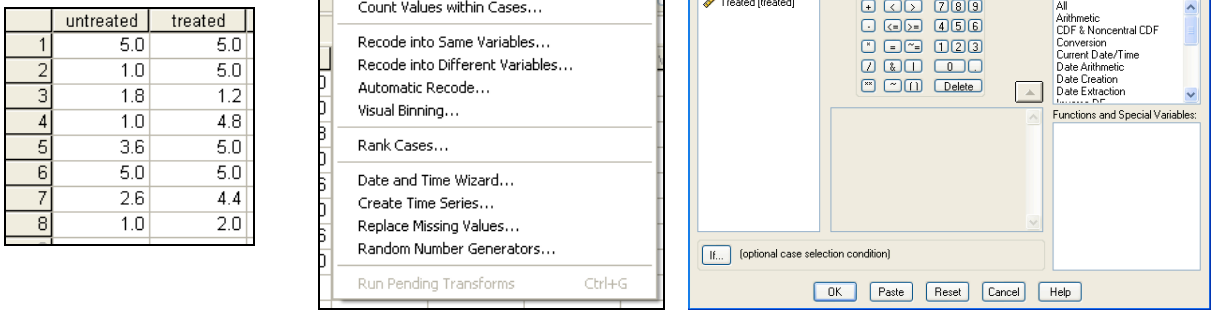
Paired-Sample T-Tests in SPSS

STAT 314

Eight samples of effluent from a pulp mill were each divided into ten batches. From each sample, five randomly selected batches were subjected to a treatment process intended to remove toxic substances. Five fish of the same species were placed in each batch, and the mean number surviving in the five treated and untreated portions of each effluent sample after five days were recorded and are given below. Test to see if the treatment increased the mean number of surviving fish. (Use $\alpha = 0.01$.)

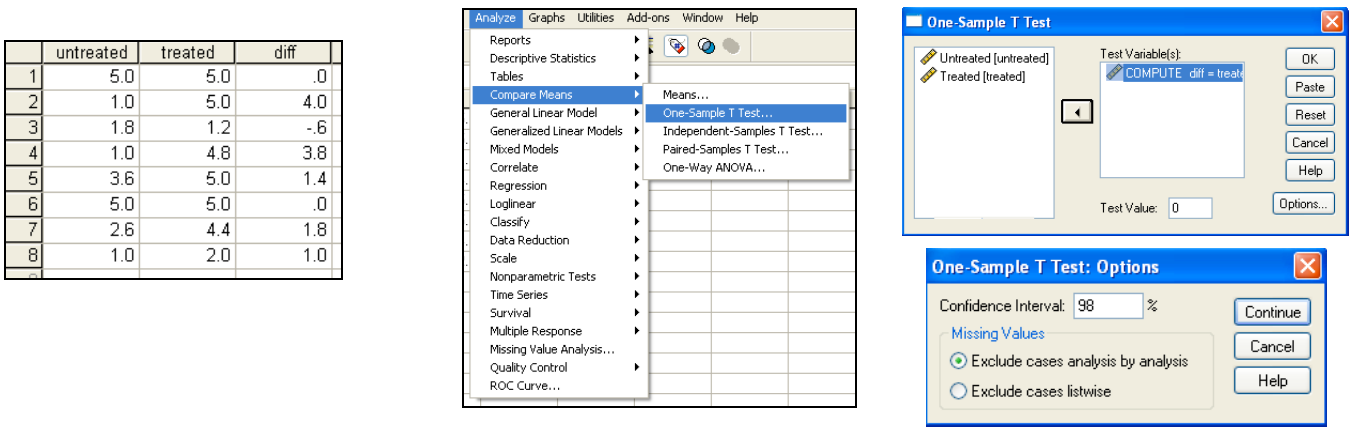
Sample No.	1	2	3	4	5	6	7	8
			Mean Number Surviving					
Untreated	5	1	1.8	1	3.6	5	2.6	1
Treated	5	5	1.2	4.8	5	5	4.4	2

1. Enter the values for "Untreated" into one variable and values for "Treated" into another variable *(see left figure, below)*. Be sure the pairings are correct from row to row. Now select "Compute Variable" from the "Transform" menu. Name the target variable "diff" and create the Numeric Expression "treated" minus "untreated". After selecting "OK," the computed differences will appear in the Data Window *(see left figure, below step 3)*. Be sure to create a Normal Q–Q Plot to assess the normality of the created differences *(see separate handout on Normal Q–Q Plots)*.

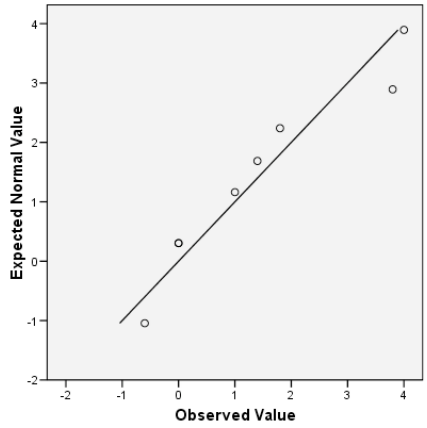


2. Select Analyze → Compare Means → One-Sample T Test… *(see middle figure, below)*.

3. Select "diff," and then click the arrow button to enter it as the test variable. Click the "Options…" button and enter the appropriate confidence level (98%), if needed. Click "Continue" to close the options and then click "OK" *(see the 2 right figures, below)*.



4. Your output should look like this.



One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
COMPUTE diff = treated - untreated	8	1.4250	1.7219	.6088

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	98% Confidence Interval of the Difference Lower	Upper
COMPUTE diff = treated - untreated	2.3407	7	.0518	1.4250	-.4001	3.2501

5. You should use the output information in the following manner to answer the question.

Let the differences be computed as "Treated" minus "Untreated."

Step 0: The data is approximately normal since the points lie close to the diagonal line in the Normal Q-Q Plot.

Step 1: **Hypotheses**

$H_0 : \mu_d = 0$

$H_a : \mu_d > 0$

Step 2: **Significance Level**

$\alpha = 0.01$

Step 3: **Rejection Region**

Since we have paired data and don't know the population variance of the differences (σ_d^2), we'll use the paired *t*-test.

Reject the null hypothesis if *p*-value ≤ 0.01.

Step 4: **Test Statistic**

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	98% Confidence Interval of the Difference Lower	Upper
COMPUTE diff = treated - untreated	2.3407	7	.0518	1.4250	-.4001	3.2501

From the output, $T = 2.3407$ with 7 degrees of freedom.

$p\text{-value} = Sig.(2-tailed) \div 2 = 0.0518 \div 2 = 0.0259$

Step 5: **Conclusion**

Since *p*-value = 0.0259 > 0.01 = α, we fail to reject the null hypothesis.

Step 6: **State conclusion in words**

At the α = 0.01 level of significance, there is not enough evidence to conclude that the treatment increased the mean number of surviving fish. [Since we failed to reject the null hypothesis, no confidence interval is needed.]