

# Independent Measures t-test

example

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	Time to complete task					
Tool A	BOB 6	SUE 3	JAN 1	AVI 8	$\bar{a} = 4.5$	$n_1 = 4$
Tool B	AL 2	JOE 4	ABE 10	TIA 6	$\bar{b} = 5.5$	$n_2 = 4$

Is there a significant difference between the two groups in their times? Use  $\alpha = 0.05$ .

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Answer:  $H_0: \mu_A - \mu_B = 0$ .

$H_1: \mu_A - \mu_B \neq 0$

$$t = \frac{(\bar{a} - \bar{b}) - \phi}{S_{\bar{a} - \bar{b}}}$$

for  $H_0$

$$S_{(\bar{a} - \bar{b})} = \sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}$$

$$s_p^2 = \frac{\sum_{i=1}^4 (a_i - \bar{a})^2 + \sum_{j=1}^4 (b_j - \bar{b})^2}{(n_1 - 1) + (n_2 - 1)}$$

$$= \frac{(1.5^2 + 1.5^2 + 3.5^2 + 3.5^2) + (3.5^2 + 1.5^2 + 4.5^2 + 1.5^2)}{6}$$

$$= \frac{66}{6} = 11$$

$$S_{\bar{a} - \bar{b}} = \sqrt{\frac{11}{4} + \frac{11}{4}} = \sqrt{\frac{11}{2}} \approx 2.3$$

So

$$t = \frac{-1}{2.3} = -0.43 > t_{(df=6, \alpha=0.05)} = -2.247$$

I cannot reject  $H_0$ .

## Repeated Measures t-test example

<u>person</u>	<u>before training</u>	<u>after training</u>	<u>diffs</u>
A	15	15	0
B	11	13	2
C	10	18	8
D	11	12	1
E	14	16	2
F	10	10	0
G	11	19	8
$n=7$			<hr/> 21 $\bar{d}=3$

Did training have a statistically significant effect? Use  $\alpha = 0.05$ .

Answer:  $H_0: \mu_{\Delta} = 0$

$H_1: \mu_{\Delta} \neq 0$

$$t \text{ for } H_0 \text{ is } \frac{\bar{d} - \mu_{\Delta}}{s_{\bar{d}}} = \frac{\bar{d} - 0}{s_{\bar{d}}}$$

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

$$s_d^2 = \frac{\sum_{i=1}^n (d_i - \bar{d})^2}{n-1}$$

$$= \frac{3^2 + 1^2 + 5^2 + 2^2 + 1^2 + 3^2 + 5^2}{6}$$

$$= \frac{74}{6} = \frac{37}{3}$$

$$\text{so } s_{\bar{d}} = \frac{s_d}{\sqrt{n}} = \frac{\sqrt{\frac{37}{3}}}{\sqrt{7}} = \sqrt{\frac{37}{21}} \approx 1.33$$

$$\text{so } t \text{ for } H_0 \text{ is } \frac{\bar{d} - 0}{s_{\bar{d}}} = \frac{3}{1.33} = 2.26$$

at  $\alpha = 0.05$ , critical value for  $t$  ( $df = 6$ )

is 2.447.  $2.26 < 2.447$ , so I cannot reject  $H_0$ .