

# Skyler MacDougall

## Homework 11: Due Friday 7/31/2020

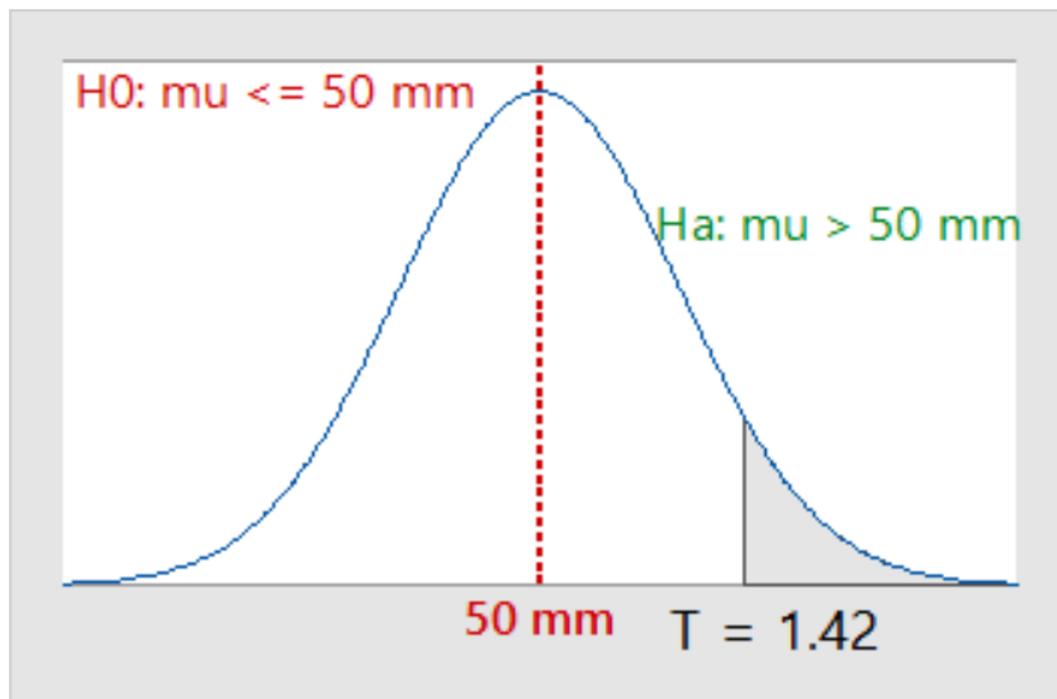
### STAT-145-02

#### Part A: Multiple Choice

1. School district officials believe that students spend plenty of time reading at home. A teacher wants to convince these officials that, on average, students spend less than 90 minutes per week reading at home.

What is the alternative hypothesis?

- ~~1.  $H_a : p < 0.9$~~
  - ~~2.  $H_a : p > 0.9$~~
  - ~~3.  $H_a : \mu > 90$~~
  4.  $H_a : \mu < 90$
2. Which statement provides a correct interpretation of the value of T test statistic?



1. My  $\bar{X}$  is 1.42 standard errors above 50.
  2. My  $\bar{X}$  is 1.42 mm above 50.
  3. My  $\bar{X}$  is 1.42 times as large as 50.
  4. My  $\bar{X}$  equals 1.42mm.
3. When the probability value is "small" in a test of hypotheses, this tells us that our sample mean is \_\_.
1. Unusual for the curve.
  2. typical for the curve.
  3. computed incorrectly.
  4. below the center of the curve.
4. If your sample has sufficient evidence to reject  $H_0$ , there is a small chance that a \_\_ occurred.

