Confidence Intervals and Hypothesis Tests: Two Samples

9.7   Hypothesis Test, Two Population Means: Matched-Pair Experiments

1. A group of 11 overweight or obese men were placed on the Alternative-Day Fasting diet (ADF diet) for 8 weeks. The diet involves consuming only 25% of your normal calorie intake every other day. During the remaining days of the week, you are instructed to eat normally. The before-after results are included below:

Subject	1	2	3	4	5	6	7	8	9	10	11
Weight Before	260	285	305	315	290	300	302	269	278	321	247
Weight After	238	269	285	295	281	287	290	265	270	307	245

    Use a 0.5% (half of one percent) significance level to test the claim that the ADF diet causes a significant amount of weight loss. $\left(\overline{x} = 12.73, s = 6.57 \right)$

2. A Statistics professor at FIU has created a review technique for applied courses which involves focusing on streamlining the solving process for a set of problems. To determine if this review method significantly shortens the length of time to complete problems on the exam, he timed 10 students while they completed two different (but similar) five question quizzes. One quiz was given before the students learned the review technique, and another was given after the students learned and had the chance to practice the review technique. The results are given below. Use a 5% significance level to determine if the review technique makes a significant difference in the time to complete the quiz. $\left(\overline{x} = 1.44, s = 1.09 \right)$

Subject	1	2	3	4	5	6	7	8	9	10
Time Before (min)	20.3	15.8	25.6	18.9	17.1	22.3	24.7	19.8	19.9	21.6
Time After	17.9	16.2	23.2	16.9	16.9	21.9	22.1	17.4	18.4	20.7

3. The Statistics professor had it pointed out to him that reviewing normally before taking the second quiz could have produced the same average difference in completion time on the quiz. To determine if this was indeed the case, again the professor timed ten students while they completed two different (but similar) five question quizzes. One quiz was given before the students had a chance to review, and another was given after the students reviewed using their own method. The results are given below. Use a 5% significance level to determine there is a significant difference in the time to complete the two quizzes. $\left(\overline{x} = 0.75, s = 1.03 \right)$

Subject	1	2	3	4	5	6	7	8	9	10
Time Before (min)	21.2	14.8	24.9	19.1	25.1	20.4	17.3	23.5	20.2	21.0
Time After	19.1	14.6	22.6	18.9	24.8	20.0	15.9	22.1	21.3	20.7

Answers:

1. Based on the sample data, it seems the ADF diet causes a significant amount of weight loss.

    $Claim: \mu_d > 0$

    $H_0: \mu_d \leq 0$

    $H_a: \mu_d > 0$

    $Test\ Stat: 6.421$

    $d.f. = 10$

    $Critical\ Value(s): 3.169$

    $Initial\ Conclusion: $ Reject the null, support the alternative

    $Final\ Conclusion: $ The sample data supports the claim...

2. Based on the sample data, it seems that the time to complete the second quiz is shorter.

    $Claim: \mu_d \neq 0$

    $H_0: \mu_d = 0$

    $H_a: \mu_d \neq 0$

    $Test\ Stat: 4.17$

    $d.f. = 9$

    $Critical\ Value(s): \pm 2.262$

    $Initial\ Conclusion: $ Reject the null, support the alternative

    $Final\ Conclusion: $ The sample data supports the claim...

3. Based on the sample data, it seems that the time to complete the second quiz is shorter, so this indicates that perhaps just reviewing and retaking improves scores significantly. However, the test statistic was more extreme in problem 2, so this might indicate that there is a more significant improvement when using the professor's method.

    $Claim: \mu_d \neq 0$

    $H_0: \mu_d = 0$

    $H_a: \mu_d \neq 0$

    $Test\ Stat: 2.29$

    $d.f. = 9$

    $Critical\ Value(s): \pm 2.262$

    $Initial\ Conclusion: $ Reject the null, support the alternative

    $Final\ Conclusion: $ The sample data supports the claim...