CI: 1 sample proportion

Question 1

The manager of a city recreation center wants to estimate the percent of city residents who favor a proposal to build a new dog park. To gather data, the manager will select a random sample of city residents.

Which of the following is the most appropriate interval for the manager to use for such an estimate?

- (A) A one-sample z-interval for a sample proportion
- (B) A one-sample z-interval for a population proportion
- (C) A one-sample z-interval for a difference between population proportions
- (D) A two-sample z-interval for a difference between sample proportions
- (E) A two-sample z-interval for a difference between population proportions

No sense - difference means 2 sample

Question 2

Biologists studying horseshoe crabs want to estimate the percent of crabs in a certain area that are longer than 35 centimeters. The biologists will select a random sample of crabs to measure.

Which of the following is the most appropriate method to use for such an estimate?

A. A one-sample z-interval for a population proportion

B. A one-sample z-interval for a sample proportion

C. A two-sample z-interval for a population proportion

D. A two-sample z-interval for a difference between population proportions

E. A two-sample z-interval for a difference between sample proportions

Question 3

A random sample of 500 adults living in a large county was selected and 304 adults from the sample indicated that the unemployment rate was of great concern. What is the standard error of the sample proportion $\hat{p}$?

A. $\sqrt{\frac{(0.61)(0.39)}{500}}$

B. $\sqrt{\frac{(0.61)(0.39)}{304}}$

C. $\sqrt{\frac{(304)(196)}{500}}$

D. $\frac{(0.304)(0.196)}{\sqrt{500}}$

E. $\frac{(0.61)(0.39)}{\sqrt{500}}$

$$P = \frac{304}{500} = 0.608 \simeq 0.61$$

$$\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{(0.61)(0.39)}{500}}$$

Question 4

Alma is estimating the proportion of students in her school district who, in the past month, read at least 1 book. From a random sample of 50 students, she found that 32 students read at least 1 book last month. Assuming all conditions for inference are met, which of the following defines a 90 percent confidence interval for the proportion of all students in her district who read at least 1 book last month?

A $32 \pm 1.645\sqrt{\frac{(32)(18)}{50}}$

B $32 \pm 1.96\sqrt{\frac{(32)(18)}{50}}$

C $0.64 \pm 1.282\sqrt{\frac{(0.64)(0.36)}{50}}$

D $0.64 \pm 1.645\sqrt{\frac{(0.64)(0.36)}{50}}$

E $0.64 \pm 1.96\sqrt{\frac{(0.64)(0.36)}{50}}$

$\hat{p} = \frac{32}{50} = 0.64$

$90\% \Rightarrow z_c = 1.645$

Question 5

A town council wants to estimate the proportion of residents who are in favor of a proposal to upgrade the computers in the town library. A random sample of 100 residents was selected, and 97 of those selected indicated that they were in favor of the proposal. Is it appropriate to assume that the sampling distribution of the sample proportion is approximately normal?

- No, because the sample is not large enough to satisfy the normality conditions.
- **B** No, because the size of the population is not known.
- **C** Yes, because the sample was selected at random.
- **D** Yes, because sampling distributions of proportions are modeled with a normal model.
- **E** Yes, because the sample is large enough to satisfy the normality conditions.

$\hat{p} = \frac{97}{100}$

- Sample size ✓

$n\hat{p} = 100\left(\frac{97}{100}\right) = 97 > 10$

$n(1-\hat{p}) = 100\left(\frac{3}{100}\right) = 3 > 10$

- Random ✓

$\hat{p} = \frac{82}{100}$

Question 6

A marketing representative wants to estimate the proportion of people in a state who like the new design on the packaging of a certain cleaning product. The representative interviewed 100 people at a certain supermarket, and 82 people indicated that they liked the new design. Have the conditions for creating a confidence interval for the population proportion been met?

- (A) Yes, because the sample was selected at random.
- (B) Yes, because sampling distributions of population proportions are modeled with a normal model.
- (C) Yes, because the sample is large enough to satisfy the normality conditions.
- (D) No, because the sample is not large enough to satisfy the normality conditions.
- (E) No, because the sample may not be representative of all people in the state.

- Sample size

$n\hat{p} = 82 > 10$

$n(1-\hat{p}) = 18 > 10$ ✓

- Random X

Same z here

$P_S = \frac{81}{2400}$ $P_J = \frac{64}{x}$

Question 7

Sue and Javier are working on a statistics project to estimate the proportion of students at their school who have a pet dog. Sue selects a random sample of 81 students from the 2,400 students at their school, and Javier selects a separate random sample of 64 students. They will both construct a 90 percent confidence interval from their estimates. Consider the situation in which the sample proportion from Sue's sample is equal to the sample proportion from Javier's sample. Which of the following statements correctly describes their intervals?

Sue Javier

$\frac{81}{2400} = \frac{64}{x}$ since told the same

$\Rightarrow x = 1896$

- (A) Javier's interval will have a greater degree of confidence than Sue's interval will.
- (B) Sue's interval will have a greater degree of confidence than Javier's interval will.
- (C) The width of Sue's interval will be the same as the width of Javier's interval.
- (D) The width of Sue's interval will be wider than the width of Javier's interval.
- (E) The width of Sue's interval will be narrower than the width of Javier's interval.

Note: Sample size & confidence % affects interval width for proportion

$1896 < 2400$ so Javier so smaller sample size $\Rightarrow$ larger interval width

Question 8

Suppose a 90 percent confidence interval to estimate a population proportion was calculated from a sample proportion of 18 percent and a margin of error of 4 percent. What is the width of the confidence interval?

- (A) 2 percent
- (B) 4 percent
- (C) 8 percent
- (D) 16 percent
- (E) 36 percent

0.18 ± 0.04

$= (.14, .22)$

OR

$2(0.04) = 0.08$

Question 9

Suppose a researcher wants to use a confidence interval to estimate an unknown population proportion p. Which of the following is <u>not</u> a correct statement?

