Sample 3

Problem 3 (16 points)

A Physics professor randomly selected 10 students who were struggling in her course (based on the previous test grades). She provided specialized tutoring sessions to the students.

Before tutoring	50	58	60	51	48	46	45	58	57	50
After tutoring	71	75	71	70	65	69	70	69	68	60

Did the test scores differ following tutoring?
Use SPSS to answer the question.

a. **Follow the four steps for hypothesis testing. Use $\alpha = .05$. (10 points)**

Hypotheses

Null hypothesis (H_0): Tutoring had no impact on the students' test scores.

Alternative hypothesis (H_1): Tutoring had an impact on the students' test scores.

The output from the paired samples t-test is as follows:

Output

Paired samples t-test results

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Post_tutoring	68.80	10	3.99444	1.26315
	Pre_tutoring	52.30	10	5.47824	1.73237

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Post_tutoring & Pre_tutoring	10	.353	.316

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Post_tutoring - Pre_tutoring	16.50	5.52268	1.74642	12.54931	20.45069	9.448	9	.000

The paired samples t-test found a statistically significant improvement after tutoring, $t(9)$ = 9.448, $p < 0.05$. The mean difference was 16.5 with a standard deviation of 5.52. The test rejects the null hypothesis, which implies there is sufficient evidence revealing that tutoring impacts students' physics scores.

b. Compute the effect size using r^2. (2 points)

$$r^2 = \frac{t^2}{t^2 + df} = \frac{9.448^2}{9.448^2 + 9} = 0.91$$

The effect size of 0.91 reveals that tutoring had a very strong effect on students' test outcomes.

c. Calculate the point estimate for μ_D. (2 points)

The point estimate for μ_D is 68.8 − 52.3 = 16.5

d. Calculate the 99% confidence interval for μ_D. (2 points)

Based on the output at 99% confidence level, the confidence interval for μ_D fall between 10.82 and 22.18.

Output

Paired samples test result at 99% confidence interval

Paired Samples Test

		Paired Differences							
					99% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Post_tutoring - Pre_tutoring	16.50	5.52268	1.74642	10.82441	22.17559	9.448	9	.000