Course : Research statistics **Lecturer : Pr. Saliha CHELLI**

Level : Master

Lecture : 9

Dependent-samples t-tests

Lecture objectives : Introducing the dependent-samples t-tests and how to compute it.

Introduction

Comparing various groups of people is the most common statistical procedure in applied linguistics research. In statistics there are different methods available for such comparisons depending on the number of groups. If we take two sets of scores, we are bound to find some difference in the raw scores, but we cannot assume that the observed difference reflects any real difference, thus, we need a t-test statistics to check whether we have a more generalizable result or whether the score is likely to be merely an artefact of random variation. Among the big number of t-test, this lectures introduces the dependent-samples t-tests.

The **dependent-samples t-test**, also called the **paired-samples t-test**, is for the research design where we want to compare two sets of scores obtained from the same group (before and after the treatment).

Before computing the test

First, we choose the level of statistical significance α= 0.05

Degree of freedom for one sample ⟶ df= N-1

Critical value for df at the level 0.05 (refer to the critical table in the appendix). We should also be aware whether the hypothesis is one –tailed or two-tailed.

The following formula can be used to compute the dependent-samples t-test

N refers to the sample

d refers to the difference between the two tests

d² refers to the difference squared

Computation of the t- test for dependent samples (Miller, 1984, p.80)

GENERAL PROCEDURE

I. Calculate the difference, *d,* between each pair of scores: ($X_1 - X_2$). Subtract consistently and be sure to record the minus signs.

II Calculate the mean difference using:

$$\bar{d} = \frac{\Sigma d}{N}$$

III Calculate the standard deviation of the differences using the formula:

$$S_d = \sqrt{\frac{\Sigma d^2}{N} - \bar{d}^2}$$

IV. Substitute the values of the mean difference the standard deviation of the differences (S_d), and the sample size *(N)* in the following formula and calculate *t:*

$$t_{N-1} = \frac{\bar{d}}{S_d / \sqrt{N-1}}$$

V. Find the critical value of *t* for the desired level of significance using the appendix . This value will depend on (1) the number of degrees of freedom (*N*−1 in this test) and (2) whether the *direction* of the difference between the two conditions was predicted before the experiment.

VI. If the observed value of *t* is equal to or greater than the critical value, reject the null hypothesis in favour of the alternate hypothesis—i.e. conclude that the independent variable has had an effect on behaviour.

EXAMPLE (adpted from Miller,1984,pp.80-81)

The experimenter predicts a difference between Method 1 and method 2 on students writing (two tailed).

Students	Test 1 Scores X_1	Test 2 scores X_2	Difference (X_1- X_2) d	Differences squared d^2
1	4	6	-2	4
2	7	8	-1	1
3	5	4	-1	1
4	4	8	-4	16
5	9	8	1	1
6	7	10	-3	9
7	6	8	-2	4
8	7	7	0	0
9	5	9	-4	16
10	7	9	-2	4

d= -16 d^2= 56

I.Calculation of the mean difference

$$\bar{d} = \frac{\Sigma d}{N} = \frac{-16}{10} = -1{\cdot}6$$

II.Calculation of the standard deviation of the difference

$$S_d = \sqrt{\frac{\Sigma d^2}{N} - \bar{d}^2} = \sqrt{\frac{56}{10} - (-1{\cdot}6)^2} = \sqrt{5{\cdot}6 - 2{\cdot}56}$$
$$= 1{\cdot}7436$$

III.calculation of the t-test

$$t_{N-1} = \frac{\bar{d}}{S_d/\sqrt{N-1}} = \frac{-1{\cdot}6}{1{\cdot}7436/\sqrt{9}} = \frac{-1{\cdot}6 \times 3}{1{\cdot}7436} = -2{\cdot}75^*$$

V Using the appendix for nine degrees of freedom the value of *t* required for the 0.05 (two-tailed) is 2·262.
VI. ***Conclusio****n.* As the observed value of *t* is greater than 2·262, we canconclude that there is a significant difference between the effects method1 and method 2

Appendix : **The *t* distribution critical values of *t* for a *two-tailed* test**

α (2 tail)	0.05	α (2 tail)	0.05
df		df	
1	12·706	16	2·120
2	4·303	17	2·110
3	3·182	18	2·101
4	2·776	19	2·093
5	2·571	20	2·086
6	2·447	21	2·080
7	2·365	22	2·074
8	2·306	23	2·069
9	**2·262**	24	2·064
10	2·228	25	2·060
11	2·201	26	2·056
12	2·179	27	2·052
13	2·160	28	2·048
14	2·145	29	2·045
15	2·131	30	2·042

References

Miller, S. (1984). Experimental design and statistics (2nd ed.). London and New York: Routledge

References for further reading

Greasley, P. (2008). Quantitative data analysis using SPSS. Mc Grill Hill : Open Univeristy.

MUIjs , D. Doing quantitative research in education with SPSS. London : Sage Publications