(A) The endpoints of the interval can vary with each new sample.

(B) The probability that p is in the interval is equal to the level of confidence for the interval. not a probability

(C) Whether the interval captures p is not known with certainty.

(D) The population proportion p is fixed, but the sample proportion $\hat{p}$ can vary from sample to sample.

(E) The interval either does or does not capture p.

0% or 100%

Question 10

A random sample of 83 residents of a certain town were asked whether they approve of a proposal to improve the town's aging bridges. The 95 percent confidence interval to estimate the proportion of all residents of the town w
approve of the proposal was calculated to be $(0.361, 0.579)$.

Which of the following is a correct interpretation of the interval?

A. There is a 0.95 probability that the proportion of all residents in the town who favor the proposal will be between 0.361 and 0.579.

B. The probability that 95 percent of the residents in the town will favor the proposal is between 0.361 and 0.579.

C. We are 95 percent confident that any sample of 83 residents will produce a sample proportion between 0.361 and 0.579.

D. We are 95 percent confident that the proportion of all residents in the sample who favor the proposal is between 0.361 and 0.579.

E. We are 95 percent confident that the proportion of all residents in the town who favor the proposal is between 0.361 and 0.579.

Question 11

A recent national survey indicated that 73 percent of respondents try to include locally grown foods in their diets. A 95 percent confidence interval for the proportion of all people in the country who try to include locally grown foods in their diets is given as $(0.70, 0.76)$.

Assume all conditions for inference were met. Based on the confidence interval, which of the following claims is supported?

A. Less than half of all people in the country try to include locally grown foods in their diets.

B. Less than 70 percent of all people in the country try to include locally grown foods in their diets.

C. Less than 75 percent of all people in the country try to include locally grown foods in their diets.

D. Less than 80 percent of all people in the country try to include locally grown foods in their diets.

E. At least 95 percent of all people in the country try to include locally grown foods in their diets.

Question 12

A recent survey of cell phone users indicated that 56 percent of the respondents prefer to use cell phones for texting rather than for making phone calls. A 95 percent confidence interval for the estimate of all cell phone users who prefer to use cell phones for texting has a margin of error of 3 percent.

Assume all conditions for inference have been met. Based on the confidence interval, which of the following claims is supported?

(A) Less than half of all people prefer texting.

(B) More than half of all people prefer texting.

$.56 \pm 0.03 = (0.53, 0.59)$

(C) At least 60 percent of all people prefer texting.

(D) At least 75 percent of all people prefer texting.

(E) At least 95 percent of all people prefer texting.

hypothesis testing - 1 sample

Question 1

A study reports that 75 percent of young adults in a county get their news from online sources. A sociologist believes that the percentage is actually greater than 75 percent. The sociologist will select a random sample of young adults from around the county to interview. Which of the following is the most appropriate method for investigating the sociologist's belief?

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

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

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

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

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

$H_a: p > 0.75$

1 sample
population

Ask yourself:
1 or 2 sample?

1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 — 11 — 12 — 13 — 14 — 15

Question 2

A study reported that 28 percent of middle school students in a certain state participate in community service activities. A teacher believes that the rate is greater than 28 percent for the middle school students in the teacher's district. The teacher selected a random sample of middle school students from the district, and the percent of students in the sample who participated in community service activities was found to be 32 percent. Which of the following is the most appropriate method for investigating the teacher's belief?

(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 population proportions

$H_0: p = 0.28$

$H_1: p > 0.28$

1 sample

population

1 — 2 — 3 — 4 — 5 — 6 — 7 — 8 — 9 — 10 — 11 — 12 — 13 — 14 — 15

Question 3

A workers' representative for a large factory believes that more than half the workers at the factory want the opportunity to work more overtime hours. Which of the following are the appropriate hypotheses to test the representative's belief?

$>$

Use population values in hypothesis

A $H_0: \hat{p} = 0.5$
$H_a: \hat{p} \neq 0.5$

B $H_0: \hat{p} = 0.5$
$H_a: \hat{p} > 0.5$

C $H_0: \hat{p} = 0.5$
$H_a: \hat{p} < 0.5$

D $H_0: p = 0.5$
$H_a: p < 0.5$

E $H_0: p = 0.5$
$H_a: p > 0.5$

Question 4

A manufacturer of cell phone screens is concerned because 12 percent of the screens manufactured using a previous process were rejected at the final inspection and could not be sold. A new process is introduced that is intended to reduce the proportion of rejected screens. After the process has been in place for several months a random sample of 100 screens is selected and inspected. Of the 100 screens 6 are rejected. What are the appropriate hypotheses to investigate whether the new process reduces the population proportion of screens that will be rejected?

$<$

$\hat{p} = 0.06$

- A. $H_0: p = 0.12$
  $H_a: p < 0.12$
- B. $H_0: p = 0.12$
  $H_a: p > 0.12$
- C. $H_0: p = 0.06$
  $H_a: p < 0.06$
- D. $H_0: \hat{p} = 0.06$
  $H_a: \hat{p} > 0.06$
- E. $H_0: \hat{p} = 0.12$
  $H_a: \hat{p} < 0.12$

$H_0: p = 0.12$

$H_a: p < 0.12$

Question 5

A one-sample z-test for a population proportion p will be conducted. Which of the following conditions checks that the sampling distribution of the sample proportion is approximately normal?

I. The sample is selected at random.
II. $np_0 \geq 10$ and $n(1 - p_0) \geq 10$ for sample size n.
III. The sample size is less than or equal to 10 percent of the population size.

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I, II, and III

- $n\hat{p} \geq 10$
  $n(1-\hat{p}) \geq 10$

doesn't say normal, says independent

- population size $\geq$ 10(sample size)

sample size $\leq \frac{\text{population size}}{10}$

sample size $\leq$ 10%(pop size)

Question 6

A newspaper article claims that 92 percent of teens use social media. To investigate the claim, a polling organization selected a random sample of 100 teens, and 96 teens in the sample indicated that they use social media. Given the data, why is it not appropriate to use a one-sample z-test for a proportion to test the newspaper's claim?

