IT3030 Biostatistics Quiz#5 2019.05.21 ID:____________________ Name:_____________________

1. (50%) Below is the systolic blood pressure for 12 subjects, measured before and after taking a drug Z.

N	Before taking Z (x_1)	After taking Z (x_2)
1	145	128
2	122	115
3	137	139
4	129	132
5	154	122
6	138	145
7	126	110
8	167	109
9	156	151
10	145	117
11	153	132
12	162	150

We'd like to perform a paired t-test at the level α=0.05 to the random variable $d=x_1-x_2$ to know whether there exists significant blood pressure change for taking the drug. (a) State your null hypothesis. (b) Is this a 1-sided or 2-sided test? Why? (c) What is the value of t? (d) What is the p-value for this test? (e)Your conclusion? Why? 【Show all your computational/MATLAB steps.】

Answer:

(a) H_o: $d=x_1-x_2 = 0$

(b) **2-sided test**, since we are asking whether these is a change of blood pressure regardless increasing or decreasing after taking the medicine.

(c)
```
>> x1
x1 =
    145    122    137    129    154    138    126    167    156
145    153    162
>> x2
x2 =
    128    115    139    132    122    145    110    109    151
117    132    150
```

```
>> d=x1-x2
d =
     17      7     -2     -3     32     -7     16     58      5     28     21     12
>> mu=mean(d)
mu =
   15.3333
>> std=std(d)
std =
   18.1325
>> t=(mu-0)/(std/sqrt(12))
t =     2.9293
>>
```

(d) Computing p-value (2-sided):
```
>> 2*(1-tcdf(t,12-1))
ans =     0.0137
>>
```

(e) Since p-value is **smaller than** α=0.05, we would **reject** the null hypothesis. That is, taking the drug Z **would change** the blood pressure significantly.

2. (50%) Given that the sample mean and standard deviation for group 1 and 2 are exactly the same as shown in class (Week 13, slide #60). Assume that n_1=15 and n_2=12. We'd like to test whether the two means are the same or not, using α=0.05. (a) Determine the t value for this test? (b) Determine the "effective" degree of freedom for performing a t-test. (c) Determine the p-value, and your conclusion whether the two means are the same or not. (d) Determine the 95% CI for $\mu_1 - \mu_2$. (e) Does your CI include the value 0 or not? Why? 【Show all your computational/MATLAB steps.】

		Group 1	Group 2
Population	Mean	μ_1	μ_2
	Standard Deviation	σ_1	σ_2
Sample	Mean	$\overline{x}_1$	$\overline{x}_2$
	Standard Deviation	s_1	s_2
	Sample Size	n_1	n_2

Answer:
(a) Computing for the t-value:
```
 >> x1=142.5; x2=156.5; s1=15.7; s2=17.3;
>> t=((x1-x2)-0)/sqrt(s1^2/15+s2^2/12)
t =      -2.1765
```

(b) The "effective" degree of freedom is computed:
```
>> v=((s1^2/15+s2^2/12)^2)/((s1^2/15)^2/14+(s2^2/12)^2/11)
v =     22.5715
```

(c) The p-value is:
```
>> 2*tcdf(t,v)
ans =      0.0402.
```
Since this is **smaller** than 0.05, we'd **reject** the null hypothesis, meaning the two means are **different**.

(d) The pooled estimate of the variance is computed:
```
>> sp2=((15-1)*s1^2+(12-1)*s2^2)/(15+12-2)
sp2 =    269.7220
```
The value of t to cut-off 2-sided 95% CI is:
```
>> t=tinv(0.975,15+12-2)
t =       2.0595
```
We then compute the SEM, which is half of the size of CI:
```
>> SEM=t*sqrt(sp2*(1/15+1/12))
SEM =      13.1001
```
The CI lower bound:
```
>> LOWER=x1-x2-SEM
LOWER =    -27.1001
```
The CI upper bound:
```
>> UPPER=x1-x2+SEM
UPPER =      -0.8999
>>
```

(e) The CI **does not contain zero**, meaning that the two means are indeed **different**. (Same conclusion as drawn from the hypothesis testing.)