E Chapter 10 Exercises

Hypothesis Tests

Perform each hypothesis test. Assume that all random samples had an equal chance of being chosen. For each exercise, complete the following steps.

a. State the null and alternative hypotheses.
b. Determine which distribution to use for the test statistic, and state the level of significance.
c. Calculate the test statistic.
d. Draw a conclusion and interpret the decision.

1. A manufacturer is responsible for making barrels used to store crude oil, which are designed to hold exactly 55 gallons of oil. As part of a routine quality check, a factory manager randomly tests 27 barrels off the assembly line and finds that their mean capacity is 54.7 gallons with a standard deviation of 0.8 gallons. Can the manager say with 99% confidence that the requirements are being met? Assume that the population distribution is approximately normal.

2. Sarah, a university junior, chose to live on the honors floor of her dorm because she was told that the students on that floor would be quiet and studious. In fact, Sarah was told that students on the honors floor study 11 hours per week. After living on the honors floor for a few months, Sarah is convinced that the students around her study less than 11 hours a week. To test her claim, Sarah polls 10 students on her floor regarding the number of hours per week that they spend studying. Use the results listed in the table below to test Sarah's claim at the 0.10 level of significance. Assume that the population distribution is approximately normal.

Hours of Study per Week

Hours of Study	12	4	14	9	8	6	10	12	11	9

3. TransAir, an international airline company, has a new jumbo jet that it believes will decrease the mean transatlantic flight time from Newark to London Heathrow. To be faster than its competitors, the mean must be less than 6 h 50 min. Because of costs, the agency monitoring the flight times only requires that eight trials be run. The results are given in the table below. If the FAA requires that the agency be 90% confident of its findings, what should the agency report? Assume that the population distribution is approximately normal.

Flying Times from Newark to London

	Flying Time
Flight 1	6 h 32 min
Flight 2	6 h 28 min
Flight 3	6 h 51 min
Flight 4	6 h 2 min
Flight 5	6 h 51 min
Flight 6	7 h 2 min
Flight 7	6 h 36 min
Flight 8	6 h 42 min

4. A computer program designer has developed an online questionnaire that she believes will take a mean time of 15 minutes to complete. Suppose that she samples 35 volunteers and finds that the mean time to complete the questionnaire is 14.0 minutes. Determine if there is sufficient evidence to conclude that the mean completion time for the online questionnaire differs from its intended duration. Use a 0.05 level of significance and assume that the population standard deviation is known to be 2.5 minutes.

5. A manufacturer of hearing-aid batteries has developed a new process that it believes will increase the usable life of each battery. Currently, the usable lifetimes for these batteries have a mean of 264 hours. Test the hypothesis that the process increases the usable life of these batteries at the 0.01 level of significance. A sample of 50 batteries is tested and found to have a mean of 271.0 hours with a standard deviation of 16.9 hours. Assume that the population standard deviation is known to be 16.9 hours.

6. If it is true that fewer than 4 people per day use a particular public restroom at the state park, the park services will close the restroom. To determine the action the park should take, the number of uses is recorded each day for a 35-day period. The results are given in the following table. At the 5% level of significance, should the park close the restroom? Assume that the population standard deviation is known to be 2.1 uses per day.

Daily Restroom Uses

3	3	3	1	2	6	9
0	2	4	3	3	5	3
7	3	0	2	1	4	1
0	0	6	3	5	10	5
3	4	0	5	2	4	6

Suppose that the actual mean usage rate for the restroom is 4 times a day. Did the park make the right decision? If not, what type of error was made?

7. While trying to convince her friends that more than half of all sophomores live off-campus, Bren took a survey of a random sample of sophomores and collected the following data. Does this evidence support Bren's claim that more than half of all sophomores live off-campus at the 0.10 level of significance?

Sophomores Living On-Campus

	Live On-Campus	Live Off-Campus
In-state Resident	25	47
Out-of-state Resident	38	19

A friend of Bren's went to the registrar's office and found out that actually 975 out of 3788 sophomores lived off-campus this year. Based on this information, did Bren make an error in her conclusion? If so, what type of error did she make?