(A) The random sample condition is not met.

$\hat{p} = \frac{96}{100}$

(B) The sample is more than 10% of the population.

(C) The observed number of teens in the sample who do not use social media is less than 10.

(D) The expected number of teens in the sample who do not use social media is less than 10.

(np)

(E) The distribution of the population is not approximately normal.

- size

$n\hat{p} = 96 > 10$ ✓

$n(1-\hat{p}) = 4 < 10$ ✗

- Random ✓

Question 7

A state biologist is investigating whether the proportion of frogs in a certain area that are bullfrogs has increased in the past ten years. The proportion ten years ago was estimated to be 0.20. From a recent random sample of 150 frogs in the area, 36 are bullfrogs. The biologist will conduct a test of $\mathrm{H_0}: p = 0.20$ versus $\mathrm{H_a}: p > 0.20$. Which of the following is the test statistic for the appropriate test?

(A) $z = \frac{0.20-0.24}{\sqrt{\frac{(0.24)(0.76)}{150}}}$

(B) $z = \frac{0.20-0.24}{\sqrt{\frac{(0.20)(0.80)}{150}}}$

(C) $z = \frac{0.24-0.20}{\sqrt{\frac{(0.24)(0.76)}{150}}}$

(D) $z = \frac{0.24-0.20}{\sqrt{\frac{(0.20)(0.80)}{150}}}$

(E) $z = \sqrt{\frac{0.24-0.20}{\frac{(0.20)(0.80)}{150}}}$

$$TS = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}}$$

$$\hat{p} = \frac{36}{150} = 0.24$$

$$= \frac{0.24 - 0.2}{\sqrt{\frac{0.20(0.80)}{150}}}$$

$H_0: p = 0.2$

$H_a: p > 0.2$

$TS = 2.25$

Question 8

A hypothesis test was conducted to investigate whether the population proportion of students at a certain college who went to the movie theater last weekend is greater than 0.2. A random sample of 100 students at this college resulted in a test statistic of 2.25. Assuming all conditions for inference were met, which of the following is closest to the p-value of the test?

(A) 0.0061

(B) 0.0122

$P(z > 2.25) = p$ value

(C) 0.0244

(D) 0.9756

(E) 0.9878

Question 9

In the United States, 36 percent of the people have a blood type that is A positive. From a random sample of 150 people from Norway, 66 had a blood type that was A positive. Consider a hypothesis test to investigate whether the proportion of people in Norway with a blood type of A positive is different from that in the United States. Which of the following is the standard deviation used to calculate the test statistic for the one-sample z-test?

A $\sqrt{\frac{(0.24)(0.76)}{150}}$

B $\sqrt{\frac{(0.44)(0.56)}{150}}$

C $\sqrt{\frac{(0.36)(0.64)}{150}}$

D $\frac{(0.44)(0.56)}{\sqrt{150}}$

E $\frac{(0.36)(0.64)}{\sqrt{150}}$

$H_0: p = 0.36$

$H_1: p \neq 0.36$

$\hat{p} = \frac{66}{150} = 0.44$

$S.D = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{0.36(0.64)}{150}}$

Question 10

Molly works for a meat producer, and she needs to determine whether containers of ground beef have the correct fat content. She obtains a random sample of 120 containers of ground beef and finds that 84 percent have the correct fat content. Molly then conducts a hypothesis test of $H_0: p = 0.80$ versus $H_a: p \neq 0.80$ and calculates a test statistic of 1.10 with a p-value of 0.273. Which of the following best represents the meaning of the p-value?

$p = 0.80$

$p \neq 0.80$

(A) If the population proportion is 0.84, the probability of observing a sample proportion of 0.80 is 0.273.

$\hat{p} = 0.84$

(B) If the population proportion is 0.84, the probability of observing a sample proportion of at least 0.04 less than 0.84 is 0.273. ✗

$\hat{p} = 0.84$

(C) If the population proportion is 0.80, the probability of observing a sample proportion within 0.04 of 0.80 is 0.273.

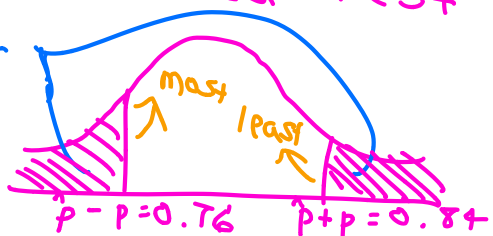
(D) If the population proportion is 0.80, the probability of observing a sample proportion at least 0.04 greater than 0.80 is 0.273.

TS = 1.10

(E) If the population proportion is 0.80, the probability of observing a sample proportion of at least 0.84 or at most 0.76 is 0.273.

2 tailed test

together make 0.273



$\hat{p} - p = 0.04$

$0.80 + 0.04 = 0.84$

$0.80 - 0.04 = 0.76$

Question 11

Chicken hatcheries employ workers to determine the sex of the baby chicks. The hatcheries claim that the workers are correct 95 percent of the time. An investigator believes the workers' success rate (workers are correct) is actually less than 95 percent of the time. The investigator selects a random sample of chicks and finds that the hatchery workers had a success rate of 0.936. The conditions for inference were checked and verified, and the p-value of the test was given as 0.0322. 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, 3.22% will result in a success rate of 93.6% or less.

B. Of all possible samples of the same size, 3.22% will result in a success rate of 93.6% or more.

C. Of all possible samples of the same size, 3.22% will result in a success rate of 95% or less.

D. Of all possible samples of the same size, 3.22% will result in a success rate of 95% or more.

E. Of all possible samples of the same size, 3.22% will result in a success rate of less than 93.6% or more than 96.4%.

$\hat{p} = 0.936$

$\hat{p} - p = 0.936$

p value = 0.0322

$H_0: p = 0.95$

$H_1: p < 0.95$

$p - \hat{p} = 0.95 - 0.014 = 0.936$ (at most)

Question 12

In a hypothesis test for a single proportion, which of the following is assumed for the calculation of the p-value?

