

Practice Assignment: P-Value

- 1) Given a test statistic of $z = 2.12$, go to <https://lumen-learning.shinyapps.io/normaldist/> to calculate the P-value for a test with hypotheses:

$$H_0: p = 0.23 \quad H_A: p < 0.23$$

Answer: 0.983

- 2) Given a test statistic of $z = 2.12$, go to <https://lumen-learning.shinyapps.io/normaldist/> to calculate the P-value for a test with hypotheses:

$$H_0: p = 0.23 \quad H_A: p > 0.23$$

Answer: 0.017

- 3) Given a test statistic of $z = 2.12$, go to <https://lumen-learning.shinyapps.io/normaldist/> to calculate the P-value for a test with hypotheses:

$$H_0: p = 0.23 \quad H_A: p \neq 0.23$$

Answer: 0.03401

- 4) Consider your answers to Questions 1–3. Which P-values seem to be the most convincing in terms of indicating that the null hypothesis is not true? Explain.

Answer: The P-value of 0.017 is the smallest, indicating a test statistic that is quite unusual in comparison to the other two test statistics.

- 5) Consider your answers to Questions 1 and 2. What is the relationship between these values? Why does this relationship exist?

Answer: The two values add up to 1. The answer to Question 1 represents the area on the right of the test statistic and the answer to Question 2 represents the area on the left of the same test statistic. Together, the two areas make up the entire area under the standard normal curve.

- 6) Consider your answers to Questions 2 and 3. What is the relationship between these values? Why does this relationship exist?

Answer: The P-value for the two-sided alternative, $H_A: p \neq 0.23$, is twice the value of the upper-tailed alternative, $H_A: p > 0.23$. This is because in the two-sided alternative we want to show that there is convincing evidence that the true proportion is different—either unusually big ($p > 0.23$) or unusually small ($p < 0.23$). There is no preconceived notion that we want to show that the proportion is greater or less than 0.23. In the upper-tailed test, we are only trying to see if there is convincing evidence that the true proportion is unusually big ($p > 0.23$).

Questions 7–9: Decide whether there is enough evidence to reject the null hypothesis at a 5% significance level and complete the following table.

	P-value	Reject or Do not reject the null hypothesis
7)	0.01	Reject
8)	0.11	Do not reject
9)	0.50	Do not reject

10) Determine whether this statement is true or false: A small P-value suggests strong evidence against the null hypothesis in favor of the alternative hypothesis.

Answer: True

11) Determine whether this statement is true or false: The direction of the alternative hypothesis has no effect on the P-value.

Answer: False

12) Determine whether this statement is true or false: The significance level of a test does not affect the decision that is made regarding the null hypothesis.

Answer: False

13) It is estimated that approximately 64% of Americans are daily coffee drinkers. A researcher conducts a study to determine whether a higher percentage of college students drink coffee.

Part A: What is the null hypothesis?

Answer: $H_0: p = 0.64$

Part B: What is the alternative hypothesis?

Answer: $H_A: p > 0.64$

Part C: In a random sample of 250 college students, 178 drink coffee daily. Given this, check the conditions for conducting a one-sample z-test for proportions.

Conditions for One-Sample Z-Test for Proportions

- 1. Large Counts:** Check that $np \geq 10$ and $n(1-p) \geq 10$.
- 2. Random Samples/Assignment:** Check that the samples are random samples.
- 3. 10% Population Size:** Check that the sample size, n , is less than 10% of the population size, N : $n < 0.10N$.

Answer:

1) $250 * 0.64 \geq 10$ and $250 * (1 - 0.64) \geq 10$

2) A random sample was taken.

3) It can be assumed that the sample size is less than 10% of all college students.

Part D: Calculate the value of the test statistic.

Answer: $z = 2.37$

Part E: Using the data analysis tool at <https://lumen-learning.shinyapps.io/normaldist/>, calculate the P-value.

Answer: P-value = 0.0089

Part F: Based on this P-value, do you think the corresponding test statistic seems unusual?

Answer: Yes, it is unusual since it is so far away from the assumed null hypothesis value.

Part G: At a 5% significance level, can we “reject the null hypothesis?”

Answer: Yes, since $0.0089 < 0.05$, we can reject the null hypothesis.

Part H: Does the researcher have convincing evidence that a higher percentage of college students drink coffee?

Answer: Yes; in rejecting the null hypothesis, we know that the sample of data that has been collected indicates that there is strong evidence that the alternative hypothesis

is true. In this case, the alternative being true means that $p > 0.64$ or that a higher percentage of college students drink coffee.