1. A study was conducted to investigate whether a new drug could significantly reduce pain in people with arthritis. From a group of 500 people with arthritis, 250 were randomly assigned to receive the drug (group 1) and the remaining people were assigned a placebo (group 2). After one month of treatment, 225 people in group 1 reported pain relief and 150 people in group 2 reported pain relief. Let $\hat{p}_C$ represent the combined (or pooled) sample proportion for the two samples. Have the conditions for inference for testing the difference in population proportions been met?

(A) No. The people in the study were not selected at random.

(B) No. The number of people in the study was too large compared with the size of the population.

(C) No. The normality of the sampling distribution cannot be assumed because $\hat{p}_C$ times each sample size is not sufficiently large.

(D) No. The normality of the sampling distribution cannot be assumed because $1 - \hat{p}_C$ times each sample size is not sufficiently large.

(E) Yes. All conditions for inference have been met. ✓

Answer E

Correct. The condition for independence has been met since treatments were randomly assigned to patients and the population of arthritis patients is likely large enough to assume that the number of patients in the two populations are both at least 10 times the sample sizes. Also, $\hat{p}_C = \frac{(250)\left(\frac{150}{250}\right)+(250)\left(\frac{225}{250}\right)}{250+250} = 0.75$, and for both samples, $250(0.75)$ and $250(0.25)$ are greater than or equal to 10. It can be assumed that the sampling distribution of the difference in sample proportions is approximately normal.

2. Researchers were investigating whether there is a significant difference between two medications, R and S, designed to reduce fleas found on cats. From a sample of 300 cat owners, the researchers randomly assigned 150 cat owners to use medication R on their cats and the remaining cat owners to use medication S. For the cats using medication R, 88 percent had no fleas. For the cats using medication S, 90 percent had no fleas. Which of the following is the most appropriate method for analyzing the results?

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

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

(C) A one-sample z-test for a sample proportion

(D) A one-sample z-test for a population proportion

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

Answer A

Correct. To determine whether a difference in proportions is significant, the two-sample z-test for a

difference in population proportions is the most appropriate method for the analysis.

3. The police in a certain city are investigating whether the proportion of minor traffic accidents is greater on Friday nights than on Sunday nights. As part of the investigation, they select a random sample of police calls from Friday nights and a random sample of police calls from Sunday nights. From both samples, they record the sample proportion of calls that involved minor traffic accidents. Let p_{F} represent the proportion of all Friday night calls, and let p_{S} represent the proportion of all Sunday night calls. Which of the following are the correct hypotheses for the investigation?

(A) $\text{H}_0 : p_{\text{F}} = p_{\text{S}}$
$\text{H}_{\text{a}} : p_{\text{F}} \neq p_{\text{S}}$

(B) $\text{H}_0 : p_{\text{F}} \neq p_{\text{S}}$
$\text{H}_{\text{a}} : p_{\text{F}} = p_{\text{S}}$

(C) $\text{H}_0 : p_{\text{F}} = p_{\text{S}}$
$\text{H}_{\text{a}} : p_{\text{F}} < p_{\text{S}}$

(D) $\text{H}_0 : p_{\text{F}} = p_{\text{S}}$
$\text{H}_{\text{a}} : p_{\text{F}} > p_{\text{S}}$ ✓

(E) $\text{H}_0 : p_{\text{F}} > p_{\text{S}}$
$\text{H}_{\text{a}} : p_{\text{F}} = p_{\text{S}}$

Answer D

Correct. The null hypothesis is a statement of no difference; that is, $p_{\text{F}} = p_S$. The alternative hypothesis reflects the belief that the proportion is greater on Friday nights, or $p_{\text{F}} > p_{\text{S}}$.

4. Market researchers wanted to know whether the placement of a new product on a supermarket shelf significantly increases the percent of shoppers who will buy the product. At Supermarket X, a new product was placed on the top shelf, and at Supermarket Y, the product was placed one shelf below the top shelf. To observe buying habits, the researchers selected a random sample of 364 shoppers at X and another random sample of 327 shoppers at Y. Of the selected shoppers at X, 15 bought the product, and of the selected shoppers at Y, 19 bought the product. Which of the following is the most appropriate method for analyzing the results?

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

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

(C) A one-sample z-test for a sample proportion

(D) A one-sample z-test for a population proportion

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

Answer B

Correct. To determine whether a difference in proportions is significant, a two-sample z-test for the difference in population proportions is the most appropriate method for the analysis.

5. Polydactyl cats are cats with extra toes. A researcher believes that the proportion of the population of polydactyl cats in region A is greater than the proportion in region B. Let p_{A} represent the population proportion of polydactyl cats in region A, and let p_{B} represent the population proportion of polydactyl cats in region B. Which of the following are the appropriate hypotheses to test the researchers belief?

(A) $\text{H}_0 : p_{\text{A}} - p_{\text{B}} = 0$
$\text{H}_{\text{a}} : p_{\text{A}} - p_{\text{B}} \neq 0$

(B) $\text{H}_0 : p_{\text{A}} - p_{\text{B}} = 0$
$\text{H}_{\text{a}} : p_{\text{A}} - p_{\text{B}} > 0$ ✓

(C) $\text{H}_0 : p_{\text{A}} - p_{\text{B}} = 0$
$\text{H}_{\text{a}} : p_{\text{A}} - p_{\text{B}} < 0$

(D) $\text{H}_0 : \hat{p}_{\text{A}} - \hat{p}_{\text{B}} = 0$
$\text{H}_{\text{a}} : \hat{p}_{\text{A}} - \hat{p}_{\text{B}} \neq 0$

(E) $\text{H}_0 : \hat{p}_{\text{A}} - \hat{p}_{\text{B}} = 0$
$\text{H}_{\text{a}} : \hat{p}_{\text{A}} - \hat{p}_{\text{B}} > 0$

Answer B

Correct. The null hypothesis is a statement of no difference, or that the population proportions are equal; $p_{\text{A}} = p_{\text{B}}$. The alternative hypothesis is a statement of the researcher's belief that the proportion in region A is greater than that of region B, or $p_{\text{A}} - p_{\text{B}} > 0$.

