



EXCEL TUTORIAL:

# PAIRED SAMPLES $t$ & WILCOXON SIGNED RANKS TESTS

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*parametric analysis for within-subjects designs*

# PAIRED SAMPLES $t$ TEST

## COMPARE MEANS (PAIRED SAMPLES $t$ )

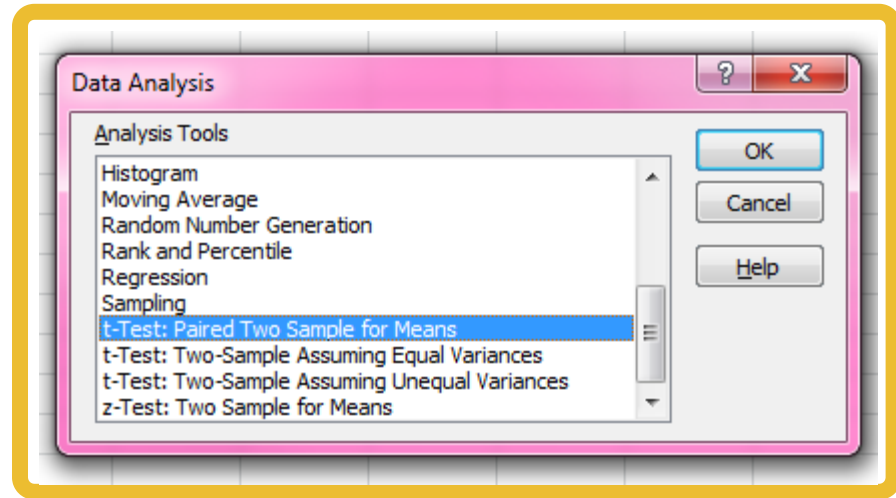
Use the *DataAnalysis* button on the *Data* tab to select the *t-Test :Paired Two Sample for Means* test, click on *OK*.

Enter the data range for the dependent variable into the *t-Test: Paired Two Sample for Means* dialogue box.

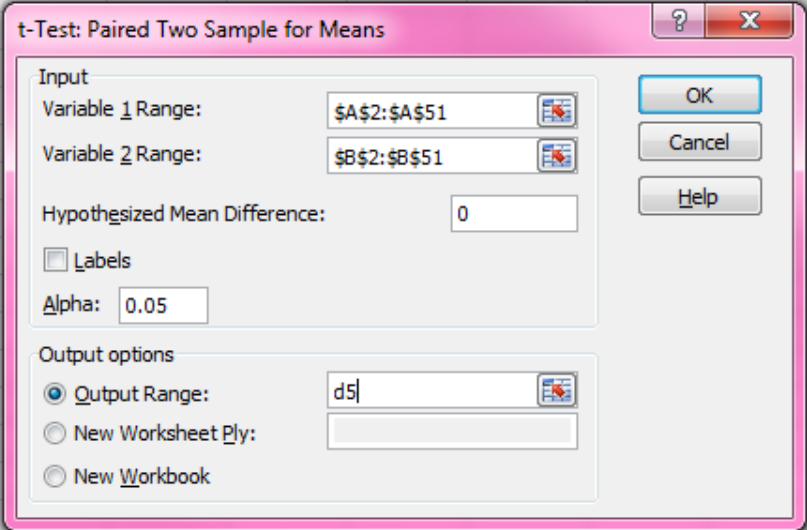
*Variable 1* = cells of DV which correspond to time1/group1

*Variable 2* = cells of DV which correspond to time2/group2

Specify hypothesized mean difference ( $H_0$ ), alpha level, output location, click on *OK*.



	A	B	C	D	E	F	G	H	I
1	Var1	Var2							
2	0.0265	1.0170							
3	0.3856	0.6742							
4	0.2449	0.6630							
5	0.2432	1.2952							
6	0.8494	0.5053							
7	0.2441	1.2034							
8	0.6415	0.7734							
9	0.9672	0.2899							
10	0.6281	0.5307							
11	0.7345	0.4790							
12	0.8739	1.4677							
13	0.9438	1.4164							
14	0.7445	1.1199							
15	0.5067	0.7152							
16	0.8787	1.0983							



## COMPARE MEANS (PAIRED SAMPLES $t$ )

Inspect output to determine if the means are significantly different from each other.

