Hypothesis Testing with Two Samples

Related Samples

Example: We give a group of students a drug awareness test, then show them a video about the dangers of drug use, and give them the test a second time after the video.

The two samples are linked on a case-by-case basis…

before & after

Drug Awareness Test Results

Subject	Test 1 T1	Test 2 T2
1	50	55
2	77	79
3	67	82
4	94	90
5	64	64
6	77	83
7	85	80
8	52	55
9	81	79
10	91	91
11	52	61
12	61	77
13	83	83
14	66	70
15	71	75

Null Hypothesis: There is no significant difference between the test scores.

That is, showing the video did not change the drug awareness of our group.

Need to find the differences between the two tests for each case

(T2 – T1)

Subject	Test 1 T1	Test 2 T2	Difference d
1	50	55	5
2	77	79	2
3	67	82	15
4	94	90	-4
5	64	64	0
6	77	83	6
7	85	80	-5
8	52	55	3
9	81	79	-2
10	91	91	0
11	52	61	9
12	61	77	16
13	83	83	0
14	66	70	4
15	71	75	4

$\Sigma d =$ 53

Ave= 3.53

Sum of the differences (Σd) = 53

Mean of the differences ($\bar{D}$ with bar over it) = 53 / 15 = 3.53

Calculate standard deviation of the differences

$$s_d = \sqrt{\frac{\Sigma(d-\bar{D})^2}{n-1}}$$

Subject	Test 1 T1	Test 2 T2	Difference d	d-Ave	$(d\text{-Ave})^2$
1	50	55	5	1.47	2.16
2	77	79	2	-1.53	2.34
3	67	82	15	11.47	131.56
4	94	90	-4	-7.53	56.7
5	64	64	0	-3.53	12.46
6	77	83	6	2.47	6.1
7	85	80	-5	-8.53	72.76
8	52	55	3	-0.53	0.28
9	81	79	-2	-5.53	30.58
10	91	91	0	-3.53	12.46
11	52	61	9	5.47	29.92
12	61	77	16	12.47	155.5
13	83	83	0	-3.53	12.46
14	66	70	4	0.47	0.22
15	71	75	4	0.47	0.22
		$\Sigma d=$	53	$\Sigma=$	525.72
		Ave=	3.53		

$$s_d = \sqrt{\frac{525.72}{15-1}}$$

$$s_d = \sqrt{37.55}$$

$$s_d = 6.13$$

Calculate the Estimate of the Standard Error

$$s_d = \sqrt{\frac{\Sigma(d-\bar{D})^2}{n-1}}$$

$$s_{\bar{D}} = \frac{s_d}{\sqrt{n}}$$

$$s_d = \sqrt{\frac{525.72}{15-1}}$$

$$s_d = \sqrt{37.55}$$

$$s_d = 6.13$$

$$s_{\bar{D}} = \frac{6.13}{\sqrt{15}}$$

$$s_{\bar{D}} = \frac{6.13}{3.87}$$

$$s_{\bar{D}} = 1.58$$

Calculate the ***t ratio***

$$t = \frac{\overline{D}}{s_{\overline{D}}}$$

$$t = \frac{3.53}{1.58}$$

$$t = 2.23$$

t ratio **= 2.23**

Identify the critical value

(Assume $\alpha = .05$)

df = n-1

=15-1

=14

Family of t Distributions (Two-Tailed Test

Degrees of Freedom (df)	LEVEL OF SIGNI		
	.20	.10	.05
5	1.476	2.015	2.571
6	1.440	1.943	2.447
7	1.415	1.895	2.365
8	1.397	1.860	2.306
9	1.383	1.833	2.262
10	1.372	1.812	2.228
11	1.363	1.796	2.201
12	1.356	1.782	2.179
13	1.350	1.771	2.160
14	1.345	1.761	2.145
15	1.341	1.753	2.131
16	1.337	1.746	2.120
17	1.333	1.740	2.110
18	1.330	1.734	2.101
19	1.328	1.729	2.093
20	1.325	1.725	2.086
21	1.323	1.721	2.080
22	1.321	1.717	2.074
23	1.319	1.714	2.069
24	1.318	1.711	2.064
25	1.316	1.708	2.060
26	1.315	1.706	2.056
27	1.314	1.703	2.052
28	1.313	1.701	2.048
29	1.311	1.699	2.045
30	1.310	1.697	2.042
40	1.303	1.684	2.021
50	1.299	1.676	2.009
60	1.296	1.671	2.000
80	1.292	1.664	1.990
100	1.290	1.660	1.984
120	1.289	1.658	1.980
∞	1.282	1.645	1.960

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11	1.363	1.796	2.201
12	1.356	1.782	2.179
13	1.350	1.771	2.160
14	1.345	1.761	2.145

df = 14
α = .05
cv = 2.145

Calculated *t ratio* was **2.23**

Critical value is **2.15**

Calculated *t ratio* was **2.23**

Critical value is **2.15**

Since the calculated t ratio (2.23) is greater than the critical value (2.15) we reject the null hypothesis that there is no difference in the test results.

Exposure to the drug awareness video appears to have some effect on test scores.