Interpreting P-Values Quiz

1. In a population of bats living in a certain region, 30 percent have a wingspan greater than 10 inches. In a random sample of 80 bats living outside of the region, 20 had a wingspan greater than 10 inches. Consider a one-sample z -test to investigate whether there is evidence that the proportion of bats with a wingspan greater than 10 inches living outside the region is different from that of the bats living in the region. Which of the following is the correct test statistic?

(A) $z = \frac{0.30-0.25}{\sqrt{\frac{(0.25)(0.75)}{80}}}$

(B) $z = \frac{0.30-0.25}{\sqrt{\frac{(0.30)(0.70)}{80}}}$

(C) $z = \frac{0.20-0.30}{\sqrt{\frac{(0.30)(0.70)}{80}}}$

(D) $z = \frac{0.25-0.30}{\sqrt{\frac{(0.25)(0.75)}{80}}}$

(E) $z = \frac{0.25-0.30}{\sqrt{\frac{(0.30)(0.70)}{80}}}$ ✓

Answer E

Correct. The sample proportion is $\frac{20}{80} = 0.25$, and the test statistic is given by $z = \frac{\hat{p}-p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{0.25-0.30}{\sqrt{\frac{(0.30)(0.70)}{80}}}$.

2. In high school X, approximately 9 percent of the students saw a certain movie on opening night. From a random sample of 200 students from high school Y, 22 saw the movie on opening night. Consider a hypothesis test to investigate whether the proportion of all students in high school Y who saw the movie on opening night is greater than that of high school X. Which of the following is the standard deviation used to calculate the test statistic for the one-sample z-test?

(A) $\sqrt{\frac{(0.11)(0.89)}{200}}$

(B) $\sqrt{\frac{(0.09)(0.91)}{200}}$ ✓

(C) $\sqrt{\frac{(22)(178)}{200}}$

(D) $\frac{(0.11)(0.89)}{\sqrt{200}}$

(E) $\frac{(0.09)(0.91)}{\sqrt{200}}$

Answer B

Correct. The standard deviation uses the value of the population proportion 0.09 and is given by

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$$\sigma_{\hat{p}} = \sqrt{\frac{p_0(1-p_0)}{n}} = \sqrt{\frac{(0.09)(0.91)}{200}}.$$

3. A significance test is conducted for which the alternative hypothesis states that more than 83 percent of all adult sea turtles on a certain beach are female. A random sample of adult sea turtles from the beach found that 85 percent of the sea turtles were female. The p-value for the test is 0.4058. If the null hypothesis is true, which of the following statements is a correct interpretation of the p-value?

(A) Of all possible samples of the same size, 40.58 percent will result in 85 percent of adult sea turtles on the beach being female.

(B) Of all possible samples of the same size, 40.58 percent will result in 85 percent or more of adult sea turtles on the beach being female. ✓

(C) Of all possible samples of the same size, 40.58 percent will result in 85 percent or less of adult sea turtles on the beach being female.

(D) Of all possible samples of the same size, 20.29 percent will result in 85 percent or more of adult sea turtles on the beach being female.

(E) Of all possible samples of the same size, 20.29 percent will result in 85 percent of adult sea turtles on the beach being female.

Answer B

Correct. The p-value represents the probability of obtaining a proportion as extreme as or more extreme than the sample proportion.

4. Past studies indicate that about 60 percent of the trees in a forested region are classified as softwood. A botanist studying the region suspects that the proportion might be greater than 0.60. The botanist obtained a random sample of trees from the region and conducted a test of $\mathrm{H}_0 : p = 0.6$ versus $\mathrm{H}_\mathrm{a} : p > 0.6$. The p-value of the test was 0.015. Which of the following is a correct interpretation of the p-value?

(A) If it is true that 60 percent of the trees in a forested region are classified as softwood, 0.015 is the probability of obtaining a population proportion greater than 0.6.

(B) If it is true that 60 percent of the trees in a forested region are classified as softwood, 0.015 is the probability of obtaining a sample proportion as small as or smaller than the one obtained by the botanist.

(C) If it is true that 60 percent of the trees in a forested region are classified as softwood, 0.015 is the probability of obtaining a sample proportion as large as or larger than the one obtained by the botanist. ✓

(D) If it is not true that 60 percent of the trees in a forested region are classified as softwood, 0.015 is the probability of obtaining a sample proportion as large as or larger than the one obtained by the botanist.

(E) If it is not true that 60 percent of the trees in a forested region are classified as softwood, 0.015 is the probability of obtaining a population proportion greater than 0.6.

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Answer C

Correct. If the null hypothesis is true, the p-value represents the probability of obtaining a sample proportion as extreme as or more extreme than the one used for the hypothesis test, in the direction of the alternative hypothesis.

5. A social scientist believed that less than 30 percent of adults in the United States watch 15 or fewer hours of television per week. To test the belief, the scientist randomly selected 1,250 adults in the United States. The sample proportion of adults who watch 15 or fewer hours of television per week was 0.28, and the resulting hypothesis test had a p-value of 0.061. The computation of the p-value assumes which of the following is true?

(A) The population proportion of adults who watch 15 or fewer hours of television per week is 0.28.

(B) The population proportion of adults who watch 15 or fewer hours of television per week is 0.30. ✓

(C) The population proportion of adults who watch 15 or fewer hours of television per week is less than 0.30.

(D) The population mean number of hours adults spend watching television per week is 15.

(E) The population mean number of hours adults spend watching television per week is less than 15.

Answer B

Correct. The computation of the p-value assumes that the null hypothesis is true. Since the scientist believes the proportion to be less than 0.30, the alternative hypothesis is $\mathrm{H_a} : p < 0.30$. The null hypothesis is that the population proportion is 0.30.

6. Consider a one-sample two-sided z-test for a population proportion. Given that conditions for inference are met, which of the following is closest to the p-value for a test statistic of $z = -1.86$?

(A) 0.0157

(B) 0.0314

(C) 0.0628 ✓

(D) 0.9371

(E) 0.9686

Answer C

Correct. Because the test is two-sided, the p-value should be twice the area under the standard normal curve to the left of -1.86. In this case, $2(0.0314) = 0.0628$.