

G7. t-tests

7.1. Paired t-tests

7.1.1. The effect of saline on the blood PH was examined in a certain disease. The blood PH value was measured two times: before the treatment and 20 minutes later, after infusion of saline (n=18). Is there a significant change in mean blood PH level a 5% level?

0'	20'	Descriptive stat.:	0'	20'	Difference
7.43	7.43	Mean	7.3821	7.3911	-0.009
7.39	7.39	SD	0.0331	0.03336	0.026

7.37 7.38
7.43 7.42
7.39 7.39
7.36 7.41
7.38 7.38
7.39 7.39
7.34 7.41
7.32 7.35
7.40 7.39
7.32 7.33
7.42 7.39
7.42 7.40
7.37 7.36
7.37 7.39
7.39 7.37
7.43 7.48

Mean-SD
diagram:



The name of the appropriate test:

H₀: H_A:

t= df= critical t-value=

Decision:

Consequences:

Check your calculation using results of SPSS:

1. Find the 95% confidence interval for the difference:

Decision based on the confidence interval:

2. Find t=, df=

Decision based on t-value:

3. Find the p-value:

Decision based on p-value:

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	D1 T0	7.3821	18	.03314	.00781
	D1 T20	7.3911	18	.03360	.00792

Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	D1 T0 - D1 T20	-.0090	.02624	.00619	-.0220	.0040	-1.455	17	.164

7.1.2. The effect of Na-lactate on the blood PH was examined in a certain disease. The blood PH value was measured two times: before the treatment and 20 minutes later, after infusion of Na-lactate (n=20). Is there a significant change in mean blood PH level a 5% level?

0'	20'		0'	20'	Difference
7.42	7.46	Mean	7.387	7.446	-0.059
7.36	7.43	SD	0.0429	0.036	0.043
7.40	7.46				
7.43	7.48				
7.38	7.42				
7.32	7.45				
7.37	7.46	Mean-SD diagram:			
7.36	7.48				
7.34	7.45				
7.31	7.37				
7.34	7.47				
7.37	7.43				
7.42	7.48				
7.42	7.43				
7.46	7.51				
7.37	7.41				
7.45	7.48				
7.42	7.44				
7.42	7.37				
7.41	7.45				

The name of the appropriate test:.....
 HO:..... HA:.....
 t=..... df=..... critical t-value=.....
 Decision.....
 Consequences

Check your calculation using results of SPSS:
 1. Find the 95% confidence interval for the difference.....
 Decision based on the confidence interval.....
 2. Find t=....., df=.....
 Decision based on t-value.....
 3. Find the p-value.....
 Decision based on p-value.....

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 D2 T0	7.3871	20	.04294	.00960
D2 T20	7.4461	20	.03594	.00804

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 D2 T0 - D2 T20	-.0590	.04364	.00976	-.0794	-.0385	-6.041	19	.000

7.1.3. The systolic blood pressure of 6 patients was measured before and after a new drug. The mean of the sample differences = 6 mmHg, the standard error of the differences was SE=4.65. Is there a significant change in blood pressure at 5% and at 1% level? ($t_{5,0.05}=2.57$, $t_{5,0.01}=4.03$).

5% level:	1% level:
H0:	H0:
HA:	HA:
$\alpha=$	$\alpha=$
degrees of freedom=.....	degrees of freedom=.....
t=.....	t=.....
decision.....	decision.....

7.1.4. The body mass of 16 patients was measured before and after a special diet. The mean of the sample differences was = 5 kg, the standard deviation of the differences was SD=2.5. Is there a significant change in blood pressure at 5% and at 1% level?.

5% level:	1% level
H0:	H0:
HA:	HA:
$\alpha=$	$\alpha=$
degrees of freedom=.....	degrees of freedom=.....
$t_{table}=$	$t_{table}=$
t=	t=
decision.....	decision.....

Problems to be solved by SPSS

7.1.5. Open the file BEAFTER.SAV . A study was conducted to determine weight loss, body composition, etc. in obese women before and after 12 weeks of treatment with a very-low-calorie diet . Column BEFORE and AFTER contain weights of 9 women. We wish to know if these data provide sufficient evidence to allow us to conclude that the treatment is effective in causing weight reduction in obese women. Let $\alpha=0.05$.

(Statistics/Compare Means/Paired-Samples T-test with variables before and after),

Before diet Meanstandard deviation.....

After diet Meanstandard deviation.....

The name of the appropriate test:.....

What is the null hypothesis?.....

What is the alternative hypothesis?.....

