Date 11-16-2026

PSYCH 10 · Fall 2026 · Worksheet for Lecture 15: Confidence intervals · Answer key

The answers are in blue. Where a question has more than one defensible answer, the key says so and describes a good answer.

Part 1 · The standard error

Two weeks before the election, Change Research polled 842 Mississippi voters about the U.S. Senate race between Senator Cindy Hyde-Smith (Republican) and Scott Colom (Democrat): Hyde-Smith 43%, Colom 40%. The estimate is Hyde-Smith's lead over Colom, 3 points, and its standard error is about 3 points.

a. The standard error is the standard deviation of a distribution. Which distribution: the individual responses in this poll, or the leads of many polls of this size? Write *responses* or *leads*, then one sentence saying what the standard error is a measure of.

a. *Leads. The standard error is the standard deviation of the sampling distribution, the distribution of the leads from many polls of this size. It measures the typical distance between one poll's lead and the true lead. The standard deviation of the individual responses is a different quantity; dividing it by the square root of n gives the standard error.*

b. Suppose the pollster had reached four times as many voters. Would the standard error be about the same, about half, about a quarter, or about double? Select one, then one sentence giving the reason.

b. *About half. The standard error is proportional to 1 over the square root of the number of voters: multiplying the number of voters by 4 divides the standard error by the square root of 4, which is 2. A student who answers "about a quarter" has divided by 4 rather than by its square root.*

c. A poll of the same size in California, a state with about ten times as many voters, would have a larger standard error. Is that right or wrong? Write *right* or *wrong*, then one sentence giving the reason.

c. *Wrong. The standard error depends on the number of voters polled, not on the number of voters in the state: the formula for the standard error contains n, the number polled, and no term for the size of the population. The size of the population affects the standard error only when the poll is a large fraction of the population, and 842 voters are a small fraction of any state.*

Part 2 · The confidence interval

The poll's 95% confidence interval for Hyde-Smith's lead runs from about -3 to 9 points.

a. Each sentence below offers a reading of that confidence interval. Write *justified* or *not justified* beside each sentence's number.

1. The true lead is plausibly anywhere in this range, and values outside the range are implausible.
2. If the poll were repeated with new voters, the new lead would fall in this range 95% of the time.
3. There is a 95% probability that the true lead lies in this range.
4. Because the range includes 0, a tie remains plausible.

a. *1 justified: that is the definition of a confidence interval, the set of true leads that could plausibly have produced the poll's lead. 2 not justified: the confidence interval is a statement about the true lead, not about the leads of future polls; a new poll's lead has sampling error of its own, so it would fall in this range less often than 95% of the time. 3 not justified: the 95% describes the method. About 95 in 100 confidence intervals built this way contain the true lead, but the true lead is one fixed number, so the probability that it lies inside this particular confidence interval is 1 or 0, not 0.95. A student who marks 3 justified but explains the 95% as a long-run share of confidence intervals has understood the 95%. 4 justified: 0 lies inside the confidence interval, so a tie remains plausible.*

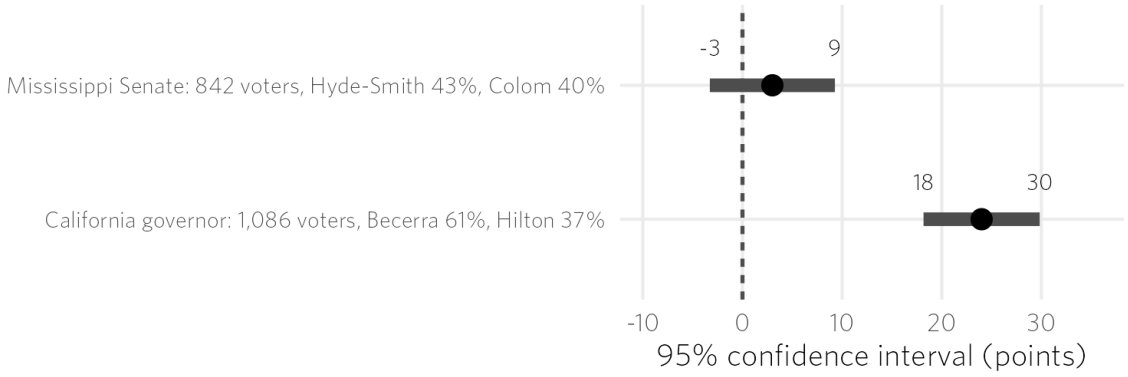
b. Suppose the poll had found a larger lead, with the same standard error. Would the confidence interval be wider, narrower, or the same width? Would it sit in the same place? One sentence.

b. *The same width: the width is about four standard errors, two on either side of the estimate, and the standard error is unchanged. The confidence interval would be centered on the larger lead; with a large enough lead, 0 would lie outside the confidence interval, and a tie would no longer be plausible.*

c. A second pollster reports a confidence interval for the same race that is twice as wide. Give two different reasons that could explain the wider confidence interval.

c. *A smaller poll: with about a quarter as many voters, the standard error doubles, and so does the width of the confidence interval. Or a higher confidence level: to contain the true lead 99 times in 100 rather than 95, a confidence interval must be wider. Either reason is enough; a student who gives both has named the two choices that set the width of a confidence interval, the number of voters polled and the confidence level.*

Part 3 · Careful conclusions from two polls



The figure shows the 95% confidence interval for the leader's lead in two polls: the Mississippi Senate poll, and a California governor poll in which Xavier Becerra (Democrat) led Steve Hilton (Republican) by a wide margin.

a. For each poll, say in one sentence what its confidence interval tells you about the leader's true lead: how large it could plausibly be, and how small.

a. *Mississippi: the true lead is plausibly anywhere from a Colom lead of about 3 points to a Hyde-Smith lead of about 9 points; the poll does not establish the size of the lead or even its direction. California: Becerra's true lead is plausibly anywhere from about 18 to 30 points; the confidence interval is 12 points wide, but every value in it is a large lead.*

b. Suppose the Mississippi pollster had reached ten times as many voters and found the same lead. Write what you could then say about the true lead, hedged as carefully as the evidence warrants, and name one thing the bigger poll would not change.

b. *With ten times the voters the standard error falls to about a third of its value, 1 point rather than 3, so the confidence interval would be about 2 points on either side of the same 3-point lead. A hedged statement: Hyde-Smith most likely led, by somewhere between about 1 and 5 points, and a tie would be unlikely but not impossible. The bigger poll would not change the estimate itself, and it would not change which voters answer polls or which voters turn out on election day, so any systematic error from those two sources would be the same size in the larger poll.*

c. A news report said that the Mississippi poll "showed Hyde-Smith ahead." Write a more carefully hedged sentence that says what the poll supports about who was ahead.

c. *A hedged version: the poll's estimate was a Hyde-Smith lead of 3 points, but a small Colom lead remained plausible, so the poll did not establish which candidate was in the lead. A good sentence reports the direction of the estimate, says that the evidence for that direction is weak, and is consistent with the confidence interval. (Colom won the election by less than a point, a result inside the confidence interval.)*