A. The alternative hypothesis is true.

B. The null hypothesis is true.

C. The distribution of the population is approximately normal.

D. The sample proportion is equal to the hypothesized proportion.

E. The sample size is 30 or more.

Question 13

A major credit card company is interested in the proportion of individuals who use a competitor's credit card. Their null hypothesis is $H_0: p = 0.65$, and based on a sample they find a sample proportion of 0.70 and a p-value of 0.053. Is there convincing statistical evidence at the 0.05 level of significance that the true proportion of individuals who use the competitor's card is actually greater than 0.65 ?

A Yes, because the sample proportion 0.70 is greater than the hypothesized proportion 0.65.

B Yes, because the p-value 0.053 is greater than the significance level 0.05.

C No, because the sample proportion 0.70 is greater than the hypothesized proportion 0.65.

D No, since the sample proportion 0.70 is exactly 0.05 away from the hypothesized proportion 0.65.

E No, because the p-value 0.053 is greater than the significance level 0.05.

$H_0: p = 0.65$

$H_1: p > 0.65$

$0.053 > 0.05$

Can't reject H_0

Question 14

A book club wonders if fewer than 40 percent of students at a local university had read at least one book during the last year. To test the claim, the book club selected a random sample of students at the local university and recorded the number of students who had read at least one book during the last year. The club conducted a test with the hypotheses $H_0: p = 0.40$ versus $H_a: p < 0.40$. The test yielded a p-value of 0.033. Assuming all conditions for inference were met, which of the following is an appropriate conclusion?

A. At the significance level $\alpha = 0.01$, the null hypothesis is rejected. There is convincing evidence to support the claim that fewer than 40% of the students at the local university read at least one book last year.

B. At the significance level $\alpha = 0.01$, the null hypothesis is rejected. There is not convincing evidence to support the claim that fewer than 40% of the students at the local university read at least one book last year.

C. At the significance level $\alpha = 0.01$, the null hypothesis is not rejected. There is convincing evidence to support the claim that fewer than 40% of the students at the local university read at least one book last year.

D. At the significance level $\alpha = 0.05$, the null hypothesis is rejected. There is convincing evidence to support the claim that fewer than 40% of the students at the local university read at least one book last year.

E. At the significance level $\alpha = 0.05$, the null hypothesis is rejected. There is not convincing evidence to support the claim that fewer than 40% of the students at the local university read at least one book last year.

$0.033 < 0.05$ reject H_0

Question 15

Is the significance level of a hypothesis test equivalent to the probability that the null hypothesis is true?

- A. No, the significance level is the probability of rejecting the null hypothesis when the null hypothesis is actually true. (α = type I error prob)
- B. No, the significance level is the probability of rejecting the null hypothesis when the null hypothesis is actually false.
- C. No, the significance level is the probability of failing to reject the null hypothesis when the null hypothesis is actually true.
- D. No, the significance level is the probability that the null hypothesis is actually false.
- E. Yes, the significance level is the probability that the null hypothesis is actually true.

Errors

Question 1

Machines at a factory produce circular washers with a specified diameter. The quality control manager at the factory periodically tests a random sample of washers to be sure that greater than 90 percent of the washers are produced with the specified diameter. The null hypothesis of the test is that the proportion of all washers produced with the specified diameter is equal to 90 percent. The alternative hypothesis is that the proportion of all washers produced with the specified diameter is greater than 90 percent.

Which of the following describes a Type I error that could result from the test?

A The test does not provide convincing evidence that the proportion is greater than 90%, but the actual proportion is greater than 90%.

B The test does not provide convincing evidence that the proportion is greater than 90%, but the actual proportion is equal to 90%.

C The test provides convincing evidence that the proportion is greater than 90%, but the actual proportion is equal to 90%.

D The test provides convincing evidence that the proportion is greater than 90%, but the actual proportion is greater than 90%.

E A Type I error is not possible for this hypothesis test.

Question 2

At a manufacturing company, the percent of defective items produced on the assembly line is 2%. The company is testing a new assembly line designed to reduce the percent of defective parts. The null and alternative hypotheses of the test are described as follows.

$$\mathrm{H_0}: \text{The percent of defective parts is at least } 2\%.$$
$$\mathrm{H_a}: \text{The percent of defective parts is less than } 2\%.$$

Which of the following describes a Type II error that could result from the test?

A. The test does not provide convincing evidence that the percent is less than 2%, but the actual percent is 3%.

B. The test does not provide convincing evidence that the percent is less than 2%, but the actual percent is 2%.

C. The test does not provide convincing evidence that the percent is less than 2%, but the actual percent is 1%.

D. The test provides convincing evidence that the percent is less than 2%, but the actual percent is 2%.

E. The test provides convincing evidence that the percent is less than 2%, but the actual percent is 1%.

Question 3

Which of the following is defined by the significance level of a hypothesis test?

(A) The standard error

(B) The power of the test

(C) The probability of Type II error

(D) The probability of Type I error

(E) The p-value

Question 4

Consider a hypothesis test in which the significance level is $\alpha = 0.05$ and the probability of a Type II error is 0.18. What is the power of the test?

A 0.95

B 0.82

C 0.18

D 0.13

E 0.05

Power $= 1 - 0.18 = 0.82$

Question 5

If all other factors are held constant, which of the following results in an increase in the probability of a Type II error?

(A) The true parameter is farther from the value of the null hypothesis.

(B) The sample size is increased.

(C) The significance level is decreased.

(D) The standard error is decreased.

(E) The probability of a Type II error cannot be increased, only decreased.

Question 6

If all other factors are held constant, which of the following results in a decrease in the probability of a Type II error?

A The true parameter is closer to the value of the null hypothesis.

B The sample size is decreased.

