10D PairedT

Contents

Textbook: Devore 8e

D Paired T-test

[ToC]

D.1 Paired T-test

If we have random samples from the normal distribution, $X_1, \ldots, X_n$ and $Y_1, \ldots, Y_n$, but each pair (X_i, Y_i) is a repeated measurements on the same subject, then we can perform paired $t-$test. We first let

$$D_i = X_i - Y_i \qquad \text{for } i = 1, \ldots, n.$$

then perform one-sample $t-$test with test statistic

$$t = \frac{\overline{D} - \Delta_0}{S_D/\sqrt{n}}.$$

This will test the same null hypothesis as $H_0 : \mu_1 - \mu_2 = \Delta_0$ against the alternative of your choice.

H_A	rejection region
upper-tailed	$t > t_{\alpha,n-1}$
lower-tailed	$t < -t_{\alpha,n-1}$
Two-tailed	$t < -t_{\frac{\alpha}{2},n-1}$ or $t > t_{\frac{\alpha}{2},n-1}$

D.2 Ex: Deer shots

- Study conducted in the Forestry and Wildlife Department at Virginia Tech
- Examined the influence of the drug succinylcholine on the circulation levels of androgens in the blood.
- samples taken from wild deer
- 1st sample: immediately after they had received darts and a capture
- 2nd sample: after 30 min

Test at the 0.05 level of significance whether the androgen concentrations are altered after 30 minutes.

Deer	30_Min_after	Time_of_Injection
1	2.76	7.02
2	5.18	3.10
3	2.68	5.44
4	3.05	3.99
5	4.10	5.21
6	7.05	10.26
7	6.60	13.91
8	4.79	18.53
9	7.39	7.91
10	7.30	4.85
11	11.78	11.10
12	11.58	11.50
13	4.90	3.74
14	22.01	81.03
15	37.38	74.03
16	18.24	31.50
17	13.58	13.10
18	3.70	3.71
19	28.00	44.03
20	67.48	54.03
21	18.94	30.50
22	5.76	6.02
23	5.68	2.80
24	2.68	7.44
25	5.07	3.59
26	4.90	4.21
27	3.90	3.74
28	26.00	94.03
29	67.48	94.03
30	17.04	40.50
31	3.76	5.02
32	5.38	2.80
33	2.68	5.44
34	3.07	3.59

```
35        4.10                 4.21
36        7.25                10.26
37        6.60                13.91
38        5.79                18.53
39        7.39                 7.41
40        7.30                 4.85
```

```
A = c(2.76, 5.18, 2.68, 3.05, 4.10, 7.05, 6.60, 4.79, 7.39, 7.30,
  11.78, 11.58, 4.90, 22.01, 37.38, 18.24, 13.58, 3.70, 28.00,
  67.48, 18.94, 5.76, 5.68, 2.68, 5.07, 4.90, 3.90, 26.00, 67.48,
  17.04, 3.76, 5.38, 2.68, 3.07, 4.10, 7.25, 6.60, 5.79, 7.39, 7.30)

B = c( 7.02, 3.10, 5.44, 3.99, 5.21, 10.26, 13.91, 18.53, 7.91, 4.85, 11.10,
  11.50, 3.74, 81.03, 74.03, 31.50, 13.10, 3.71, 44.03, 54.03, 30.50, 6.02,
   2.80, 7.44, 3.59, 4.21, 3.74, 94.03, 94.03, 40.50, 5.02, 2.80, 5.44, 3.59,
   4.21, 10.26, 13.91, 18.53, 7.41, 4.85)

t.test(A,B, alternative="less")

t.test(A-B, alternative="less")
```

```
Welch Two Sample t-test
t = -1.5453, df = 63.221, p-value = 0.06363
alternative hypothesis: true difference in means is less than 0
95 percent confidence interval:
      -Inf 0.5828901
sample estimates:
mean of x mean of y 12.00800  19.27175
sd(A)  15.10759
sd(B)  25.60379



One Sample t-test
t = -2.8804, df = 39, p-value = 0.003211
alternative hypothesis: true mean is less than 0
95 percent confidence interval:
      -Inf -3.014893
sample estimates:
mean of x -7.26375
sd(A-B)    15.94903
```

D.3 Ex: Zinc concentration at bottom and top

p.344