11.1 Section Exercises

Test Statistics for Hypothesis Tests for Two Population Means

Calculate the test statistic for a hypothesis test for two population means using the given information.

1. $\bar{x}_1 = 9.21,\ \sigma_1 = 2.01,\ n_1 = 45,\ \bar{x}_2 = 8.76,\ \sigma_2 = 1.77,\ n_2 = 51,\ H_0: \mu_1 - \mu_2 \geq 0$

2. $\bar{x}_1 = 72.82,\ \sigma_1 = 7.90,\ n_1 = 31,\ \bar{x}_2 = 75.11,\ \sigma_2 = 6.54,\ n_2 = 39,\ H_0: \mu_1 - \mu_2 \leq 0$

3. $\bar{x}_1 = 118.4,\ \sigma_1 = 5.93,\ n_1 = 64,\ \bar{x}_2 = 104.3,\ \sigma_2 = 5.74,\ n_2 = 65,\ H_0: \mu_1 - \mu_2 \geq 15$

4. $\bar{x}_1 = 43.1,\ \sigma_1 = 2.33,\ n_1 = 71,\ \bar{x}_2 = 34.3,\ \sigma_2 = 2.96,\ n_2 = 70,\ H_0: \mu_1 - \mu_2 = 8$

Null and Alternative Hypotheses for Hypothesis Tests for Two Population Means

State the null and alternative hypotheses for each scenario.

5. The claim is that the mean of Population 1 is more than 30 units less than the mean of Population 2.

6. Ann claims that the mean drive time for her to get home from work on a Friday (Population 1) is less than her mean drive time from work to home on a Thursday (Population 2).

7. Biontrix (Population 1) claims that their customer rebates are higher on average than that of their competitor, E.D.G. Inc. (Population 2).

8. Carly claims that 6 months ago her mean time to walk a mile (Population 1) was more than 4 minutes longer than it is currently (Population 2).

9. A newspaper claims that the mean age of its current readers (Population 1) has dropped 3.6 years over the last 10 years (Population 2). A market researcher believes that the newspaper's claim is incorrect and plans to conduct a hypothesis test to provide evidence against the newspaper's claim.

10. East Wind Hospital (Population 1) claims that their patients spend less time in the waiting room on average than Brown County Hospital (Population 2).

Hypothesis Tests for Two Population Means (σ Known)

Perform each hypothesis test using the method of your choice or the one assigned by your instructor. 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 by comparing the *p*-value to the level of significance and interpret the decision.

11. A car company claims that its new SUV gets better gas mileage than its competitor's SUV. A random sample of 35 of its SUVs has a mean gas mileage of 12.6 miles per gallon (mpg). The population standard deviation is known to be 0.4 mpg. A random sample of 31 competitor's SUVs has a mean gas mileage of 12.4 mpg. The population standard deviation for the competitor is known to be 0.3 mpg. Test the company's claim at the 0.05 level of significance.

12. A college student is interested in investigating the claim that students who graduate with a master's degree earn higher salaries, on average, than those who finish with a bachelor's degree. She surveys, at random, 42 recent graduates who completed their master's degrees, and finds that their mean salary is $38,400 per year. The standard deviation of annual salaries for the population of recent graduates who have master's degrees is known to be $3100. She also surveys, at random, 45 recent graduates who completed their bachelor's degrees, and finds that their mean salary is $36,750 per year. The standard deviation of annual salaries for the population of recent graduates with only bachelor's degrees is known to be $3700. Test the claim at the 0.05 level of significance.

13. Fran is training for her first marathon, and she wants to know if there is a significant difference between the mean number of miles run each week by group runners and individual runners who are training for marathons. She interviews 32 randomly selected people who train in groups, and finds that they run a mean of 49.0 miles per week. Assume that the population standard deviation for group runners is known to be 4.2 miles per week. She also interviews a random sample of 30 people who train on their own and finds that they run a mean of 47.2 miles per week. Assume that the population standard deviation for people who run by themselves is 4.8 miles per week. Test the claim at the 0.05 level of significance.

14. Rob and Phil are both internal medicine residents in the Southeast, but they work at different hospitals. When they compare their schedules, Rob is convinced that, on average, residents at his hospital work for over 3 hours more per week than those at Phil's hospital. Rob asks a random sample of 30 residents at his hospital to record their hours for one week. He finds that they worked for a mean of 74.3 hours. Phil also asks 30 randomly selected residents at his hospital to record their hours for the same week. He calculates that they worked for a mean of 70.1 hours. Assume that the population standard deviation for the hospital where Rob works is known to be 2.6 hours and the population standard deviation for the hospital where Phil works is known to be 2.9 hours. Test Rob's claim at the 0.05 level of significance.

