

6.3.1: Exercises

1. According to a poll conducted by Gallup⁸ 46% of US adults were satisfied with the quality of the environment in 2020. You wonder if the proportion of US adults who are satisfied with the quality of the environment has decreased. You randomly survey 300 US adults and find that 117 respondents are satisfied with the quality of the environment. Is the sample proportion strong enough evidence to support your claim? Test it at a level of 5% significance.

Step 1. Determine hypotheses

- a. Let p represent the population proportion of interest (the proportion we are testing a claim about). Write what p represents in words.

- b. The null hypothesis is a statement of no change that we will test our claim against. If the proportion has not changed since 2020, what is it equal to?

Null hypothesis: $p =$ _____

- c. The alternative hypothesis is the mathematical representation of the claim: “You wonder if the proportion of US adults who are satisfied with the quality of the environment has decreased.” Write the alternative hypothesis with one of the following options: $p < \text{assumed value}$, $p > \text{assumed value}$, or $p \neq \text{assumed value}$ where the assumed value is given in the null hypothesis. (Fill in the blank with the appropriate inequality).

Alternative hypothesis: p _____ 0.46

Step 2. Collect sample data

- a. Compute the *expected* number of successes and failures in the sample assuming the null hypothesis is true ($np = \#$ of expected successes , $n(1 - p) = \#$ of expected failures). Verify that the sampling distribution of sample proportions is approximately normal.

- b. Compute the sample proportion $\hat{p} = \frac{\text{number of observed successes}}{\text{sample size } (n)}$.

Step 3. Assess the evidence (using probability)

- a. Compute the mean and standard error for the sampling distribution of sample proportions.
- b. Compute the Z-score for the sample proportion, \hat{p} . Round to two decimal places.
- c. Sketch the standard normal distribution. Locate the Z-score on the horizontal axis and shade the area to the *left* of the Z-score.
- d. The P-value is the probability of observing a test statistic that is at least as extreme as the one we observed. In this hypothesis test, the P-value is the probability of observing a sample proportion as low or lower than the one we observed. This is the area you shaded in c. Use desmos to compute the P-value.
- e. The null hypothesis assumes that the proportion of US adults who are satisfied with the quality of the environment is the same as in 2020 (46%). We observed a sample proportion that was lower. Does the P-value indicate that the sample proportion we observed was unusual compared to the assumed population proportion?

Step 4. State the conclusion in context

a. When the P-value is less than the level of significance, the sample proportion is considered statistically significant. Is our observed sample proportion statistically significant?

b. Do we reject or fail to reject the null hypothesis?

c. Can we support the alternative hypothesis or not?

d. Fill in the blanks in the following conclusion:

The sample data _____ the claim that the true _____ of US adults who are satisfied with the quality of the environment has _____ since 2020.

2. Juanda is thinking about buying a new car and is deciding between different colors. She likes the color red but is concerned that red cars get pulled over more often than other cars. She does some research and finds that all cars get pulled over at a rate of around 9%. She wants to know if red cars get pulled over at a higher rate.

a. p represents:

b. Null hypothesis:

c. Alternative hypothesis:

d. To find the P-value, should Juanda use a left-, right-, or two-tailed test based on her alternative hypothesis?

Reference

⁸ Jeffrey M. Jones, “Americans Offer Gloomy State of the Nation Report,” *Gallup.com*, February 2, 2022, accessed September 27, 2022, <https://news.gallup.com/poll/389309/americans-offer-gloomy-state-nation-report.aspx>

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