Exercise 5C.1

You are interested in studying if systolic blood pressure in older males varies after sitting for 30 minutes. You sample 20 men and collect their blood pressures before (`bp_before`) and after (`bp_after`) sitting for 30 minutes. These data are summarized in the Stata output below. Use this information to test your hypothesis (that BP is different before and after sitting).

```
. generate diff = bp_after - bp_before

. summarize

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
   bp_before |        20       165.3    8.844267       147        180
    bp_after |        20      162.85    11.63604       146        185
        diff |        20       -2.45    14.32875       -29         29
```

Use the data for the variable `diff` and do a one-sample t-test: $n = 11, \bar{d} = -2.45, s_d = 14.3$

$H_0 : \delta = 0$ *where* $\delta =$ *mean difference in BP, after sitting minus before sitting*

$H_a : \delta \neq 0$

$$t = \frac{\bar{d} - 0}{s_d/\sqrt{n}} = \frac{-2.45}{14.3/\sqrt{20}} = -0.766 \quad \textit{Under } H_0, T \sim t_{n-1} = t_{19}$$

P-value Method:

p-value $= 2 \times P(t_{19} > |-0.766|) = 2 \times P(t_{19} > 0.766)$

From table, $P(t_{19} > 0.688) = 0.25$ *and* $P(t_{19} > 0.861) = 0.2$

So we know $P(t_{19} > 0.766)$ *between 0.2 & 0.25*

Thus p-value = between 0.4 *and* 0.5 *(Exact p-value from Stata* $= 0.453$*)*

Is p-value $< \alpha$*? No* $\rightarrow$ *Fail to reject* H_0

Critical Value Method:

critical value from t_{19} *with 0.025 in the tail is* $t^* = 2.093$

Is $|t| > t^*$*? No,* $|0.766| < 2.093 \rightarrow$ *Fail to reject* H_0

There is no evidence that mean BP is different when sitting compared to standing in the population of older males.

Exercise 5C.2

Do piano lessons improve the spacial-temporal reasoning of preschool children? A study designed to test this hypothesis measured the spacial-temporal reasoning of 30 preschool children before and after 6 months of piano lessons. The average change in reasoning scores was +3.83 with a standard deviation of 3.0. Test the hypothesis that there was a change in reasoning. Will the 95% CI contain the value 0?

$n = 30, \bar{d} = 3.83, s_d = 3.0$

$H_0 : \delta = 0$ *where* $\delta =$ *mean difference in reasoning scores*

$H_a : \delta \neq 0$ *(assume before* $-$ *after, but doesn't matter for 2-sided test)*

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} = \frac{3.83}{3.0/\sqrt{30}} = 6.99 \quad \textit{Under } H_0, T \sim t_{n-1} = t_{29}$$

P-value Method:

p-value $= 2 \times P(t_{29} > |6.99|) = 2 \times P(t_{29} > 6.99)$

From table, $P(t_{29} > 3.659) = 0.0005$ *so we know* $P(t_{29} > 6.99) < 0.0005$

Thus p-value $< 2 \times 0.0005 = 0.001$ *(Exact p-value from Stata* $= 0.0000001$*)*

Is p-value $< \alpha$*? Yes,* $0.001 < 0.05 \rightarrow$ *Reject* H_0

Critical Value Method:

critical value from t_{29} *with 0.025 in the tail is* $t^* = 2.045$

Is $|t| > t^*$*? Yes,* $|6.99| > 2.045 \rightarrow$ *Reject* H_0

There is evidence that mean reasoning scores are different before and after 6 months of piano lessons.

The 95% CI will **not** *contain 0 since we reject* $H_0 : \delta = 0$ *at level* $\alpha = 0.05$*.*