

1. Two voting districts, C and M, were sampled to investigate voter opinion about tax spending. From a random sample of 100 voters in District C, 22 percent responded yes to the question “Are you in favor of an increase in state spending on the arts?” An independent random sample of 100 voters in District M resulted in 26 percent responding yes to the question. A 95 percent confidence interval for the difference ( $p_c - p_m$ ) was calculated as  $-0.04 \pm 0.12$ . Which of the following is the best interpretation of the interval?
- (A) We are 95% confident that the majority of all voters in the state favor an increase in state spending for the arts.
  - (B) We are 95% confident that less than half of all voters in the state favor an increase in state spending for the arts.
  - (C) We are 95% confident that the difference in the proportions of all voters in districts C and M who favor an increase in state spending for the arts is between  $-0.16$  and  $0.08$ . ✓
  - (D) We are 95% confident that the difference in the sample proportions of voters in districts C and M who favor an increase in state spending for the arts is between  $-0.16$  and  $0.08$ .
  - (E) We are 95% confident that the proportion of all voters in the state who favor an increase in state spending for the arts is between  $-0.16$  and  $0.08$ .

**Answer C**

Correct. The interval is calculated as  $-0.04 \pm 0.12 = (-0.16, 0.08)$ . The interval is a statement of plausible values for the difference in the population proportions between the two districts on who would answer yes to the question.

2. Consider a 95 percent confidence interval constructed for the difference between two population proportions  $p_R$  and  $p_S$ . The interval for  $p_R - p_S$  is given as  $(-0.05, 0.15)$ . Which of the following is an appropriate interpretation of the confidence level?
- (A) In repeated random sampling with the same sample size,  $\hat{p}_R - \hat{p}_S$  will be contained in the interval approximately 95 percent of the time.
  - (B) In repeated random sampling with the same sample size,  $p_R$  will be contained in the interval approximately 95 percent of the time.
  - (C) In repeated random sampling with the same sample size,  $\hat{p}_R$  will be contained in the interval approximately 95 percent of the time.
  - (D) The probability is 0.95 that the difference in the sample proportions  $\hat{p}_R - \hat{p}_S$  is between  $-0.05$  and  $0.15$ .
  - (E) In repeated random sampling with the same sample size, approximately 95 percent of the intervals will capture the difference in population proportions,  $p_R - p_S$ . ✓

**Answer E**

Correct. The confidence level is an indication of the percent of intervals that will capture the population

parameter if the process is repeated over and over again. In this case, the population difference will be captured by 95 percent of all possible intervals created from repeated sampling.

3. Independent random samples of voters from two voting districts, G and H, were selected to investigate the proportion of all voters who favor a proposal to widen a road that runs through both districts. The difference between the sample proportions (G minus H) was used to create the 95 percent confidence interval  $(0.13, 0.47)$  for the population difference between districts.

Which of the following is the best interpretation of the interval?

- (A) It is likely that the majority of voters in both districts favor the proposal, because all values in the interval are positive.
- (B) It is likely that more voters in district H favor the proposal than in district G, because all values in the interval are positive.
- (C) It is likely that more voters in district G favor the proposal than in district H, because all values in the interval are positive. ✓
- (D) It is likely that less than half the voters in both districts favor the proposal, because all values in the interval are less than 0.5.
- (E) It is likely that there is no difference between the districts in voters who favor the proposal, because 0 is not contained in the interval.

### Answer C

Correct. The confidence interval was created from the sample statistic of the proportion in favor of the proposal from district G minus the proportion in favor of the proposal from district H. Because all values of the difference are positive, it is likely that the population proportion from G is greater than that from H.

4. A recent study was conducted in which a random sample of men and a random sample of women were surveyed about whether they were fans of a professional football team. The study found that 39 percent of men in the sample were fans and 22 percent of women in the sample were fans. A 99 percent confidence interval for the difference in the proportion of fans of a professional football team between men and women was reported as  $(0.133, 0.207)$ . Which of the following statements is the best interpretation of the interval?

- (A) The difference in the percents of fans of a professional football team between men and women is 17%.
- (B) There is a 99% chance of finding a difference between 13.3% and 20.7% for the percents of men and women who are fans of a professional football team.
- (C) We are 99% confident that the percent of men who are fans of a professional football team exceeds that of women by at least 20.7%.
- (D) We are 99% confident that the difference in the sample percents of men and women who are fans of a professional football team is between 13.3% and 20.7%.
- (E) We are 99% confident that the difference in the population percents of all men and women who are fans of a professional football team is between 13.3% and 20.7%.

**Answer E**

Correct. The interpretation gives a level of confidence about what we believe are plausible values of the population parameter. In this case, the parameter is the difference in the proportions, or percent, of all men and women who are fans of a professional football team.

5. A 95 percent confidence interval for the proportion difference  $p_1 - p_2$  was calculated to be  $(-0.12, 0.17)$ .

Which of the following conclusions is supported by the interval?

- (A) There is evidence to conclude that  $p_1 > p_2$  because 0.17 is greater than  $-0.12$ .
- (B) There is evidence to conclude that  $p_2 > p_1$  because 0.17 is greater than 0.12.
- (C) There is evidence to conclude that  $p_1 > p_2$  because the range of positive values in the interval is greater than the range of negative values.
- (D) There is evidence to conclude that  $p_2 > p_1$  because the range of positive values in the interval is greater than the range of negative values.
- (E) There is not sufficient evidence to determine which proportion is greater.

**Answer E**

Correct. All values in the interval are plausible. The interval indicates that the difference could be positive ( $p_1 > p_2$ ), negative ( $p_2 > p_1$ ), or 0 ( $p_1 = p_2$ ).

6. A service company recently revised its call-routing procedures in an attempt to increase efficiency in routing customer calls to the appropriate agents. A random sample of customer calls was taken before the revision, and another random sample of customer calls was taken after the revision. The selected customers were asked if they were satisfied with the service call. The difference in the proportions of customers who indicated they were satisfied ( $p_{\text{after}} - p_{\text{before}}$ ) was calculated. A 90 percent confidence interval for the difference is given as  $(-0.02, 0.11)$ . The manager of the company claims that the revision in procedure will change the proportion of customers who will indicate satisfaction with their calls.

Does the confidence interval support the manager's claim?

- (A) No. The value of 0 is contained in the interval, which indicates that it is plausible that there is no difference in the proportion of customers who will indicate satisfaction with their calls. ✓
- (B) No. All values in the interval are less than 0.12, which indicates that the difference in the proportion of customers who will indicate satisfaction with their calls is very small.
- (C) Yes. There are more positive values in the interval than negative values, which indicates that more customers indicated satisfaction with their calls after the revision.
- (D) Yes. The length of the interval is greater than 0.10, which indicates that the sample difference in the proportion of customers who will indicate satisfaction with their calls is plausible.
- (E) Yes. The value of 0 is contained in the interval, which indicates that a difference in the proportion of customers who will indicate satisfaction with their calls is plausible.

### Answer A

Correct. The confidence interval does not support the claim of a difference. When  $p_{\text{after}} = p_{\text{before}}$ , the difference  $p_{\text{after}} - p_{\text{before}} = 0$ . A value of 0 contained in a confidence interval for a difference indicates that 0 is a plausible value for that difference. It is plausible that the proportion of satisfied customers after the revision is the same as that before the revision.