

$\alpha = 0.05$ , the null hypothesis is rejected in favor of the alternative, since the test statistic has a  $P$ -value (0.0392) less than 0.05.

Table 11.5.2 – If $P$ -Value = 0.0392	
Level of the Test	Reject or Fail to Reject
0.10	Reject
0.05	Reject
0.03	Fail to Reject
0.01	Fail to Reject

## 11.5 Exercises

### Basic Concepts

- How does testing a hypothesis about a proportion differ from testing a hypothesis about a mean?
- What is the appropriate test statistic to be used in hypothesis testing of a population proportion?
- What conditions must be met in order to perform a hypothesis test about a population proportion?
- How are  $P$ -values determined for a proportion?

### Exercises

- Determine the critical value(s) of the test statistic for each of the following large sample tests for the population proportion.
  - Left-tailed test,  $\alpha = 0.05$
  - Right-tailed test,  $\alpha = 0.01$
  - Two-tailed test,  $\alpha = 0.10$
- Determine the critical value(s) of the test statistic for each of the following large sample tests for the population proportion.
  - Left-tailed test,  $\alpha = 0.07$
  - Right-tailed test,  $\alpha = 0.04$
  - Two-tailed test,  $\alpha = 0.09$
- A commercial airline is concerned about the increase in usage of carry-on luggage. For years, the percentage of passengers with one or more pieces of carry-on luggage has been stable at approximately 68%. The airline recently selected 300 passengers at random and determined that 237 possessed carry-on luggage. Is there overwhelming evidence of an increase in carry-on luggage at a significance level of 0.01?

8. Ordinarily, when a company recruits a technical staff member, about 25% of the applicants are qualified. However, based on the information in 120 recently received resumes, 18 appear to be technically qualified.
  - a. Is there overwhelming evidence that the percentage of qualified applicants is less than 25%? Test at the 0.05 level.
  - b. What concerns might you have about the data in this problem?
  - c. What concerns might you have about creating a hypothesis after examining the data?
9. In a survey on social media usage, a survey was emailed to 7500 randomly selected people. There were 1413 surveys returned.
  - a. Test that the survey return rate is less than 20% at the 0.05 level.
  - b. What concerns might you have about the data in this problem?
10. Paper International, Inc. has a large staff of salespeople nationwide. Top officials of the company believe that 75% of their salespeople have met their monthly sales goals by the end of the third week of each month. To investigate this, they randomly select 250 salespeople and examine their sales records at the end of the third week of the current month. One-hundred seventy-five of the 250 salespeople surveyed had already met their monthly sales goals.
  - a. Does this sample support the belief of the top officials at the company at  $\alpha = 0.10$ ?
  - b. What concerns might you have about the manner in which the data were collected?
11. Ships arriving in US ports are inspected by customs officials for contaminated cargo. Assume, for a certain port, that 20% of the ships arriving in the previous year contained cargo that was contaminated. A random selection of 50 ships in the current year included five that had contaminated cargo.
  - a. Does the data suggest that the proportion of ships arriving in the port with contaminated cargoes has decreased in the current year at  $\alpha = 0.01$ ?
  - b. Do you have any concerns about the sample size? Explain.
  - c. Do you have any concerns about constructing a hypothesis after looking at the data?
12. Electronic circuit boards are randomly selected each day to determine if any of the boards are defective. A random sample of 300 boards from one day's production has twelve boards that are defective.
  - a. Based on the data, is there overwhelming evidence that more than 5% of the circuit boards are defective? Test at the  $\alpha = 0.10$  level.
  - b. Do you have any concerns about the sample size? Explain.
13. Loch Ness Fish Farm breeds fish for commercial sale. The fish are kept in breeder tanks until at least 70% of the fish are five inches long at which time they are transferred to outdoor ponds. To determine if it is the appropriate time to transfer the fish, 50 fish are randomly selected and measured. If 33 of the fish are found to be over five inches long, does the sample data suggest that it is the appropriate time to transfer the fish at  $\alpha = 0.05$ ?

