11.3 Section Exercises

Hypothesis Tests for the Mean of the Paired Differences for Two Populations (σ Unknown, Dependent Samples)

Perform each hypothesis test using the method of your choice or the one assigned by your instructor. Assume that the population of paired differences is normally distributed. 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 necessary sample statistics then compute the test statistic.
d. Draw a conclusion and interpret the decision.

1. An anger-management course claims that, after completing its seminar, participants will lose their tempers less often. Always a skeptic, you decide to test this claim. A random sample of 12 seminar participants is chosen, and these participants are asked to record the number of times that they lost their tempers in the two weeks prior to the course. After the course is over, the same participants are asked to record the number of times that they lost their tempers in the next two weeks. The following table lists the results of the survey. Using these data, test the claim at the 0.05 level of significance.

Number of Times Temper Was Lost during a Two-Week Period												
Before	8	10	6	7	4	11	12	5	6	3	6	4
After	6	5	6	6	5	9	4	5	4	4	5	4

2. The manufacturer of a new eye cream claims that the cream reduces the appearance of fine lines and wrinkles after just 14 days of application. To test the claim, 10 women are randomly selected to participate in a study. The number of fine lines and wrinkles that are visible around each participant's eyes is recorded before and after the 14 days of treatment. The following table displays the results. Test the claim at the 0.01 level of significance.

Numbers of Fine Lines and Wrinkles										
Before	8	14	13	15	10	16	9	10	11	10
After	6	14	11	14	10	14	9	9	11	8

3. An SAT prep course claims to increase student scores by more than 60 points, on average. To test this claim, 9 students who have previously taken the SAT are randomly chosen to take the prep course. Their SAT scores before and after completing the prep course are listed in the following table. Test the claim at the 0.01 level of significance.

SAT Scores									
Before Prep Course	1010	980	1170	1200	1040	1280	1450	1470	1500
After Prep Course	1100	1260	1190	1280	1170	1370	1440	1500	1520

4. Sarah believes that completely cutting caffeine out of a person's diet will allow him or her more restful sleep at night. In fact, she believes that, on average, adults will have more than two additional nights of restful sleep in a four-week period after removing caffeine from their diets. She randomly selects 8 adults to help her test this theory. Each person is asked to consume two caffeinated beverages per day for 28 days and then cut back to no caffeinated beverages for the following 28 days. During each period, the participants record the numbers of nights of restful sleep that they had. The following table gives the results of the study. Test Sarah's claim at the 0.05 level of significance.

Numbers of Nights of Restful Sleep in a Four-Week Period								
With Caffeine	21	20	26	20	24	21	18	15
Without Caffeine	22	24	27	23	21	26	22	23

5. To test the claim that children with the same parents do not have the same weights, some students in an upper-level statistics class surveyed nine families with at least two boys in the family having the same parents. The boys' weights, taken at the same age, are listed in the following table. Is there enough evidence, at the 0.10 level of significance, to support the claim that, on average, two boys with the same parents do not have equal weights?

Boys' Weights (in Pounds)									
Boy A	94	138	171	131	159	110	148	90	170
Boy B	93	140	176	130	173	112	145	90	178

6. One of the top golf camps in the country advertises that a week with its coaches will lower your average golf score by two points. One disgruntled customer claims that the camp does not live up to its advertised claim. To test the customer's claim, eight randomly selected people attending the camp agreed to participate in a study, and their pre-camp and post-camp average scores are listed in the following table. (These are their average scores on a par-72 golf course.) Test the customer's claim at the 0.10 level of significance.

Average Golf Scores								
Before Camp	75	74	76	75	76	76	74	77
After Camp	73	72	73	74	74	72	74	75

7. A violin teacher wants to convince parents of 5-year-olds that, after a year of lessons, the students will increase their stamina for standing in the correct position by more than 30 minutes, on average. She recorded the length of time that each student could hold the correct position while practicing at the beginning of the year, and then again at the end of the year. Her results are listed in the following table. Is there evidence, at the 0.10 level of significance, that the 5-year-olds' stamina times increase by a mean of more than 30 minutes after one year of violin lessons?

Stamina for Correct Position (in Minutes)

Start of Lessons	5	7	5	4	10	6	8	5
After a Year of Lessons	36	39	40	35	41	37	38	37

8. A psychology graduate student wants to test the claim that there is a significant difference between the IQs of spouses. To test this claim, she measures the IQs of 9 married couples using a standard IQ test. The results of the IQ tests are listed in the following table. Using a 0.05 level of significance, test the claim that there is a significant difference between the IQs.

IQs of Married Couples

Spouse 1	100	110	132	120	90	115	124	121	107
Spouse 2	98	111	134	119	95	116	122	118	110

9. An economist studying inflation in electricity prices in 2018 and 2019 believes that the average price of electricity, even after adjusting for inflation, changed between these two years. To test his claim, he samples 9 different counties and records the average price of electricity in each county from each year. He then adjusts the prices for inflation. His results are given in the following table. Test the economist's claim at the 0.01 level of significance.

Average Residential Retail Prices of Electricity ($/kWh)

2018	2019
20.37	19.30
15.44	15.48
17.45	15.29
16.47	16.06
15.73	15.99
14.82	15.36
16.63	16.55
17.66	18.63
11.67	12.79

10. A local school district is looking at adopting a new textbook that, according to the publishers, will increase standardized test scores of second graders by more than 10 points, on average. Never willing to believe a publisher's claim without evidence to support it, the school board decides to test the claim. The school board chooses two second-grade classes for the study. One class was assigned the new textbook and the other class used the traditional textbook. Eight children from each class were then paired based on demographics and ability levels. The following table lists the standardized test scores for the pairs. Do the data support the company's claim at the 0.05 level of significance?

Standardized Test Scores of Second Graders

New Book	78	82	90	67	79	83	89	93
Old Book	67	70	79	54	68	71	78	82