Examples from Module 9 review

Hypothesis test checklist:

1. State hypotheses; check assumptions if requested
2. State test statistic, df, and $pvalue$
3. Results of test (reject or not)
4. Conclusion of test with context
5. State potential error (Type I happens when null is rejected, or Type II happens when null is NOT rejected)

The desired **average** amount of silicon dioxide (SiO2) in a certain type of aluminous cement is 5.5. To test whether the true **average** percentage is 5.5 for a certain facility, 16 independently obtained random samples are analyzed; percentage of SiO2 is normally distributed. Is there sufficient evidence the true **average** percentage of SiO2 differs from 5.5?

One Sample
t-test data: sio2
t = -2.4544, df = 15, p-value = 0.02681
alternative hypothesis: true mean is not equal to 5.5
95 percent confidence interval:
5.129985 5.473945
sample estimates:
mean of x
5.301965

1. State hypotheses; check assumptions if requested
   $$H_0: \mu = 5.5 \; vs. \; H_a: \mu \neq 5.5$$
   * Independence: (stated this time; otherwise met if random)
   * random: stated
   * normality: yes
2. State test statistic, df, and $pvalue$
   t = -2.4544, df = 15, p-value = 0.02681
3. Results of test (reject or not)
   Reject null if $pvalue \leq \alpha(0.05)$
   $pvalue = 0.02681 \leq \alpha(0.05) \therefore H_0$ is rejected
4. Conclusion of test with context
   Since null was rejected, the average amount of silicon dioxide is significantly different than 5.5
5. State potential error (Type I happens when null is rejected, or Type II happens when null is NOT rejected)
   Error: Type I error because null was rejected. Rejected null when the null is true. We think silicon dioxide amount differs from 5.5, when it does not

In an experiment designed to measure the time necessary for an inspector's eyes to become used to the reduced amount of light necessary for penetrate inspection, assuming a random sample of adaptation times (n = 9) shows an approximate normal distribution. It was previously assumed that the average adaption time was about 7 seconds. Is there evidence the adaptation time differs from the usual 7 seconds? Let α = 0.1.

Sample t-test
data: eyes
t = 0.44436, df = 8, p-value = 0.6686
alternative hypothesis: true mean is not equal to 7
90 percent confidence interval:
5.866778 8.844861
sample estimates:
mean of x
7.355819

1. State hypotheses; check assumptions if requested
   $$H_0: \mu = 7 \; vs. H_a: \mu \neq 7$$
   * Independence: covered if random (yes is random)
   * random: yes
   * normality: yes adaption times are normal
2. State test statistic, df, and $pvalue$
   t = 0.44436, df = 8, p-value = 0.6686
3. Results of test (reject or not)
   Reject null if $pvalue \leq \alpha(0.10)$
   $pvalue = 0.6686 \nleq \alpha(0.10) \therefore H_0$ is not rejected
4. Conclusion of test with context
   Since null was not rejected, there is not sufficient evidence to state reaction times are anything but 7 (maintain reaction times are around 7 seconds)
5. State potential error (Type I happens when null is rejected, or Type II happens when null is NOT rejected)
   Error: we could have made a Type II error because the null was not rejected. We think reaction time is 7 seconds when it is something other than 7 seconds

State DMV records indicate that of all vehicles undergoing emissions testing during the previous year, 70% passed on the first try. A random sample of 200 cars tested in a particular county during the current year yields 124 that passed on the initial test. Does this suggest that the true proportion for this county during the current year differs from the previous statewide proportion?

One Sample t-test
data: dmv
t = -2.325, df = 199, p-value = 0.02108
alternative hypothesis: true mean is not equal to 0.7
95 percent confidence interval:
0.5521487 0.6878513
sample estimates:
mean of
x 0.62

1. State hypotheses; check assumptions if requested

$$H_0: \pi = 0.7 \; vs. H_a: \pi \neq 0.7$$

   * independence: met if random – yes
   * random: yes
   * normality: $n = 200 \geq 60$ (yes)
2. State test statistic, df, and $pvalue$
   t = -2.325, df = 199, p-value = 0.02108
3. Results of test (reject or not)
   Reject null if $pvalue \leq \alpha(0.05)$
   $pvalue = 0.02108 \leq \alpha(0.05) \therefore H_0$ is rejected
4. Conclusion of test with context
   There is sufficient evidence that this county's vehicles proportion of passing on the first try is different from the previous year's rate. Yes there is a difference compared to previous year's rate.
5. State potential error (Type I happens when null is rejected, or Type II happens when null is NOT rejected)
   Error: since null was rejected, we could have made a Type I error. We think there is a difference in the passing rate when there is not