C The significance level is decreased.

D The standard error is decreased.

E The probability of a Type II error cannot be decreased, only increased.

Question 7

A new drug to treat a certain condition is being tested. The null hypothesis of the test is that the drug is not effective. For the researchers, the more consequential error would be for the drug to be effective, but the test does not detect the effect.

Which of the following should the researchers do to avoid the more consequential error?

(A) Increase the significance level to increase the probability of Type I error.

(B) Increase the significance level to decrease the probability of Type I error.

(C) Decrease the significance level to increase the probability of Type I error.

(D) Decrease the significance level to decrease the probability of Type I error.

(E) Decrease the significance level to decrease the standard error.

Question 8

Researchers are testing a new diagnostic tool designed to identify a certain condition. The null hypothesis of the significance test is that the diagnostic tool is not effective in detecting the condition. For the researchers, the more consequential error would be that the diagnostic tool is not effective, but the significance test indicated that it is effective.

Which of the following should the researchers do to avoid the more consequential error?

(A) Increase the significance level to increase the probability of Type I error.

(B) Increase the significance level to decrease the probability of Type I error.

(C) Decrease the significance level to increase the probability of Type I error.

(D) Decrease the significance level to decrease the probability of Type I error.

(E) Decrease the significance level to decrease the standard error.

Question 9

At a research facility that designs rocket engines, researchers know that some engines fail to ignite as a result of fuel system error. From a random sample of 40 engines of one design, 14 failed to ignite as a result of fuel system error. From a random sample of 30 engines of a second design, 9 failed to ignite as a result of fuel system error. The researchers want to estimate the difference in the proportion of engine failures for the two designs. Which of the following is the most appropriate method to create the estimate?

A. A one-sample z-interval for a sample proportion

B. A one-sample z-interval for a population proportion

C. A two-sample z-interval for a population proportion

D. A two-sample z-interval for a difference in sample proportions

E. A two-sample z-interval for a difference in population proportions

Question 10

Which of the following indicates that the use of a two-sample z-interval for a difference in population proportions is appropriate?

I. Two populations of interest exist.
II. The variable of interest is categorical.
III. The intent is to estimate a difference in sample proportions.

(A) I only

(B) II only

(C) III only

(D) I and II only

(E) I, II, and III

Question 11

A random sample of 100 people from Country S had 15 people with blue eyes. A separate random sample of 100 people from Country B had 25 people with blue eyes. Assuming all conditions are met, which of the following is a 95 percent confidence interval to estimate the difference in population proportions of people with blue eyes (Country S minus Country B) ?

A $(-0.01, 0.21)$

B $(-0.15, -0.05)$

C $(-0.19, -0.01)$

D $(-0.21, 0.01)$

E $(-0.24, 0.04)$

Question 12

A random sample of 240 adults over the age of 40 found that 144 would use an online dating service. Another random sample of 234 adults age 40 and under showed that 131 would use an online dating service. Assuming all conditions are met, which of the following is the standard error for a 90 percent confidence interval to estimate the difference between the population proportions of adults within each age group who would use an online dating service?

$\sqrt{\frac{\frac{144}{240}\left(1-\frac{144}{240}\right)}{240}+\frac{\frac{131}{234}\left(1-\frac{131}{234}\right)}{234}}$

B $1.65\sqrt{\frac{\frac{144}{240}\left(1-\frac{144}{240}\right)}{240}+\frac{\frac{131}{234}\left(1-\frac{131}{234}\right)}{234}}$

C $1.96\sqrt{\frac{\frac{144}{240}\left(1-\frac{144}{240}\right)}{240}+\frac{\frac{131}{234}\left(1-\frac{131}{234}\right)}{234}}$

D $\sqrt{\frac{\frac{275}{474}\left(1-\frac{275}{474}\right)}{474}}$

E $1.65\sqrt{\frac{\frac{275}{474}\left(1-\frac{275}{474}\right)}{474}}$

Question 13

A wildlife biologist is doing research on chronic wasting disease and its impact on the deer populations in northern Colorado. To estimate the difference between the proportions of deer with chronic wasting disease in two different regions, a random sample of 200 deer was obtained from one region and a random sample of 197 deer was obtained from the other region. The biologist checked for the following.

$$(200)(0.06) \geq 10$$
$$(200)(0.94) \geq 10$$
$$(197)(0.086) \geq 10$$
$$(197)(0.914) \geq 10$$

Which of the following conditions for inference was the biologist checking?

(A) The population of deer within each region is approximately normal.

(B) It is reasonable to generalize from the samples to the populations.

(C) The samples are independent of each other.

(D) The observations within each sample are close to independent.

(E) The sampling distribution of the difference in sample proportions is approximately normal.

Question 14

A recent increase in sales of microchips has forced a computer company to buy a new processing machine to help keep up with demand. The builders of the new machine claim that it produces fewer defective microchips than the older machine. From a random sample of 90 microchips produced on the old machine, 5 were found to be defective. From a random sample of 83 microchips produced on the new machine, 3 were found to be defective. The quality control manager wants to construct a confidence interval to estimate the difference between the proportion of defective microchips from the older machine and the proportion of defective microchips from the new machine.

Why is it not appropriate to calculate a two-sample z-interval for a difference in proportions?

(A) The microchips were not randomly assigned to a machine.

(B) There is no guarantee that microchips are approximately normally distributed.

(C) The normality of the sampling distribution of the difference in sample proportions cannot be established.

(D) Both sample proportions are less than 0.10.

(E) The sample sizes are not the same.

Question 1

In a large study designed to compare the risk of cardiovascular disease (CVD) between smokers and nonsmokers, random samples from each group were selected. The sample proportion of people with CVD was calculated for each group, and a 95 percent confidence interval for the difference (smoker minus nonsmoker) was given as $(-0.01, 0.04)$. Which of the following is the best interpretation of the interval?

A. We are 95% confident that the difference in proportions for smokers and nonsmokers with CVD in the sample is between -0.01 and 0.04.

