Confidence Intervals for the Difference of Two Proportions Quiz

1. There are 1,000 golden delicious and 1,000 red delicious apples in a cooler. In a random sample of 75 of the golden delicious apples, 48 had blemishes. In a random sample of 75 of the red delicious apples, 42 had blemishes. Assume all conditions for inference have been met. Which of the following is closest to the interval estimate of the difference in the numbers of apples with blemishes (golden delicious minus red delicious) at a 98 percent level of confidence?

(A) $(-0.076, 0.236)$

(B) $(-0.105, 0.265)$

(C) $(-10.5, 26.5)$

(D) $(-76, 236)$

(E) $(-105, 265)$ ✓

Answer E

Correct. The 98 percent confidence interval for the difference in proportions of apples with blemishes is $(-0.105, 0.265)$. The interval estimate for the difference in the numbers of apples with blemishes is found by multiplying the endpoints of the interval for the proportion by 1,000.

2. Two large containers, X and Y, contain many colored beads. From a random sample of beads taken from container X, the proportion of blue beads in the sample was recorded as $\hat{p}_{\mathrm{X}} = 0.35$. From a random sample of beads taken from container Y, the proportion of blue beads in the sample was recorded as $\hat{p}_{\mathrm{Y}} = 0.39$. Assuming all conditions for inference are met, which of the following procedures is the most appropriate for estimating the difference between the proportions of all blue beads in the containers?

(A) A two-sample z-interval for a difference in population proportions ✓

(B) A two-sample z-interval for a difference in sample proportions

(C) A one-sample z-interval for a population proportion

(D) A one-sample z-interval for a sample proportion

(E) A one-sample z-interval for a difference in population proportions

Answer A

Correct. A two-sample z-interval is appropriate for estimating the difference between two population proportions.

3. A researcher calculated sample proportions from two independent random samples. Assuming all conditions for inference are met, which of the following is the best method for the researcher to use to estimate the true difference between the population proportions?

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(A) Construct a two-sample z-interval for the difference between population proportions. ✓

(B) Construct a two-sample z-interval for the difference between sample proportions.

(C) Perform a z-test for the difference in sample proportions.

(D) Subtract the proportions and construct a one-sample z-interval for a single population proportion.

(E) Subtract the proportions and construct a z-interval for a single sample proportion.

Answer A

Correct. The two-sample z-interval is intended to estimate the true difference between population proportions when there are two independent random samples.

4. Which of the following is not a condition for constructing a confidence interval to estimate the difference between two population proportions?

(A) The samples must be selected randomly.

(B) The data must come from populations with approximately normal distributions. ✓

(C) When samples are taken without replacement, each population must be at least 10 times as large as its corresponding sample.

(D) The samples must be independent of each other.

(E) The observed number of successes and failures for both samples must be at least 10.

Answer B

Correct. Distributions of categorical data cannot be normally distributed. It is the sampling distribution of the difference in sample proportions that should be an approximately normal distribution.

5. A biologist wants to compare the proportions of rainbow trout infected with whirling disease (an illness of trout and salmon caused by a microscopic parasite) coming from two separate watersheds. For each watershed, the biologist will collect a random sample of trout and record the proportion infected in the sample. The biologist intends to estimate the difference for all trout in the two watersheds. Assuming all conditions for inference are met, which of the following is the most appropriate method for the biologist to use to analyze the results?

(A) A one-sample z-interval for a population proportion

(B) A one-sample z-interval for a sample proportion

(C) A one-sample z-interval for a difference in sample proportions

(D) A two-sample z-interval for a difference in population proportions ✓

(E) A two-sample z-interval for a difference in sample proportions

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Answer D

Correct. Two independent random samples will be taken, and two sample proportions will be calculated. To estimate the difference in the population proportions, the two-sample z-interval is the most appropriate to use.

6. Consider a situation in which sampling without replacement is used to generate a random sample from each of two separate populations. To calculate a confidence interval to estimate the difference between population proportions, which of the following checks must be made?

(A) Each population must be at least 10 times as large as its corresponding sample. ✓

(B) Both populations must be approximately normal.

(C) The data from both samples must be unimodal, symmetrical, and approximately normal.

(D) Each sample proportion value must be less than or equal to 0.5.

(E) The sample sizes must be the same.

Answer A

Correct. The 10 percent rule checks that the sample is small relative to the population (that is, that the population is at least 10 times as large as the sample size) so that independence of observations within a sample is reasonable to assume.

