

Exercise 1:

In a study designed to discover whether men or women drink more coffee, a researcher on a very limited budget observes five men and five women randomly selected from her university department

Define null and alternative hypotheses for this study

Run the appropriate test, assuming that both men and women were originally part of one random sample with $n=10$ and were then divided into men's and women's groups

Can you reject the null hypothesis at $p=0.05$?

Men	Women
5	8
1	3
4	7
2	3
3	5
$\bar{X}_1 = 3.0$	$\bar{X}_2 = 5.2$
$n_1 = 5$	$n_2 = 5$
$SD_1^2 = 2.5$	$SD_2^2 = 5.2$

$$\text{Reminder } SD^2 = \frac{\sum(x - \bar{x})^2}{N-1}$$

$$t_{obt} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{SD_1^2 + SD_2^2}{n}}}$$

Degrees of freedom = total number of subjects - 2 = 8.

(use = VAR(A1:A5) if calculating using Excel)

H_0 (null hypothesis): Men and women drink the same amount of coffee
 $\bar{X}_1 = \bar{X}_2$

H_1 (alternative hypothesis): Men and women drink different amounts of coffee
 $\bar{X}_1 \neq \bar{X}_2$

$$t_{obt} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{SD_1^2 + SD_2^2}{n}}} = \frac{3.0 - 5.2}{\sqrt{\frac{2.5 + 5.2}{5}}} = \frac{-2.2}{\sqrt{1.54}} = \frac{-2.2}{1.24} = -1.77$$

* Ignore the sign *

Look up t_{crit} for $p=0.05$ and $df=8 \rightarrow 2.306$

$t_{obt} = 1.77$ which is less than $t_{crit} = 2.306$ so we cannot therefore reject the null hypothesis

Exercise 2

Using hospital and agency records, a researcher locates six pairs of twins, one of whom was adopted and one of whom was in foster care for at least three years. All of the twins are now five years old. The researcher wants to show that early adoption leads to better intellectual ability so tests all of the twins with an appropriate test. The results are as shown.

Define null and alternative hypotheses for this study

Run the appropriate test

Can you reject the null hypothesis at $p=0.05$?

Twin pair #	Adopted twin	Fostered twin	D
1	105	103	2
2	99	97	2
3	112	105	7
4	101	99	2
5	124	104	20
6	100	110	-10

Reminder $SD^2 = \frac{\sum(x-\bar{x})^2}{N-1}$

$$t_{obt} = \frac{\bar{D}}{\left(\frac{SD_D}{\sqrt{n}}\right)}$$

Degrees of freedom = total number of pairs - 1 = 5

$$\bar{D} = 3.83$$

$$SD_D = 9.72$$

$$df = 5$$

H_0 (null hypothesis): There is no difference between the two groups
 H_1 (alternative hypothesis): There is a difference between the two groups

$$t_{obt} = \frac{\bar{D}}{\left(\frac{SD_D}{\sqrt{n}}\right)} = \frac{3.83}{\left(\frac{9.72}{\sqrt{6}}\right)} = \frac{3.83}{\left(\frac{9.72}{2.45}\right)} = \frac{3.83}{3.97} = 0.96 \text{ * ignore the sign *}$$

Look up t_{crit} for $p=0.05$ and $df=5 \rightarrow 2.57$

$t_{obt} = 0.96$ which is less than $t_{crit} = 2.57$ so we cannot therefore reject the null hypothesis

Exercise 3

A researcher tests the high-frequency hearing acuity of a group of teens two days before they attend a rock concert. Two days after the concert she tests them again. Her results are in file DAV Datafile 16. She expects to find that the teens hear better before the concert than afterwards (the higher the score on the test the poorer the hearing)

Using the appropriate Excel function, analyse the data according to the 5 stage process

1. State your hypotheses
2. Select α , your significance level
3. Calculate t_{obt}
4. Find t_{crit}
5. Decide whether or not to reject the null hypothesis

H_0 (null hypothesis): Hearing was better after the concert
 H_1 (alternative hypothesis): Hearing was better before the concert.
 This is a paired two-sample test.

t-Test: Paired Two Sample for Means

	Before concert	After concert
Mean	8.333333333	10.08333333
Variance	15.87878788	20.4469697
Observations	12	12
Pearson Correlation	0.724836709	
Hypothesized Mean Difference	0	
df	11	
t Stat	-1.89771871	t_{obt}
P(T<=t) one-tail	0.042137572	
t Critical one-tail	1.795884819	t_{crit}
P(T<=t) two-tail	0.084275144	
t Critical two-tail	2.20098516	

ignore the sign

Because we specifically want to show that the "before" value is lower than the "after" value (not just different to) we use the one-tailed test.

$t_{obt} = 1.90$ which is greater than $t_{crit} = 1.80$ so we can therefore reject the null hypothesis and accept the alternative hypothesis.