B. We are 95% confident that the difference in proportions for smokers and nonsmokers with CVD in the population is between -0.01 and 0.04.

C. We are 95% confident that the proportion of all smokers with CVD is greater than the proportion of all nonsmokers with CVD because the interval contains more positive values.

D. The probability is 0.95 that for all random samples of the same size, the difference in the sample proportions for smokers and nonsmokers with CVD will be between -0.01 and 0.04.

E. The probability is 0.95 that there is no difference in the proportions of smokers and nonsmokers with CVD because 0 is included in the interval -0.01 and 0.04.

Question 2

A research group studying cell phone habits asked the question “Do you ever use your cell phone to make a payment at a convenience store?” to people selected from two random samples of cell phone users. One sample consisted of older adults, ages 35 years and older, and the other sample consisted of younger adults, ages 18 years to 34 years. The proportion of people who answered yes in each sample was used to create a 95 percent confidence interval of $(0.097, 0.125)$ to estimate the difference (younger minus older) between the population proportions of people who would answer yes to the question. Which of the following is the best description of what is meant by 95 percent confidence?

(A) In repeated random sampling with the same sample size, approximately 95% of the sample proportions from the younger group will be between 0.097 and 0.125 greater than the sample proportion from the older group.

(B) In repeated random sampling with the same sample size, approximately 95% of the intervals constructed from the samples will capture the difference in sample proportions of people who would answer yes to the question.

(C) In repeated random sampling with the same sample size, approximately 95% of the intervals constructed from the samples will capture the difference in population proportions of people who would answer yes to the question.

(D) The probability is 0.95 that the difference in the sample proportions of people who would answer yes to the question is between 0.097 and 0.125.

(E) The probability is 0.95 that the difference in the population proportions of people who would answer yes to the question is between 0.097 and 0.125.

Question 3

Consider a 90 percent confidence interval constructed to estimate the difference between two population proportions. Which of the following is the best interpretation of what is meant by 90 percent confidence?

A The probability that the true difference in population proportions falls within the bounds of the confidence interval is 0.90.

B For repeated random sampling from the populations with samples of the same size, approximately 90% of the sample proportions will fall within the bounds of the confidence interval.

C If the sampling process is repeated 10 times, 9 intervals will capture the true difference between the population proportions and 1 interval will not.

For repeated random sampling from the populations with samples of the same size, approximately 90% of the confidence intervals constructed will capture the true difference between the population proportions.

E For repeated random sampling from the populations with samples of the same size, approximately 90% of the confidence intervals constructed will capture the sample difference between the population proportions.

Question 4

Surveys were sent to a random sample of owners of all-wheel-drive (AWD) vehicles and to a random sample of owners of front-wheel-drive (FWD) vehicles. The proportion of owners who were satisfied with their vehicles was recorded for each sample. The sample proportions were used to construct the 95 percent confidence interval for a difference in population proportions $(\mathrm{FWD}$ minus $\mathrm{AWD})$ for satisfied owners. The interval is given as $(-0.01, 0.12)$.

A car company believes that the proportion of satisfied owners of AWD vehicles differs from the proportion of satisfied owners of FWD vehicles. Does the confidence interval provide evidence that this belief is plausible?

No. The interval contains 0.

B No. Most of the values in the interval are not close to 0.

C No. The value of 0 is not in the middle of the interval.

D Yes. The interval does contain 0.

E Yes. There are more positive values in the interval than negative values.

Question 5

A large company offered gym memberships to its employees as part of a program to keep employees healthy. A random sample of employees with a gym membership and a random sample of employees without a gym membership were taken, and the proportion of employees who had taken at least one sick day in the past month was recorded for each sample. A 90 percent confidence interval for the difference in population proportions (membership minus no membership) was found to be $(-0.13, 0.05)$.

Employees believe that there is no difference in absenteeism between those with a gym membership and those without a gym membership. Does the confidence interval provide evidence that this belief is plausible?

(A) No. It is likely that employees with a gym membership are absent less often than employees without a gym membership, because $-0.13 < 0.05$.

(B) No. It is likely that employees with a gym membership are absent more often than employees without a gym membership, because the absolute value of -0.13 is greater then 0.05.

(C) No. The range of negative values is greater than the range of positive values in the interval, which indicates that employees with a gym membership tend to be absent less often than employees without a gym membership.

(D) Yes. The length of the interval is 0.18, which indicates a low probability of a difference.

(E) Yes. The value of 0 is contained in the interval, which indicates that no difference is plausible.

Question 6

A 90 percent confidence interval for the proportion difference $p_1 - p_2$ was calculated to be $(0.247, 0.325)$.

Which of the following conclusions is supported by the interval?

A. There is evidence to conclude that $p_1 > p_2$ because 0.325 is greater than 0.247.

B. There is evidence to conclude that $p_1 < p_2$ because 0.325 is greater than 0.247.

C. There is evidence to conclude that $p_1 > p_2$ because all values in the interval are positive.

D. There is evidence to conclude that $p_1 < p_2$ because all values in the interval are positive.

E. There is evidence to conclude that $p_2 > p_1$ because 0.247 and 0.325 are both greater than 0.05.

Question 7

A yearbook company was investigating whether there is a significant difference between two states in the percents of high school students who order yearbooks. From a random sample of 150 students selected from one state, 70 had ordered a yearbook. From a random sample of 100 students selected from the other state, 65 had ordered a yearbook. 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 difference in sample proportions

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

(E) A two-sample z-test for a population proportion

Question 8

A behavioral scientist investigated whether there is a significant difference in the percentages of men and women who purchase silver-colored cars. The scientist selected a random sample of 50 men and a random sample of 52 women who had recently purchased a new car. Of the men selected, 16 had purchased a silver-colored car. Of the women selected, 9 had purchased a silver-colored car. Which of the following is the most appropriate method for analyzing the results?

