

# Problems

Solutions for problems whose numbers appear within a colored box can be found in the Student Solution Files.

## Level A

1. The file **P09\_01.xlsx** contains a random sample of 100 lightbulb lifetimes. The company that produces these lightbulbs wants to know whether it can claim that its lightbulbs typically last more than 1000 burning hours.
  - a. Identify the null and alternative hypotheses.
  - b. Can this lightbulb manufacturer claim that its lightbulbs typically last more than 1000 hours at the 5% significance level? What about at the 1% significance level? Explain your answers.
2. A manufacturer is interested in determining whether it can claim that the boxes of detergent it sells contain, on average, more than 500 grams of detergent. The firm selects a random sample of 100 boxes and records the amount of detergent (in grams) in each box. The data are provided in the file **P09\_02.xlsx**.
  - a. Identify the null and alternative hypotheses.
  - b. Is there statistical support for the manufacturer's claim? Explain.
3. A producer of steel cables wants to know whether the steel cables it produces have an average breaking strength of 5000 pounds. An average breaking strength of less than 5000 pounds would not be adequate, and to produce steel cables with an average breaking strength in excess of 5000 pounds would unnecessarily increase production costs. The producer collects a random sample of 64 steel cable pieces. The breaking strength for each of these cable pieces is recorded in the file **P09\_03.xlsx**.
  - a. Identify the null and alternative hypotheses.
  - b. Using a 5% significance level, what statistical conclusion can the producer reach regarding the average breaking strength of its steel cables? Would the conclusion be any different at the 1% level? Explain your answers.
4. A U.S. Navy recruiting center knows from past experience that the heights of its recruits have traditionally been normally distributed with mean 69 inches. The recruiting center wants to test the claim that the average height of this year's recruits is greater than 69 inches. To do this, recruiting personnel take a random sample of 64 recruits from this year and record their heights. The data are provided in the file **P09\_04.xlsx**.
  - a. Identify the null and alternative hypotheses.
  - b. On the basis of the available sample information, do the recruiters find support for the given claim at the 5% significance level? Explain.
  - c. Use the sample data to calculate a 95% confidence interval for the average height of this year's recruits.

Based on this confidence interval, what conclusion should recruiting personnel reach regarding the given claim?

5. Suppose you wish to test  $H_0: \mu \leq 10$  versus  $H_a: \mu > 10$  at the  $\alpha = 0.05$  significance level. Furthermore, suppose that you observe values of the sample mean and sample standard deviation when  $n = 40$  that do *not* lead to the rejection of  $H_0$ . Is it true that you might reject  $H_0$  if you observed the same values of the sample mean and sample standard deviation from a sample with  $n > 40$ ? Why or why not?

## Level B

6. A study is performed in a large southern town to determine whether the average amount spent on food per four-person family in the town is significantly different from the national average. A random sample of the weekly grocery bills of two-person families in this town is given in the file **P09\_06.xlsx**. Assume the national average amount spent on food for a four-person family is \$150.
  - a. Identify the null and alternative hypotheses.
  - b. Is the sample evidence statistically significant? If so, at what significance levels can you reject the null hypothesis?
  - c. For which values of the sample mean (i.e., average weekly grocery bill) would you reject the null hypothesis at the 1% significance level? For which values of the sample mean would you reject the null hypothesis at the 10% level?
7. An aircraft manufacturer needs to buy aluminum sheets with an average thickness of 0.05 inch. The manufacturer knows that significantly thinner sheets would be unsafe and considerably thicker sheets would be too heavy. A random sample of 100 sheets from a potential supplier is collected. The thickness of each sheet in this sample is measured (in inches) and recorded in the file **P09\_07.xlsx**.
  - a. Identify the null and alternative hypotheses.
  - b. Based on the results of an appropriate hypothesis test, should the aircraft manufacturer buy aluminum sheets from this supplier? Explain why or why not.
  - c. For which values of the sample mean (i.e., average thickness) would the aircraft manufacturer decide to buy sheets from this supplier? Assume a significance level of 5% in answering this question.
8. Suppose you observe a random sample of size  $n$  from a normally distributed population. If you are able to reject  $H_0: \mu = \mu_0$  in favor of a two-tailed alternative hypothesis at the 10% significance level, is it true that you can definitely reject  $H_0$  in favor of the appropriate one-tailed alternative at the 5% significance level? Why or why not?

2009 sheet for now.) Test the admission director's claim at the 5% significance level and report your findings. Does your conclusion change when the significance level is increased to 10%?

12. A market research consultant hired by a leading soft-drink company wants to determine the proportion of consumers who favor its low-calorie drink over the leading competitor's low-calorie drink in a particular urban location. A random sample of 250 consumers from the market under investigation is provided in the file **P08\_17.xlsx**.
- Calculate a 95% confidence interval for the proportion of all consumers in this market who prefer this company's drink over the competitor's. What does this confidence interval tell us?
  - Does the confidence interval in part **a** support the claim made by one of the company's marketing managers that more than half of the consumers in this urban location favor its drink over the competitor's? Explain your answer.
  - Comment on the sample size used in this study. Specifically, is the sample unnecessarily large? Is it too small? Explain your reasoning.
13. The CEO of a medical supply company is committed to expanding the proportion of highly qualified women in the organization's staff of salespersons. He claims that the proportion of women in similar sales positions across the country in 2019 is less than 50%. Hoping to find support for his claim, he directs his assistant to collect a random sample of salespersons employed by his company, which is thought to be representative of sales staffs of competing organizations in the industry. These data are listed in the Data 2019 sheet of the file **P09\_13.xlsx**. (You can ignore the data in the Data 2014 sheet for now.) Test this manager's claim using the given sample data and report a  $p$ -value. Is there statistical support for his hypothesis that the proportion of women in similar sales positions across the country is less than 50%?
14. Management of a software development firm would like to establish a wellness program during the lunch hour to enhance the physical and mental health of its employees. Before introducing the wellness program, management must first be convinced that a sufficiently large majority of its employees are not already exercising at lunchtime. Specifically, it plans to initiate the program only if less than 40% of its personnel take time to exercise prior to eating lunch. To make this decision, management has surveyed a random sample of 100 employees regarding their midday exercise activities. The results of the survey are given in the Before sheet of the file **P09\_14.xlsx**. Is there sufficient evidence at the 10% significance level for managers of this organization to initiate a corporate wellness program? Why or why not? What about at the 1% significance level?
15. The managing partner of a major consulting firm is trying to assess the effectiveness of expensive computer skills training given to all new entry-level professionals. In an effort to make such an assessment, she administers