend over decades is what matters, and a hand-picked window can hide it.
15. Two-point increase could be noise. Without a control group (e.g., a similar school using the old program) and a hypothesis test, we can't rule out random variation.
16. A variable correlated with both the treatment and the response. It can fake or hide a treatment effect.
17. Researchers watch what naturally happens, without actively assigning groups. Causation is off the table.
18. Keep the rule visible: $p < 0.05$ proves the effect is statistically different from zero, but says nothing about the effect's size. Tiny effects can be highly significant with huge samples. That gives a quick check on the answer.
19. "Up to" is a maximum, not a typical. The actual discount could be 5% on most items, with one clearance item at 50%.
20. Start with the key idea: 3-D effects can make perspective-foreground bars look bigger than they really are. The honest version is plain 2-D. That gives a quick check on the answer.
21. Two reasons the headline overreaches: (1) Observational data cannot establish causation. (2) Confounders almost certainly exist – daily blueberry eaters are likely wealthier, more health-conscious, eat less junk food, and exercise more. Any of those could be the real driver of longer lifespan. To justify a causal claim, you'd need a *randomized experiment* – randomly assign people to blueberry-eating or not, and track outcomes. (Long-term human diet experiments are notoriously hard to run, which is why nutrition research often stops at association.)
22. The 95% CI is $58\% \pm 4\% = [54\%, 62\%]$. The entire interval lies above 50%, so we have evidence that a majority does support the bill – the headline is reasonable. Contrast that with a $\hat{p} = 52\%$ with the same MOE: the CI would be $[48\%, 56\%]$, which includes 50%, and the "majority" claim would be premature.
23. The truncated y-axis (185 to 200) shows a 6-pound drop on a 15-pound range – 40% of the visual height. The same drop on a y-axis from 0 to 200 would look like 3% of the height – a barely visible blip. Both are technically correct, but the truncated version *visually exaggerates* a modest change. An honest version starts the axis at 0 (or, if context demands a closer view, clearly labels the scale and notes the truncation).
24. With $n = 50{,}000$, even tiny effects can be statistically significant – the standard error is so small that almost *any* non-zero difference shows up as $p < 0.05$. But 0.4 points on a 100-point alertness scale is a negligible practical difference – smaller than the noise from a slightly different night's sleep. Statistical significance and practical importance are different questions. Always ask: is the effect large enough to matter?

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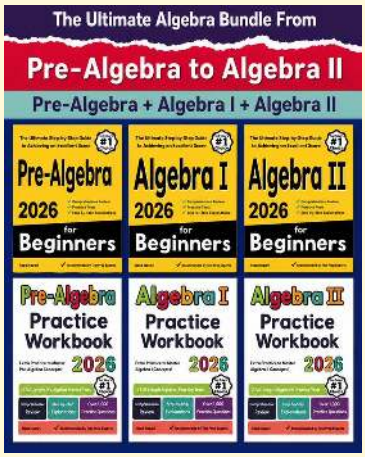

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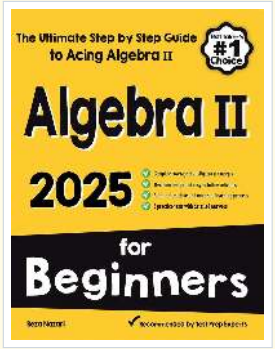

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