

9.3 - Testing a Claim About Two Means (dependent samples)

EXAMPLE 1 The following is a random sample of 12 students exam scores from Exam 2 and Exam 3 from a Math 099 course. Test the claim that individual student exam scores improve from Exam 2 to Exam 3, and find a confidence interval for the mean improvement. Use $\alpha = 0.05$. Be sure to test for normality.

Exam 2	39	46	35	40	39	51	36	31	29	33	34	51
Exam 3	40	48	42	45	39	47	39	33	42	45	39	47

$H_0: \mu_1 = \mu_2$
 $H_1: \mu_1 > \mu_2$ claim
 $\alpha = 0.05$ $P = 0.022$

1) Enter data into L1 & L2

4) T-test

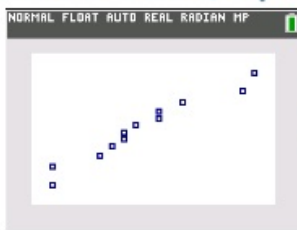
OR

Hypothesis Test for Matched Pairs Using Data	
Var1	Var2
1	40
2	48
3	42
4	45
5	39
6	47
7	39
8	33
9	42
10	45
11	39
12	47
13	
14	
15	
16	
17	
18	
19	
20	

Sample Mean Difference=	3.5000
Standard Deviation=	5.3513
Variance=	19.6061
Sample Size=	12
Degrees of Freedom=	11
Hypothesized Difference=	0
Type:	Ha: $\mu_d > 0$
t-statistic=	2.2657
P-Value=	0.0223
Confidence Interval	
Confidence Level	0.9
	0.7257 6.2743

2) In L3 heading enter L2-L1

3) Make a normal-Quantile plot



Normal?
Not bad.
✓

There is evidence to claim the mean of test scores improved from Exam 2 to Exam 3, and I'm 90% confident the improvement was between 0.7 and 6.3 points.

Example 2

Newt	1	2	3	4	5	6	7	8	9	10	11	12
Control Limb	36	41	39	42	44	39	39	56	33	20	49	30
Experimental Limb	28	31	27	33	33	38	45	25	28	33	47	23

a) Yes, it's paired.

b) $d = \{8, 10, 12, 9, 11, 1, -6, 31, 5, -13, 2, 7\}$

$$H_0 : \mu_d = 0$$

$$H_1 : \mu_d > 0$$

c)
$$\begin{array}{c|c} -1 & 3 \\ -0 & 6 \\ 0 & 1 \ 2 \ 5 \ 7 \ 8 \ 9 \\ 1 & 0 \ 1 \ 2 \\ 2 & \\ 3 & 1 \end{array}$$

Looks normal with 31 an outlier.

T-test 1 with all data

$$t = 2.076$$

$$P = 0.0311$$

There appears to be evidence at $\alpha = 0.05$ level that $\mu_d > 0$.

t-test 2 removing 31

$$t = 1.7881$$

$$P = 0.0521$$

Not enough evidence to say $\mu_d > 0$ at the $\alpha = 0.05$ level.

Modified Box plot



t-test 3 removing 31 and -13

$$t = 3.3637$$

$$P = 0.0042$$

Very strong evidence that $\mu_d > 0$