6. Two locations of a fast-food restaurant, Location Q and Location W, were in a certain town with a large number of residents. A nutritionist investigated whether the proportion of orders that contained a salad was different at the two locations. The nutritionist obtained a random sample of orders from the Location Q restaurant and a random sample of orders from the Location W restaurant. Of the 215 Location Q orders, 27 contained a salad; of the 175 Location W orders, 14 contained a salad. Let $\hat{p}_{\text{c}}$ represent the combined sample proportion, and let n_{Q} and n_{W} represent the respective sample sizes for Locations Q and W. Have the conditions for inference for testing a difference in population proportions been met?

(A) No, the condition for independence has not been met because random samples were not selected from each location.

(B) No, the condition for independence has not been met because the sample sizes are too large when compared to the corresponding population sizes.

(C) No, the condition that the sampling distribution of the difference in sample proportions is approximately normal has not been met because $n_{\text{W}}(\hat{p}_c)$ is not greater than 10.

(D) No, the condition that the sampling distribution of the difference in sample proportions is approximately normal has not been met because $n_{\text{Q}}(1-\hat{p}_c)$ is not greater than 10.

(E) Yes, all conditions for making statistical inference have been met. ✓

Answer E

Correct. Both samples are described as random, and it is reasonable to assume that the total number of orders in both populations is at least 10 times the sample size. The combined sample proportion is $\hat{p}_{\text{c}} = \frac{27+14}{215+175} \approx 0.11$. Each of $n_{\text{Q}}(\hat{p}_c)$, $n_{\text{W}}(\hat{p}_c)$, $n_{\text{Q}}(1-\hat{p}_c)$, and $n_{\text{W}}(1-\hat{p}_c)$ is greater than or equal to 10, so the sampling distribution of the difference in sample proportions is approximately normal.

7. A local school board wanted to investigate whether their approval ratings had changed during the past year. The board selected random samples of voters at both the beginning and the end of the year, and each time the voters were asked whether they approve of the school board. Let p_1 represent the proportion of voters who approved of the school board at the beginning of the year and p_2 represent the proportion of voters who approved of the school board at the end of the year. Which of the following are the correct null and alternative hypotheses for the school board's investigation?

(A) $\text{H}_0 : p_1 = p_2$, $\text{H}_{\text{a}} : p_1 \neq p_2$ ✓

(B) $\text{H}_0 : p_1 \neq p_2$, $\text{H}_{\text{a}} : p_1 = p_2$

(C) $\text{H}_0 : p_1 = p_2$, $\text{H}_{\text{a}} : p_1 < p_2$

(D) $\text{H}_0 : p_1 = p_2$, $\text{H}_{\text{a}} : p_1 > p_2$

(E) $\text{H}_0 : p_1 > p_2$, $\text{H}_{\text{a}} : p_1 = p_2$

Answer A

Correct. The null hypothesis is a statement of no difference, or that $p_1 = p_2$. The alternative hypothesis

is a statement of the board's belief that the proportion of voters who approved of the school board at the end of the year has changed, or $p_1 \neq p_2$.

8. To investigate whether there is a significant difference between two regions of a state in the percent of voters who intend to vote for the incumbent governor in the next election, a polling agency interviewed 300 randomly selected voters from the north of the state and 400 randomly selected voters from the south of the state. Of those interviewed, 200 from the north and 325 from the south indicated they intended to vote for the incumbent governor in the next election. Which of the following is the most appropriate method for analyzing the results?

(A) A one-sample z-test for a sample proportion

(B) A one-sample z-test for a population proportion

(C) A two-sample z-test for a sample proportion

(D) A two-sample z-test for a difference in sample proportions

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

Answer E

Correct. To determine if a difference in proportions is significant, the two-sample z-test for the difference in population proportions is the most appropriate method for the analysis.

9. A fitness center piloted two new programs to help people reduce stress levels and maintain a healthy lifestyle. After one month, 112 of the 125 people who volunteered for a program in mindfulness reported a reduction in stress levels, and 110 of the 135 people who volunteered for a yoga program reported a reduction in stress levels. The fitness center wants to investigate whether there is a significant difference between the proportions of all people in the two programs who would report reductions in stress levels. Have the conditions for inference been met?

(A) No, because the samples were not selected or assigned using a random method. ✓

(B) No, because the sizes of the samples are too large compared to the size of the population.

(C) No, because the normality of the sampling distribution cannot be assumed; the number of people who experienced stress relief is not large enough.

(D) No, because the normality of the sampling distribution cannot be assumed; the number of people who did not experience stress relief is not large enough.

(E) Yes, because all conditions for making statistical inference have been met.

Answer A

Correct. The people in the samples volunteered for the program and were not randomly assigned to either program. Because they volunteered for the program of their choice, there are possible confounding

variables that would prevent the fitness center from generalizing from cause (the program) to effect (reduced stress levels).