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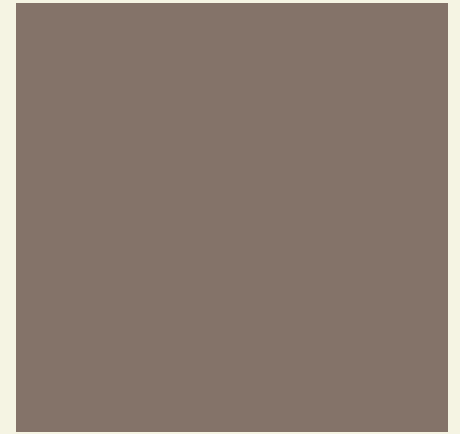
ICCPP-STATISTICS

- A test

Vishal Lohchab

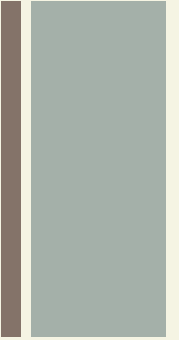
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+ Definition

- A-test is a statistical test which is used to check the mean difference of two dependent (correlating) samples for statistical significance.



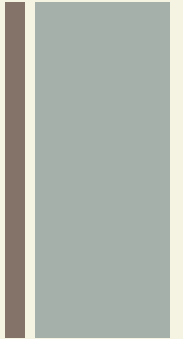
+ Purpose

- The \bar{A} -test is suitable for the two-sided test of the null hypothesis

$$H_0: \mu_1 - \mu_2 = \Delta = 0.$$

- The test statistic \bar{A} is derived from the t-statistic, so that the \bar{A} -test always leads to the same conclusions regarding the significance as the t-test for dependent samples.

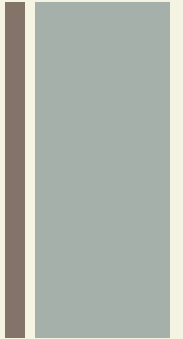
+ A test



- Advantage

The advantage of the A-test lies in the much simpler calculation of the test size.

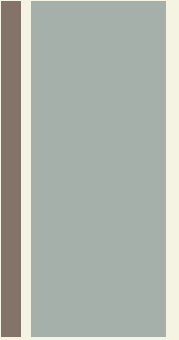
+ Requirements



- There are two dependent samples;
or to put it another way: there is a population of
pairs of measured values
and this population has become a random sample
was drawn.

+ Requirements

- The differences between the pairs of measured values D_i (where $D_i = X_{i,1} - X_{i,2}$) are normally distributed in the population.

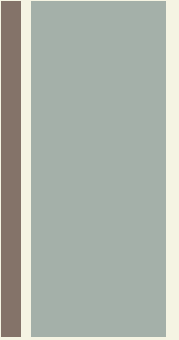


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Null hypothesis

- The two samples come from total populations with the same mean values.

$$H_0 : \mu_1 = \mu_2 ; \text{ or } \mu_1 - \mu_2 = \Delta = 0$$



+ Null hypothesis

- Or in other words:

The sample with the mean D ($D = \text{mean of the differences} = x_{.1} - x_{.2}$) comes from a population with the mean $\Delta = 0$.

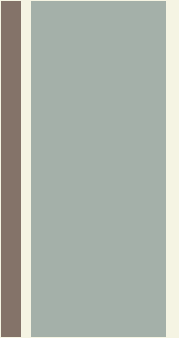
$$H_0 : \Delta = 0$$

+ Alternative hypothesis

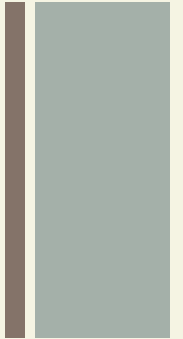
- $H_1 : \mu_1 \neq \mu_2 ;$

- or $\mu_1 - \mu_2 = \Delta \neq 0$

- or $\Delta \neq 0$



+ A test



- (A) Arrangement of the data

The data from the investigation can be arranged as follows:



Measured value pair no.	Condition (sample 1)	Condition (sample 2)	Difference between the pairs of measured values	
	Column 1	Column 2	Column 3	Column 4
1	X_{11}	X_{12}	$D_1 = X_{11} - X_{12}$	
2	X_{21}	X_{22}	$D_2 = X_{21} - X_{22}$	
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
1	X_{i1}	X_{i2}	$D_i = X_{i1} - X_{i2}$	
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
n	X_{n1}	X_{n2}	$D_n = X_{n1} - X_{n2}$	

+ A test

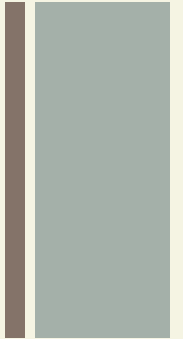
- (B) Overview of the calculations:

The null hypothesis is tested against H1 using the following test statistic:

$$A = \frac{\sum_{i=1}^n D_i^2}{\left(\sum_{i=1}^n D_i\right)^2}$$

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A test



■ Where:

$D_i = X_{i1} - X_{i2}$ = difference between the measured values in the measured value pair (test subjects) i .

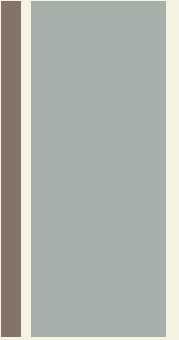
Degree of freedom: $FG = n - 1$

(where n = number of value pairs)

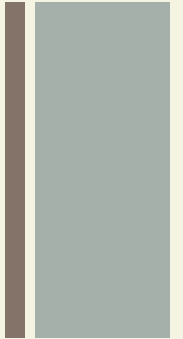
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A test

- The null hypothesis is rejected if the calculated A-value is equal to or smaller than the table value in the A-table belonging to "a" and the degrees of freedom.



+ Calculation steps



For a clearer execution of the calculation steps 1-4 we create a table (like the one in section A).

Step 1

For each of the n pairs of measured values, form the difference D_i from the two measured values, i. e.

+ Calculation steps

For each pair, subtract the measured value of term 2 (column 2 of the table) from the measured value under condition 2 (column 2 of the table) from the measured value under both conditions 2 (column 1 of the table).

The differences D_i are entered in column 3 of the table.

$$D_1 = X_{11} - X_{12}, \dots, D_i = X_{i1} - X_{i2}, \dots, D_n = X_{n1} - X_{n2}$$

+ Calculation steps

Step 2

Square the differences D_i calculated at 1, i.e. square the values in column 3 of the table.

Enter the squared differences in column 4 of the table.

$$D_1^2, \dots, D_i^2, \dots, D_n^2$$

+ Calculation steps

Step 3

Add up the n differences calculated for 1, i.e. add up the values in column 3 of the table.

That is the sum of the differences.

$$\sum_{1}^{n} D_1$$

+ Calculation steps

Step 4

Add up the values D_i^2 calculated for 2, i.e. add up the values in column 4 of the table.

That gives the sum of the squared differences.

$$\sum_{i=1}^n D_i^2$$

+ Calculation steps

Step 5

Calculate the value of the test statistic A by plugging the results of 3 and 4 into the following formula 1:

$$A = \frac{(4)}{(3)^2} = \frac{\sum_1^n D_i^2}{\left(\sum_1^n D_i\right)^2}$$

+ Calculation steps

Step 6

Determine the number of degrees of freedom:

$$FG = n - 1$$

The \bar{A} value calculated for 5 is now compared with the table value in the \bar{A} table (Table 5). This table value is

$$A_a; n - 1$$

+ Calculation steps

Step 7

Decision about the null hypothesis

If the \bar{A} value calculated at 5 is greater than the table attendant $\bar{A}_a ; n - 1$ ' then the null hypothesis is maintained.

+ Calculation steps

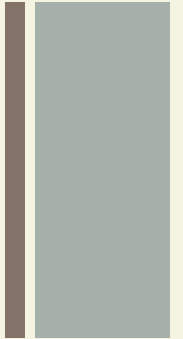
If the calculated \bar{A} value is equal to or less than the table value $\bar{A}_a; n - 1$ ' then the null hypothesis is rejected.

This leads to the acceptance of the alternative hypothesis:

$$H_1 : \mu_1 - \mu_2 = \Delta \neq 0 .$$



References



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