If  $p > \alpha$ ,  $t$  test is not significant, and null hypothesis should be retained.

t-Test: Paired Two Sample for Means		
	Variable 1	Variable 2
Mean	0.500772757	0.986656537
Variance	0.0845837	0.13479887
Observations	50	50
Pearson Correlation	0.052675192	
Hypothesized Mean Difference	0	
df	49	
t Stat	-7.530894641	
P(T<=t) one-tail	5.01483E-10	
t Critical one-tail	1.676550893	
P(T<=t) two-tail	1.00297E-09	
t Critical two-tail	2.009575237	

## CALCULATE EFFECT SIZE (COHEN'S $d$ )

Use the online effect size calculator to calculate the Cohen's  $d$  effect size for the paired samples  $t$  test statistic

<http://www.uccs.edu/~lbecker/>

### Calculate $d$ and $r$ using means and standard deviations

Calculate the value of Cohen's  $d$  and the effect-size correlation,  $r_{Y\lambda}$ , using the means and standard deviations of two groups (treatment and control).

$$\text{Cohen's } d = M_1 - M_2 / \sigma_{\text{pooled}}$$

$$\text{where } \sigma_{\text{pooled}} = \sqrt{[(\sigma_1^2 + \sigma_2^2) / 2]}$$

$$r_{Y\lambda} = d / \sqrt{(d^2 + 4)}$$

Note:  $d$  and  $r_{Y\lambda}$  are positive if the mean difference is in the predicted direction.

Group 1	Group 2
$M_1$ .9867	$M_2$ .5008
$SD_1$ .1348	$SD_2$ .0846
<input type="button" value="Compute"/>	<input type="button" value="Reset"/>
<b>Cohen's <math>d</math></b> 4.3177722	<b>effect-size <math>r</math></b> 0.9073842

*nonparametric analysis for within-subjects designs*

# WILCOXON SIGNED RANKS TEST

# COMPARE DIFFERENCE RANKS (WILCOXON)

**Step 1:** Calculate difference scores for the two variables

`=CELL1-CELL2`

	A	B	C
1	Var1	Var2	DIFFERENCE
2	0.0265	1.0170	=A2-B2
3	0.3856	0.6742	0.7006

**Step 2:** Calculate absolute values of difference scores

`=ABS(DIFFERENCESCORE)`

	A	B	C	D	E
1	Var1	Var2	DIFFERENCE	ABS-difference	RANK
2	0.0265	1.0170	-0.9905	=ABS(C2)	
3	0.3856	0.6742	-0.2886	0.288618068	

**Step 3:** Calculate ranks for absolute values of difference scores

`=RANK.AVG(CELL,RANGE,1)`

	A	B	C	D	E	F	G
1	Var1	Var2	DIFFERENCE	ABS-difference	RANK-corrected	POSITIVE	NEGATIVE
2	0.0265	1.0170	-0.9905	0.990484412	=RANK.AVG(D2,\$D\$2:\$D\$5,1)		
3	0.3856	0.6742	-0.2886	0.288618068	RANK.AVG(number, ref, [order])		
4	0.7449	0.6630	-0.4181	0.418123464			

# COMPARE DIFFERENCE RANKS (WILCOXON)

**Step 4:** Create column for ranks of positive difference scores

`=IF(DIFFERENCESCORE>0,VALUE,CELL,"")`

	A	B	C	D	E	F	G
1	Var1	Var2	DIFFERENCE	ABS-difference	RANK-corrected	POSITIVEr	NEGAT
2	0.0265	1.0170	-0.9905	0.990484412	43	=IF(C2>0,E2,"")	
3	0.3856	0.6742	-0.2886	0.288618068	13	IF(logical test, [v	

**Step 5:** Create column for ranks of negative difference scores

`=IF(DIFFERENCESCORE<0,VALUE,CELL,"")`

	A	B	C	D	E	F	G	H
1	Var1	Var2	DIFFERENCE	ABS-difference	RANK-corrected	POSITIVEr	NEGATIVErank	
2	0.0265	1.0170	-0.9905	0.990484412	43		=IF(C2<0,E2,"")	
3	0.3856	0.6742	-0.2886	0.288618068	13		IF(logical test, [v	

**Step 6:** Sum positive ranks, sum negative ranks

`=SUM(RANGE)`

	F	G	H	I	J	K	L
d	POSITIVEr	NEGATIVErank					
13			43	sum positi		=SUM(F2:F51)	
13			13	sum negative ranks =		SUM(number1, [r	
11			21				



# COMPARE DIFFERENCE RANKS (WILCOXON)

**Step 7:** Calculate sample size of ranks in positive and negative values columns

**=COUNT(RANGE)**

F	G	H	I	J	K	L	M
POSITIVEranks	NEGATIVEranks						
	43			sum positive ranks =	96		
	13			sum negative ranks =	1179		
	21						
	44			sample size =	=COUNT(F2:G51)		
14							
	**						

**Step 8:** Compare smaller of two ranked sum values and sample size to the *Wilcoxon Distribution Table* of critical values

sum of ranks (smaller)	96	1179
sample size	50	
<b>p &lt; 0.01 (obtained from critical value table)</b>		