A two-sample z-test for the difference in population proportions

(B) A two-sample z-test for the 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

Question 9

A farmer wants to investigate whether a new pesticide will decrease the proportion of pumpkin plants that are being eaten by bugs in the farmer's pumpkin patches compared to the current pesticide being used. The farmer applied the old pesticide to patch A and the new pesticide to patch B. Let p_A represent the proportion of pumpkin plants eaten by bugs in patch A and p_B represent the proportion of pumpkin plants eaten by bugs in patch B. Assume all conditions for inference were met. Which of the following are the correct null and alternative hypotheses to test whether the new pesticide results in fewer pumpkin plants eaten by bugs?

A
$H_0: p_A > p_B$
$H_a: p_A = p_B$

$H_0: p_A = p_B$
$H_a: p_A > p_B$

C
$H_0: p_A = p_B$
$H_a: p_A \neq p_B$

D
$H_0: \hat{p}_A = \hat{p}_B$
$H_a: \hat{p}_A \neq \hat{p}_B$

E
$H_0: \hat{p}_A = \hat{p}_B$
$H_a: \hat{p}_A > \hat{p}_B$

Students at Hereford High School want to investigate whether they have more school spirit than students at Blake High School. To test this hypothesis, the students will select a random sample of students from each school and determine the proportion of the sampled students who wear school colors to their respective pep rallies. Let p_H represent the proportion of Hereford students who wear school colors to their pep rally and p_B represent the proportion of Blake students who wear school colors to their pep rally. Which of the following are the correct null and alternative hypotheses for the investigation?

A. $H_0: p_H - p_B = 0$
$H_a: p_H - p_B \neq 0$

B. $H_0: p_H - p_B = 0$
$H_a: p_H - p_B > 0$

C. $H_0: p_H - p_B = 0$
$H_a: p_H - p_B < 0$

D. $H_0: p_H - p_B > 0$
$H_a: p_H - p_B = 0$

E. $H_0: p_H - p_B < 0$
$H_a: p_H - p_B = 0$

Question 11

A potato chip company produces a large number of potato chip bags each day and wants to investigate whether a new packaging machine will lower the proportion of bags that are damaged. The company selected a random sample of 150 bags from the old machine and found that 15 percent of the bags were damaged, then selected a random sample of 200 bags from the new machine and found that 8 percent were damaged. Let $\hat{p}_O$ represent the sample proportion of bags packaged on the old machine that are damaged, $\hat{p}_N$ represent the sample proportion of bags packaged on the new machine that are damaged, $\hat{p}_C$ represent the combined proportion of damaged bags from both machines, and n_O and n_N represent the respective sample sizes for the old machine and new machine. Have the conditions for statistical 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.

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 distribution of $\hat{p}_O - \hat{p}_N$ is approximately normal has not been met, because $n_N(\hat{p}_C)$ is not greater than or equal to 10.

D. No, the condition that the distribution of $\hat{p}_O - \hat{p}_N$ is approximately normal has not been met, because $n_O(1 - \hat{p}_C)$ is not greater than or equal to 10.

E. All conditions for making statistical inference have been met.

Question 12

Two schools are investigating whether there is a difference in the proportion of students who attend the homecoming football game. Both schools have over 2,000 students. School A selected a simple random sample of 100 students and found that 98 attended the homecoming football game. School B selected a simple random sample of 150 students and found that 142 attended the homecoming football game. Let $\hat{p}_{\mathrm{c}}$ represent the combined sample proportion for the two schools, and let n_{A} and n_{B} represent the respective sample sizes. Have the conditions for statistical 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 both schools.

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 distribution of the difference in sample proportions is approximately normal has not been met, because $n_{\mathrm{A}}(\hat{p}_{\mathrm{c}})$ is not greater than or equal to 5.

D. No, the condition that the distribution of the difference in sample proportions is approximately normal has not been met, because $n_{\mathrm{A}}(1-\hat{p}_{\mathrm{c}})$ is not greater than or equal to 5.

E. All conditions for making statistical inference have been met.

Question 13

Researchers studying starfish collected two independent random samples of 40 starfish. One sample came from an ocean area in the north, and the other sample came from an ocean area in the south. Of the 40 starfish from the north, 6 were found to be over 8 inches in length. Of the 40 starfish from the south, 11 were found to be over 8 inches in length.

Which of the following is the test statistic for the appropriate test to investigate whether there is a difference in proportion of starfish over 8 inches in length in the two ocean areas (north minus south) ?

A $\frac{6-11}{\sqrt{\frac{6}{40}+\frac{11}{40}}}$

B $\frac{6-11}{\sqrt{\frac{0.15}{40}+\frac{0.275}{40}}}$

C $\frac{0.15-0.275}{\sqrt{(0.15)(0.275)\left(\frac{1}{40}+\frac{1}{40}\right)}}$

D $\frac{0.15-0.275}{\sqrt{(0.2125)(0.7875)\left(\frac{1}{40}+\frac{1}{40}\right)}}$

E $\frac{0.15-0.275}{(0.2125)(0.7875)\sqrt{\frac{1}{40}+\frac{1}{40}}}$

Question 14

A week before a state election, a random sample of voters from City J and a random sample of voters from City K were taken. Of the 100 voters selected from City J, 65 indicated they were supporting a certain candidate for state senate. Of the 125 voters selected from City K, 75 indicated they were supporting the candidate.

Which of the following is the correct test statistic for a two-sample z-test for a difference in population proportions for the two cities (J minus K) in their support for the candidate?