14. Digger and Digger, a precious metals mining company, is considering the development of a new mining area. They have a lease on an area which they believe contains gypsum. The area will be profitable to mine if more than 15% of the samples contain more than trace amounts of the mineral. Eighty identical samples are randomly selected and the amount of gypsum is measured. Thirteen samples are observed to have more than trace amounts of the mineral. Based on the sample data, should Digger and Digger conclude that the area will be profitable to mine? Use  $\alpha = 0.01$ .
15. A socially conscious corporation wants to relocate their headquarters to another part of town. One concern expressed by workers is that their commuting distance will increase. The corporation has decided that if more than 50% of the employees will have to drive farther to the proposed new location, they will cancel the move. In a random sample of 398 employees, 201 indicated that their commuting distance to the new office will be longer. Based on the sample data, should the corporation cancel the move? Use a significance level of 0.01.
16. A production process will normally produce defective parts 0.2% of the time. In a random sample of 1400 parts, three defectives are observed.
- Is this overwhelming evidence at the 0.05 level to indicate that the defective rate of the process has increased?
  - Compute the  $P$ -value for the test statistic.
  - Based on the  $P$ -value, would the decision change at  $\alpha = 0.01$ ?
17. Bombay Charlie's, a fast-food Indian restaurant, is thinking about adding a certain spice to their chicken curry dish to attract more customers. The restaurant manager has decided to add the spice if more than 80% of his customers prefer the taste of the chicken curry with the spice added. Sixty-five customers are randomly selected to participate in a blind taste test. Fifty-four of these customers prefer the chicken curry with the added spice.
- Find the  $P$ -value for the hypothesis test that the manager will perform to decide if more than 80% of the customers prefer the taste of the chicken curry with the added spice.
  - Does the data suggest that more than 80% of the customers prefer the curry with the new spice at  $\alpha = 0.05$ ?
18. The news program for KOPE, the local television station, claims to have 40% of the market. A random sample of 500 viewers conducted by an independent testing agency found 192 who claim to watch the KOPE news program on a regular basis.
- Find the  $P$ -value for testing the hypothesis that the news program for KOPE does not have at least 40% of the market as it claims.
  - Is there sufficient evidence to reject the hypothesis that KOPE does not have at least 40% of the market at a significance level of 0.05?

19. The length of time that a storm window will last before beginning to leak is of interest to a window manufacturer who wishes to guarantee his windows. He believes that more than 50% of the windows will last at least four years. To research this, 931 windows, which were installed at least four years ago, are randomly selected and checked for leakage. Five hundred of the windows are found to still be leak-free.
- Find the  $P$ -value for testing the hypothesis that more than 50% of the windows will be leak-free in four years.
  - Does the sample support the hypothesis that more than 50% of the windows will be leak-free in four years at  $\alpha = 0.05$ ?
20. Some cities, like Berkeley, California, have introduced a “soda tax” to raise money for the city and to reduce the consumption of soda and other sugar-sweetened drinks which can lead to obesity and diabetes. Taxing at the rate of \$0.015 per ounce increases the cost of sugar-sweetened drinks by as much as 20%. Prior to the price increase the percentage of consumers that drank at least one sugar-sweetened drink per day was 48%. Suppose that two months after the price increase, a random sample of consumers was selected to determine changes in consumption of sugar-sweetened drinks. With  $\alpha = 0.05$ , can we conclude that the price increase was effective in decreasing the consumption of sugar-sweetened drinks if 78 of the 200 consumers drink sugar-sweetened drinks on a daily basis?
21. About 44% of the households in the United States had cable television in 2021.<sup>14</sup> Suppose that a sample of 200 households is selected in 2024 and it is determined that 78 of them have cable television.
- With  $\alpha = 0.05$ , can it be concluded that a lower proportion of households in 2024 have cable television as compared with 2021?
  - In the sample of 200, what is the most number of people who have cable television that would allow the conclusion that a lower proportion of households in 2024 have cable television as compared to 2021?
22. The winner of the coin toss in a football game has their choice of one of three privileges: deciding which team receives the kickoff, deciding which goal his team will defend, or deferring and deciding in the second half whether to kick or receive the kickoff. Using the Super Bowl data set, determine if winning the coin toss seemed to impact winning the game by looking at the proportion of game winners who also won the coin toss. Test at the  $\alpha = 0.05$  level.

## Data

[stat.hawkeslearning.com](http://stat.hawkeslearning.com)

Discovering Statistics and Data,  
Fourth Edition > Data Sets > Super  
Bowl