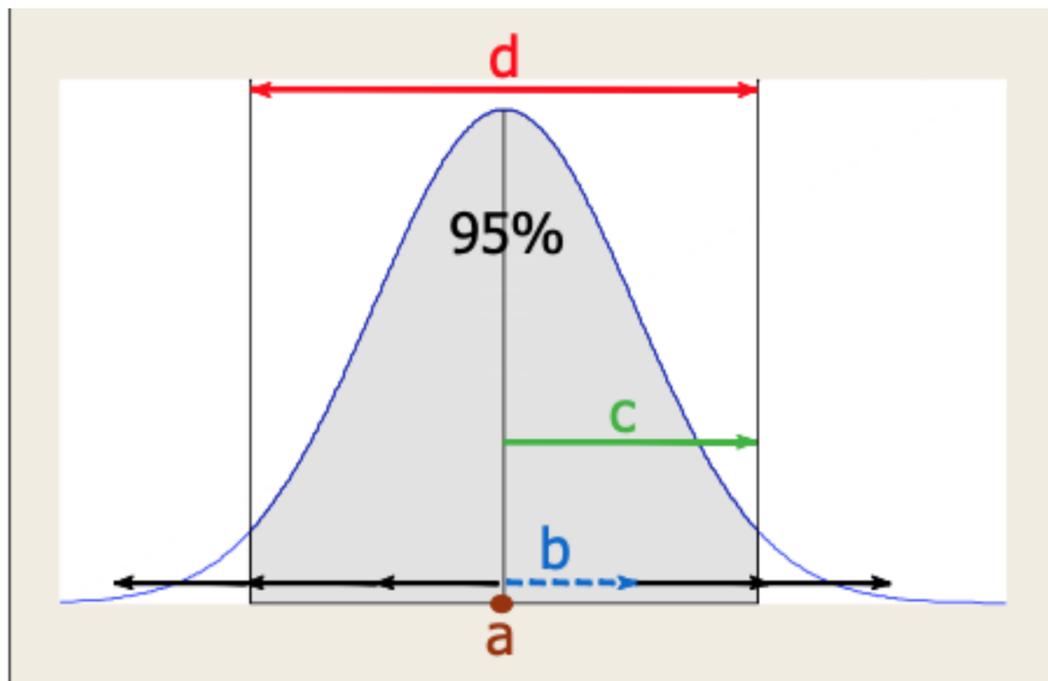
1. ~~large probability value~~
  2. Type I error
  3. Type II error
  4. correct decision
5. When testing the hypotheses

$$H_0 : p = 0.6 \quad (1)$$

$$H_a : p > 0.6$$

you check that the normal is appropriate by showing that:

1.  ~~$p \geq 10$~~
  2. ~~you have a random sample~~
  3.  ~~$n \geq 30$  OR  $NPP$   ~~$p$ -value  $> 0.05$~~~~
  4.  $|n(0.6)(1 - 0.6)| \geq 10$
6. Researchers will create a confidence interval with the proportion of all first-grade children who are overweight. The chance that this method will provide a correct result is determined by the:
1. sample size
  2. level of confidence
  3. sample mean
  4. ~~population standard deviation~~
7. See the confidence interval diagram below.



The margin of error is represented by:

1. ~~The dot labelled "a".~~
  2. ~~the dashed arrow labelled "b".~~
  3. the arrow labelled "c".
  4. ~~the double arrow labelled "d".~~
8. A 95% confidence interval for the average speed of drivers on the New York State Thruway is (65mph, 75mph). What is the value of his point estimate?
1. 65 mph
  2. 5 mph
  3. 40 mph
  4. 70 mph

9. When creating a confidence interval for a numerical variable, you check that the “t-curve” is appropriate to use by showing that
1. you have a random sample
  2.  $|n \geq 30 \text{ OR } NPP \text{ } p - \text{value} > 0.05|$
  3.  ~~$n \geq 10$~~
  4.  ~~$n(p)(1-p) \geq 10$~~
10. A 95% confidence interval for the percentage of all Rochester area drivers who text while driving is (35%, 43%). Which statement is reasonable based on the CI result?
1. The percentage of Rochester area drivers who text while driving is equal to 37%
  2. The percentage of Rochester area drivers who text while driving is equal to 34%
  3. The percentage of Rochester area drivers who text while driving is equal to 30%
  4. The percentage of Rochester area drivers who text while driving is equal to 48%
11. Based on a random sample of 50 full-time college students, we can be 90% confident that for all college students the mean time spent studying per week is between 9.25 hours and 10.75 hours.
- Which of the following intervals is a reasonable 95% confidence interval for this sample?
1. (9.10, 10.90)
  2. (9.30, 10.70)
  3. (9.45, 10.55)
  4. (9.00, 10.50)
12. If you want to estimate the proportion of all RIT students who smoke within 0.05 with 90% confidence, what is the minimum sample size you will need?
1. 1562
  2. 2033
  3. 271
  4. 549
13. We are 95% confident that during October 2016 the mean water usage for all Rochester households was between 1250 and 1350 cubic feet.
- In which statement can you have 95% confidence?
1. Mean water usage is greater than 1300 cubic feet.
  2. Mean water usage is less than 1400 cubic feet.
  3. Mean water usage is between 1200 and 1300 cubic feet.
  4. Mean water usage is less than 1300 cubic feet.