8. Don believes that fewer than one-third of the students at his college hold part-time jobs while in school. To test his claim, he randomly selects 116 students from whom he collects the following data. Does this evidence support Don's claim at the 0.05 level of significance?

Students Holding Part-Time Jobs

	Part-Time Job Held
Yes	32
No	84

In a campus-wide end-of-year survey, the office of research was able to determine that 33% of students say they held a part-time job. Did Don draw the correct conclusion? If not, what type of error did he make?

9. A student organization that promotes diversity believes that the percentage of minority students is no longer 35%. In a random sample of 250 students, 97 of the students are minorities. Does this evidence support the organization's claim that the percentage of minority students is not 35% at the 0.01 level of significance?

The registrar reports that 38% of currently enrolled students are minorities according to their admissions records. Based on this new information, did the organization draw the correct conclusion? If not, what type of error was made?

10. A clothing designer produces thousands of pairs of blue jeans each week. The denim for each pair of jeans is cut by a machine, and if the cuts are not made properly, then the jeans will not be properly sized once they are sewn together. To ensure that the jeans are properly sized, the variance in the lengths of the denim, which are measured in millimeters, must be less than 0.25. To test the accuracy of the cuts, 20 pieces of denim are pulled from the line after being cut by the machine and their lengths are measured. The variance in these lengths is found to be 0.1369. Does this evidence support the claim that the variance in the lengths of the denim is less than 0.25, at the 0.10 level of significance?

11. From microminis to floor-length skirts, a historian believes that the variance in the lengths of hems on dresses and skirts is more now than at any other point in recorded history. Specifically, she claims that the variance in the lengths of skirts' hems, which are measured in inches, is more than 15.5. To test her claim, she randomly selects 25 dresses and skirts from a department store and measures the hem length of each. She finds that the variance in the lengths of the hems is 17.3. Does this evidence support the historian's claim, at the 0.05 level of significance?

12. A statistics professor is concerned that the variance in the grades on the final exam will not be 138, as it has been in previous semesters. She randomly selects 35 of her many exams and finds that the variance in the grades is 142. Does this evidence support the professor's claim at the 0.01 level of significance?

13. A city police department has always had an equal number of officers on patrol in each beat. However, each month the police chief reevaluates to make sure that he is utilizing the department's resources and manpower effectively. To do this, he records the number of calls received from each beat over the course of the month. The data for one month are summarized below. Does this evidence support the claim that there is a difference in the number of calls between the different areas of the city, at the 0.05 level of significance?

Calls Received in One Month

	Beat 1	Beat 2	Beat 3	Beat 4
Number of Calls	28	19	31	38

14. A factory workers' union is appealing to the factory management for more vacation time for its employees. The union claims that workers are more productive when they come back from vacation than before. The following table contains the production rates, measured in units per hour, for a sample of employees. The union feels that it needs to be 90% confident of its claim before going into talks with the employers. Does the union have strong enough evidence to support its claim?

Production Rates

	100–125 Units per Hour	126–150 Units per Hour	More Than 150 Units per Hour	Total
Before Vacation	210 workers	319 workers	58 workers	587
After Vacation	178 workers	387 workers	60 workers	625
Total	388	706	118	1212

15. A sociologist wants to study the education levels of people living in various regions of the United States. He surveys a random sample of 100 people in each of the following regions: Northeast, Southeast, Midwest, and West. The results obtained are found in the following table. Does this evidence support the sociologist's claim that the level of education differs by region, at the 0.05 level of significance?

Education Levels

	Less Than a High School Diploma	High School Graduate, No College	Some College or Associate Degree	College Graduate	Total
Northeast	11	29	45	15	100
Southeast	19	28	44	9	100
Midwest	15	25	47	13	100
West	13	31	42	14	100
Total	58	113	178	51	400