(A) $\frac{0.65-0.60}{\sqrt{(0.65)(0.6)\left(\frac{1}{100}+\frac{1}{125}\right)}}$

$\frac{0.65-0.60}{\sqrt{(0.62)(0.38)\left(\frac{1}{100}+\frac{1}{125}\right)}}$

(C) $\frac{0.65-0.60}{\sqrt{(0.62)(0.38)\left(\frac{1}{100+125}\right)}}$

(D) $\frac{65-75}{\sqrt{(0.65)(0.60)\left(\frac{1}{100}+\frac{1}{125}\right)}}$

(E) $\frac{65-75}{\sqrt{\frac{0.62}{100}+\frac{0.38}{125}}}$

Question 15

Independent random samples of students were taken from two high schools, R and S, and the proportion of students who drive to school in each sample was recorded. The difference between the two sample proportions (R minus S) was 0.07. Under the assumption that all conditions for inference were met, a hypothesis test was conducted where the alternative hypothesis was the population proportion of students who drive to school for R was greater than that for S. The p-value of the test was 0.114.

Which of the following is the correct interpretation of the p-value?

(A) The probability of selecting a student from high school R who drives to school is 0.07, and the probability of selecting a student from high school S who drives to school is 0.114.

(B) If the proportion of all students who drive to school at R is greater than the proportion who drive to school at S, the probability of observing that difference is 0.114.

(C) If the proportion of all students who drive to school at R is greater than the proportion who drive to school at S, the probability of observing a sample difference of at least 0.07 is 0.114.

(D) If the proportions of all students who drive to school are the same for both high schools, the probability of observing a sample difference of at least 0.07 is 0.114.

(E) If the proportions of all students who drive to school are the same for both high schools, the probability of observing a sample difference of 0.114 is 0.07.

Question 16

Medical researchers are studying a certain genetic trait found in two populations of people, W and X. From an independent random sample of people taken from each population, the difference between the sample proportions of people who carried the trait (W minus X) was 0.22. Under the assumption that all conditions for inference were met, a hypothesis test was conducted using the following hypotheses.

$$\mathrm{H}_0 : p_{\mathrm{W}} = p_{\mathrm{X}}$$
$$\mathrm{H}_\mathrm{a} : p_{\mathrm{W}} > p_{\mathrm{X}}$$

The p-value of the test was 0.03. Which of the following is the correct interpretation of the p-value?

(A) The probability of selecting a person from population W who carries the trait is 0.22, and the probability of selecting a person from population X who carries the trait is 0.03.

(B) If the proportions of all people who carry the trait are the same for both populations, the probability of observing a sample difference of at least 0.22 is 0.03.

(C) If the proportions of all people who carry the trait are the same for both populations, the probability of observing a sample difference of 0.22 is 0.03.

(D) If the difference in proportions of people who carry the trait between the two populations is actually 0.22, the probability of observing that difference is 0.03.

(E) If the difference in proportions of people who carry the trait between the two populations is actually 0.03, the probability of observing that difference is 0.22.

Question 17

Researchers conducted an experiment in which people with a certain condition were given either a drug or a placebo to treat the condition. At the significance level of $\alpha = 0.01$, a test of the following hypotheses was conducted.

$$\mathrm{H}_0: p_{\mathrm{D}} = p_{\mathrm{P}}$$
$$\mathrm{H}_{\mathrm{a}}: p_{\mathrm{D}} > p_{\mathrm{P}}$$

In the hypotheses, p_{D} represents the proportion of all people who experience an allergic reaction while taking the drug, and p_{P} represents the proportion of all people who experience an allergic reaction while taking the placebo.

All conditions for inference were met, and the resulting p-value was 0.12. Which of the following is the correct decision for the test?

A. The p-value is less than α, and the null hypothesis is rejected. There is convincing evidence to support the claim that the proportion of people with an allergic reaction will be greater for those taking the drug than for those taking the placebo.

B. The p-value is less than α, and the null hypothesis is rejected. There is not convincing evidence to support the claim that the proportion of people with an allergic reaction will be greater for those taking the drug than for those taking the placebo.

C. The p-value is greater than α, and the null hypothesis is not rejected. There is not convincing evidence to support the claim that the proportion of people with an allergic reaction will be greater for those taking the drug than for those taking the placebo.

D. The p-value is greater than α, and the null hypothesis is rejected. There is convincing evidence to support the claim that the proportion of people with an allergic reaction will be greater for those taking the drug than for those taking the placebo.

E. The p-value is greater than α, and the null hypothesis is not rejected. There is convincing evidence to support the claim that the proportion of people with an allergic reaction will be greater for those taking the drug than for those taking the placebo.

Question 18

At many college bookstores, students can decide whether to purchase or to rent a textbook for a class. A study was conducted to investigate whether the percent of rented textbooks for all science classes in the state was greater than the percent of rented textbooks for all literature classes in the state. The following hypothesis test was done at the significance level of $\alpha = 0.05$.

$$\mathrm{H}_0 : p_\mathrm{S} = p_\mathrm{L}$$
$$\mathrm{H}_\mathrm{a} : p_\mathrm{S} > p_\mathrm{L}$$

In the hypotheses, p_S represents the proportion of all science textbooks that are rented, and p_L represents the proportion of all literature textbooks that are rented.

All conditions for inference were met, and the resulting p-value was 0.035. Which of the following is the correct decision for the test?

- (A) The p-value is less than α. Since $0.035 < 0.05$, the null hypothesis is rejected, and the claim is supported. There is convincing statistical evidence that the proportion of all science textbooks that are rented is greater than the proportion of all literature textbooks that are rented.
- (B) The p-value is less than α, and the null hypothesis is rejected. There is not convincing evidence to support the claim that the proportion of all science textbooks that are rented is greater than the proportion of all literature textbooks that are rented.
- (C) The p-value is less than α, and the null hypothesis is not rejected. There is not convincing evidence to support the claim that the proportion of all science textbooks that are rented is greater than the proportion of all literature textbooks that are rented.
- (D) The p-value is greater than α, and the null hypothesis is rejected. There is convincing evidence to support the claim that the proportion of all science textbooks that are rented is greater than the proportion of all literature textbooks that are rented.
- (E) The p-value is greater than α, and the null hypothesis is not rejected. There is not convincing evidence to support the claim that the proportion of all science textbooks that are rented is greater than the proportion of all literature textbooks that are rented.