## Part B: Test and CI

14. It is commonly thought that very few US adults believe in reincarnation (the rebirth of a soul into a new body). But a researcher thinks that group has been growing and wants to convince others that the percentage who believe in reincarnation is greater than 20%. In the researcher’s random sample of 942 US adults, 195 stated that they believe in reincarnation. Does the researcher’s sample provide sufficient evidence to support the idea that more than 20% of all US adults believe in reincarnation? Show the complete testing process and always include your statistical output.

### Population

We are studying the percentage of US adults who believe in reincarnation.

$p$  = the true proportion of US adults who believe in reincarnation.

Goal: Test to see if there is support for saying that  $p$  has increased from 20% of the American population.

## Method

$$\begin{aligned}H_0 : p &= 0.20 \\H_a : p &> 0.20 \\ \alpha &= 0.05\end{aligned}\tag{2}$$

## Sample

### Interpretation for a 1-Sample Z-test

Decision Rule Based on p-value

Reject  $H_0$  : p-value  $\leq \alpha$

Fail to Reject  $H_0$  : p-value  $> \alpha$

p-value=0.2946

$\alpha = 0.050$

For the p-value approach:

Since  $0.2946 > 0.05$ , we fail to reject the null hypothesis.

There is not enough evidence to support the claim of the alternative hypothesis.

$$\begin{aligned}n(p_0)(1 - p_0) &\geq 10 \\942(0.207)(0.793) &\geq 10 \\154.63 &\geq 10\end{aligned}\tag{3}$$

$\therefore$

*The sample can be considered normal*

## Results

$$\begin{aligned}Z &= \frac{\hat{p} - p_0}{\sqrt{\frac{(p_0)(1-p_0)}{n}}}\tag{4} \\Z &= \frac{0.20 - 0.207}{\sqrt{\frac{(0.207)(1-0.207)}{942}}} \\Z &= \frac{-0.007}{\sqrt{\frac{(0.207)(0.793)}{942}}} \\Z &= \frac{-0.007}{\sqrt{\frac{0.164}{942}}} \\Z &= -0.53\end{aligned}$$

My sample mean is 0.53 standard errors below 20%.

My p-value is 0.2946.

Assuming that the true proportion equals 20%, there is a 29.46% probability of getting a sample population ( $\hat{p}$ ) at least as extreme as the one we got from sampling.

## Conclusion

At the 5% level of significance, the sample data does not provide sufficient evidence to say that the true proportion has increased from 20% of US adults who believe in reincarnation.

15. How much caffeine is in *King of Caffeine* cola? A dozen randomly selected cans of *King of Caffeine* cola had the values of caffeine, measured in mg, noted in the provided excel sheet.

1. Estimate the mean caffeine level among all cans of *King of Caffeine* cola with a 95% confidence.

$$\mu \in (32.349, 33.685)$$

2. What minimum sample size would be needed to estimate the mean caffeine level within 0.4mg with 95% confidence? **Show your work.**

$$n \geq \left( \frac{z * \sigma}{MOE} \right)^2 \quad (5)$$

$$n \geq \left( \frac{1.96 * 1.181}{0.4} \right)^2$$

$$n \geq \left( \frac{2.315}{0.4} \right)^2$$

$$n \geq (5.7869)^2$$

$$n \geq 33.488$$

$$n \geq 34$$