15. A weight-loss company wants to make sure that its clients lose more weight, on average, than they would without the company's help. An independent researcher collects data on the amount of weight lost in one month from 45 of the company's clients and finds a mean weight loss of 12 pounds. The population standard deviation for the company's clients is known to be 7 pounds per month. Data from 50 dieters not using the company's services reported a mean weight loss of 10 pounds in one month. The population standard deviation for dieters not using the company's services is known to be 6 pounds per month. Test the company's claim that using its services results in a greater mean weight loss at the 0.05 level of significance.

16. Two friends, Karen and Jodi, work different shifts for the same ambulance service. They wonder if the different shifts average different numbers of calls. Looking at past records, Karen determines from a random sample of 35 shifts that she had a mean of 5.2 calls per shift. She knows that the population standard deviation for her shift is 1.3 calls. Jodi calculates from a random sample of 34 shifts that her mean was 4.8 calls per shift. She knows that the population standard deviation for her shift is 1.2 calls. Test the claim that there is a difference between the mean numbers of calls for the two shifts at the 0.05 level of significance.

17. A professor believes that, for the introductory art history classes at his university, the mean test score of students in the evening classes is more than 5 points lower than the mean test score of students in the morning classes. He collects data from a random sample of 250 students in evening classes and finds that they have a mean test score of 80.2. He knows the population standard deviation for the evening classes to be 11.9 points. A random sample of 300 students from morning classes results in a mean test score of 86.8. He knows the population standard deviation for the morning classes to be 10.2 points. Test his claim with a 95% level of confidence.

18. A state board of directors for higher education is comparing the mean salaries of entry-level Ph.D. positions at the state's two major universities to make sure there is not a difference in entry-level pay. Use the information given in the following table, which was collected by the board of directors for higher education, to perform the hypothesis test at the 0.05 level of significance.

Salaries of Entry-Level Ph.D. Positions

	University A	University B
Sample Size	42	51
Mean Entry-Level Salary	$58,500	$60,200
Population Standard Deviation	$3200	$11,700

19. A parent interest group is looking at whether birth order affects scores on the ACT test. It was suggested that, on average, first-born children earn lower ACT scores than second-born children. After surveying a random sample of 100 first-born children, the parents' group found that they had a mean score of 20.9 on the ACT. A survey of 175 second-born children resulted in a mean ACT score of 21.1. Assume that the population standard deviation for first-born children is known to be 1.8 points and the population standard deviation for second-born children is known to be 2.3 points. Is there sufficient evidence at the 10% level of significance to say that the mean ACT score of first-born children is lower than the mean ACT score of second-born children?

20. Lauren and Keri live in different states and disagree about who has higher electric bills. To settle their disagreement, the girls decide to sample electric bills in their area for the month of June and perform a hypothesis test. The electric company in Lauren's state reports that a random sample of 35 monthly residential electric bills has a mean of $104.53. For a random sample of 51 monthly residential electric bills in Keri's state, the mean is $101.48. Assume that the population standard deviation in Lauren's state is known to be $17.81, and the population standard deviation in Keri's state is known to be $25.30. Is there evidence at the 0.01 level to say that the mean monthly residential electric bill is higher for Lauren's state than for Keri's state?

21. A car servicing shop wants to use the best windshield wiper blades for its customers. It has kept track of the mean numbers of sets of blades needed per year for two different brands of blades. A random sample of 35 customers using Brand A needed a mean of 1.2 sets of blades per year, and 30 randomly selected customers using Brand B needed a mean of 1.3 sets of blades per year. Assume that the population standard deviations for Brand A and Brand B are 0.3 and 0.7 sets per year, respectively. Is there sufficient evidence at the 0.15 level to say that the mean number of sets of wiper blades needed per year is lower for Brand A than for Brand B?

22. Two college friends are big sports fans. While they are watching baseball one season, they think that there is probably a difference between the mean batting averages of players in the SEC East and SEC West divisions. To test their theory, they find the mean batting average of 40 randomly selected SEC West players to be .260. They also find the mean batting average of a random sample of 50 SEC East players to be .249. Assume that the population standard deviation for the SEC West division is known to be .026 and the population standard deviation for the SEC East division is known to be .051. Is there sufficient evidence at the 0.10 level of significance to say that there is a difference between the mean batting averages for the two SEC divisions?