The result of the test

Based on confidence interval

95% CI for the difference: (..... ,)

Decision:.....

Based on t-value

t=..... df=..... $t_{table}=$ Decision:

Based on p-value

.p=..... Decision

7.1.6. Open the file **QUEST2010.SAV**. Compare the mean change of the body mass.

7.1.7. Open the file **Anthropometrics.sav**. Compare the mean of two consecutive measurements.

7.2. Two-sample t-tests.

Problems to be solved manually

7.2.1. Suppose we measured the blood pressure of two groups of people: the first group was not treated (control group), the second group was treated. We would like to test prove that the treatment was effective.

Control group Treatment group

170
160
150
150
180
170
160
160

120
130
120
130
110
130
140
150
130
120

$\bar{x}=162.5$

$SD_x=10.351$

$SD_x^2=107.14$

$\bar{y}=128$

$SD_y=11.35$

$SD_y^2=128.88$

$s_p^2 = \frac{7 \cdot 107.14 + 9 \cdot 128.88}{10 + 8 - 2} = \frac{749.98 + 1160}{16} = 119.37$

$$t = \frac{162.5 - 128}{\sqrt{119.37}} \cdot \sqrt{\frac{10 \cdot 8}{18}} = \frac{34.5}{10.92} \cdot \sqrt{4.444} = 6.6569$$

The name of the appropriate test:.....

HO:.....

HA:.....

Assumptions:.....

Check visually the equality of variances:

a) Make a decision based on t -value.

$t=$ $df=$ critical t -value= $.....$ Decision:.....

b) Make a decision based on p -value. $p=0.000005511$. Decision:

Check your calculation using results of SPSS:

Group Statistics

	treatment	N	Mean	Std. Deviation	Std. Error Mean
BP	Control	8	162.5000	10.35098	3.65963
	Treatment	10	128.0000	11.35292	3.59011

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
BP	Equal variances assumed	.008	.930	6.657	16	.000	34.50000	5.18260	23.51337	45.48663
	Equal variances not assumed			6.730	15.669	.000	34.50000	5.12657	23.61347	45.38653

Equality of variances, p -value:.....

Equality of variances, decision:.....

Equality of population means:

$t=$ $df=$ $p=$

95% CI of the difference:

7.2.2. The body mass of secondary school girls was compared in two Hungarian cities. Decide whether the two samples are drawn from populations having the same mean? Read the results from the SPSS output below.

Group Statistics

	VAROS	N	Mean	Std. Deviation	Std. Error Mean
Jelenlegi testsúlya /kg/	Szeged	133	57.94	9.093	.788
	Békéscs.	69	54.97	7.837	.943

The name of the appropriate test:.....
 HO:.....
 HA:.....
 Assumptions:.....
 Check visually the equality of variances:
 Equality of variances, p-value:.....
 Equality of variances, decision:.....
 Equality of population means:
 t=..... df=..... p=.....
 95% CI of the difference:

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Jelenlegi testsúlya /kg/	Equal variances assumed	.031	.861	2.304	200	.022	2.97	1.289	.428	5.510
	Equal variances not assumed			2.415	156.767	.017	2.97	1.229	.540	5.397

Problems to be solved by SPSS

7.2.3. Open the file **QUEST2010.SAV**. Compare the mean body mass of boys and girls.
 (Statistics/Compare Means/Independent-Samples T-test with mass->Test variable and sex->Grouping variable/Define Groups: 0 and 1/Continue/OK),

The name of the appropriate test:.....
 HO:.....
 HA:.....
 Assumptions:.....

Male Sample size..... Meanstandard deviation.....
 Female Sample size..... Meanstandard deviation.....
 Equality of Variances.....
 t.....df (degrees of freedom).....2-Tail Sig (p-value).....
 Conclusions.....

7.2.4. Open the file **szulsuly.sav**. Variable **bwt** contains the body weight of the newborn babies and variable **smoke** contains values according to the mother smoking (0- not, 1 – yes). Compare the mean body weight of the babies by smoking habits of the mother!

7.2.5. Open the file **Anthropometrics.sav**. Compare the body height of boys and girls! Find other variables to be compared and find the appropriate test!

7.2.6. Open the file **CALC.SAV**. Here, systolic blood pressures are given before and after a calcium treatment in two groups. Find problems where paired t-tests can be used. Find problems where two-sample t-tests can be used.

7.2.7. Open the file **NEWDRUG.SAV** from the SPSS library (c:\Program Files\SPSS.....). Find problems where paired t-tests can be used. Find problems where two-sample t-tests can be used.