

MATHEMATICS 360-255-LW

Quantitative Methods II

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Two Population Tests with Excel

Hypothesis testing for the mean of two dependent samples

Example 1

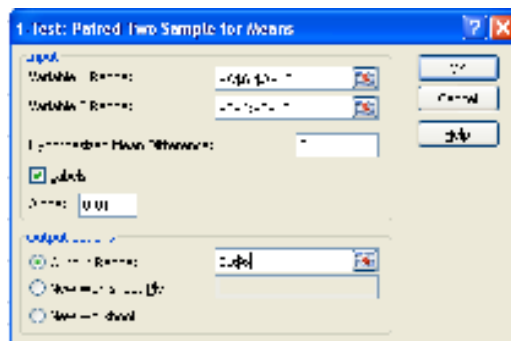
A company claims its 12-week exercise program significantly reduces weight. A random sample of 6 persons was selected and their weight (in kg) measured before and after the program.

Before	After
91	86
84	88
109	100
142	121
94	92
120	111

At the 1% level of significance, can you conclude that the mean weight loss is greater than zero? Assume the populations are normally distributed. Use the classical approach.

Make the usual heading in cells A1:A4. In cell A6 write “Before” and in cell B6 “After”. Enter the above data in below these two headings, in cells A6:B11.

Go to DATA – DATA ANALYSIS – T-TEST: PAIRED TWO SAMPLE FOR MEANS to access the following dialogue box. If you cannot find DATA ANALYSIS, go to EXCEL OPTIONS, ADD-INS and click on ANALYSIS TOOL PACK. Here is the dialogue box that should appear.



For the VARIABLE 1 RANGE, we use the Before column, so cells A6:A11. For the VARIABLE 2 RANGE, we use the After column. The HYPOTHESIZED MEAN DIFFERENCE is 0 since the null hypothesis is $H_0 : \mu_d = 0$. Click on LABELS. Use D6 for the OUTPUT RANGE, and make sure that you put 1% for ALPHA.

Once you have the results, adjust the columns widths accordingly and round some of the numbers. Your Excel worksheet should look like:

	Before	After	t-Test: Paired Two Sample for Means	
	91	86		
	84	88		
	109	100	Mean	106.67 99.67
	142	121	Variance	470.27 193.07
	94	92	Observations	6 6
	120	111	Pearson Correlation	0.9832
			Hypothesized Mean Difference	0
			df	5
			t Stat	2.038
			P(T<=t) one-tail	0.0486
			t Critical one-tail	3.365
			P(T<=t) two-tail	0.097
			t Critical two-tail	4.032

$H_0: \mu_d = 0$

Degrees of freedom

$$t = \frac{\bar{d} - \mu_d}{\frac{s_d}{\sqrt{n}}}$$

$p\text{-value} - \text{one tail}$

$t_{(df, \alpha)}$

$p\text{-value} - \text{two tails}$

$t_{(df, \frac{\alpha}{2})}$

You can then complete the 5 steps, making cell references in step 3 and step 4. Here is what your worksheet should look like, where the shaded cells are obtained with an appropriate cell reference.

	Before	After	t-Test: Paired Two Sample for Means			Step 1
	91	86				Assumptions: Population normally distributed
	84	88				Step 2
	109	100	Mean	106.67 99.67		$H_0: \mu_d = 0$
	142	121	Variance	470.27 193.07		$H_A: \mu_d > 0$
	94	92	Observations	6 6		Step 3
	120	111	Pearson Correlation	0.9832		Test statistic: t with df = 5
			Hypothesized Mean Difference	0		Right-tailed Test
			df	5		$\alpha = 5\%$
			t Stat	2.038		t critical = 3.365
			P(T<=t) one-tail	0.0486		t = 2.04
			t Critical one-tail	3.365		Step 4
			P(T<=t) two-tail	0.097		t is not in the critical region
			t Critical two-tail	4.032		Step 5
						Fail to reject H_0
						There is not sufficient evidence, at the 5% level of significance to conclude that student heights are different than 1.7 m.

Hypothesis testing for the mean of two independent (unknown σ)

Example 3

A social psychologist was interested in sex differences in the sociability of teenagers. Using the number of good friends as a measure, he compared the sociability of eight female and seven male teenagers. Is there a difference with respect to sociability between teenage females and males? Use a 3% level of significance. Assume that the sociability of female and male teenagers are normally distributed. Use the p -value approach.

Females	Males
8	1
3	5
1	8
7	3
7	2
6	1
8	2
5	

As in the previous example, copy this table in cells A6:B14. Proceed as in the previous example, except use T-TEST: TWO-SAMPLE ASSUMING EQUAL VARIANCES in DATA ANALYSIS. Your results should look like this (where the relevant information was highlighted).

Females	Males	t-Test: Two-Sample Assuming Equal Variances		Step 1	Assumptions: Population normally distributed
8	1				Samples are independent
3	5				Variances are equal
1	8	Mean	5.625 3.143	Step 2	H ₀ : $\mu_F - \mu_M = 0$
7	3	Variance	6.268 6.476		H _A : $\mu_F - \mu_M \neq 0$
7	2	Observations	8 7	Step 3	Test statistic: t with $df = 13$
6	1	Pooled Variance	6.3640		Two-tailed Test with $\alpha = 5\%$
8	2	Hypothesized Mean Difference	0	Step 4	$t = 1.901$
5		df	13	Step 5	t critical = 0.0797
		t Stat	1.901		p -value > α
		P(T<=t) one-tail	0.0398		Fail to reject H ₀
		t Critical one-tail	2.060		There is not sufficient evidence, at the 5% level of significance to conclude that there is a difference in sociability between teenage men and women
		P(T<=t) two-tail	0.0797		
		t Critical two-tail	2.436		

$$S_p = \sqrt{\frac{(n_F - 1)s_F^2 + (n_M - 1)s_M^2}{n_F + n_M - 2}}$$

$$t = \frac{\bar{x}_F - \bar{x}_M}{S_p \sqrt{\frac{1}{n_F} + \frac{1}{n_M}}}$$