7. A gardener wants to know if soaking seeds in water before planting them increases the proportion of seeds that germinate. To investigate, the gardener will assign 50 seeds to be soaked before planting and 50 seeds to be planted without being soaked. After two weeks, the gardener will record how many seeds in each group germinated and construct a 95 percent confidence interval for the difference in proportions. Which of the following conditions for inference should be met?

I. The seeds should be randomly assigned to a treatment.
II. The group sizes should be less than 10 percent of the population sizes.
III. The number of successful seeds and unsuccessful seeds in each group should be at least 10.

(A) I only

(B) II only

(C) III only

(D) I and III only ✓

(E) I, II, and III

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Answer D

Correct. Because this is an experiment, random assignment to the treatments is a necessary condition. Also, the sample size needs to be sufficiently large to support the normality of the sampling distribution.

8. Researchers are studying the distribution of subscribers to a certain streaming service in different populations. From a random sample of 200 people in City C, 34 were found to subscribe to the streaming service. From a random sample of 200 people in City K, 54 were found to subscribe to the streaming service. Assuming all conditions for inference are met, which of the following is a 90 percent confidence interval for the difference in population proportions (City C minus City K) who subscribe to the streaming service?

(A) $\left(0.17-0.27\right)\pm 1.65\sqrt{\frac{0.17}{200}+\frac{0.27}{200}}$

(B) $\left(0.17-0.27\right)\pm 1.96\sqrt{\frac{(0.17)(0.83)+(0.27)(0.73)}{400}}$

(C) $\left(0.17-0.27\right)\pm 1.65\sqrt{\frac{(0.17)(0.83)+(0.27)(0.73)}{400}}$

(D) $(0.17-0.27)\pm 1.96\sqrt{\frac{(0.17)(0.83)+(0.27)(0.73)}{200}}$

(E) $(0.17-0.27)\pm 1.65\sqrt{\frac{(0.17)(0.83)+(0.27)(0.73)}{200}}$ ✓

Answer E

Correct. The sample proportions are $\frac{34}{200}=0.17$ for City C and $\frac{54}{200}=0.27$ for City K. The appropriate z-value is 1.65 for 90% confidence. The correct interval is

$$\left(\widehat{p}_1-\widehat{p}_2\right)\pm z^*\sqrt{\frac{\widehat{p}_1(1-\widehat{p}_1)}{n_1}+\frac{\widehat{p}_2(1-\widehat{p}_2)}{n_2}}=\left(0.17-0.27\right)\pm 1.65\sqrt{\frac{0.17(0.83)}{200}+\frac{0.27(0.73)}{200}}=(0.17-0.27$$

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9. From a random sample of 185 children from school G, 108 indicated they wanted to study science in college. From a different random sample of 165 children from school H, 92 indicated they wanted to study science in college. Assuming all conditions for inference are met, which of the following is closest to the standard error for a confidence interval for the difference in population proportions between the two schools of children who want to study science in college?

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(A) $\sqrt{\frac{\left(\frac{200}{350}\right)\left(1-\frac{200}{350}\right)}{350}}$

(B) $1.96\sqrt{\frac{\left(\frac{200}{350}\right)\left(1-\frac{200}{350}\right)}{350}}$

(C) $\sqrt{\frac{\left(\frac{108}{185}\right)\left(1-\frac{108}{185}\right)}{185}-\frac{\left(\frac{92}{165}\right)\left(1-\frac{92}{165}\right)}{165}}$

(D) $\sqrt{\frac{\left(\frac{108}{185}\right)\left(1-\frac{108}{185}\right)}{185}+\frac{\left(\frac{92}{165}\right)\left(1-\frac{92}{165}\right)}{165}}$

(E) $1.96\sqrt{\frac{\left(\frac{108}{185}\right)\left(1-\frac{108}{185}\right)}{185}+\frac{\left(\frac{92}{165}\right)\left(1-\frac{92}{165}\right)}{165}}$

Answer D

Correct. The standard error is given by $\sqrt{\frac{\widehat{p}_1(1-\widehat{p}_1)}{n_1}+\frac{\widehat{p}_2(1-\widehat{p}_2)}{n_2}}=\sqrt{\frac{\left(\frac{108}{185}\right)\left(1-\frac{108}{185}\right)}{185}+\frac{\left(\frac{92}{165}\right)\left(1-\frac{92}{165}\right)}{165}}$.