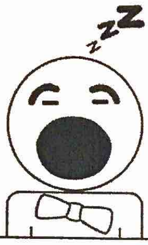
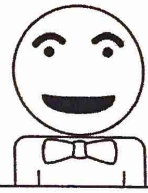
Name: ______________________________ Hour: _____ Date: ______

Lesson 10.1: Day 1: Is Yawning Contagious?



MYTHBUSTERS



Mythbusters investigated this question. Here's a brief recap. Each subject was placed in a booth for an extended period of time and monitored by hidden camera. 34 subjects were given a "yawn seed" by one of the experimenters: that is, the experimenter yawned in the subject's presence before leaving the room. The remaining 16 subjects were given no yawn seed.

1. Draw an outline of *Mythbuster's* experiment.

50 subjects → Random Assignment → Group1 (34) → Yawn seed → Compare yawning

Random Assignment → Group2 (16) → No seed → Compare yawning

2. Here are the Mythbusters results.

	Subject Yawned?		
Yawn seed?	Yes	No	Total
Yes	10	24	34
No	4	12	16
Total	14	36	50

Call p_1 the true proportion of people who given the yawn seed will yawn. $\hat{p}_1$ = 10/34 = .29

Call p_2 the true proportion of people who given no yawn seed will yawn. $\hat{p}_2$ = 4/16 = .25

What is the difference in proportions $\hat{p}_1 - \hat{p}_2$? 0.29 − 0.25 = .04

3. Do the data provide *some* evidence that yawning is contagious? Why?

Yes, people given the yawn seed yawned more often than people not given the yawn seed. (.29 to .25).

4. Adam Savage and Jamie Hyneman, the cohosts of *Mythbusters* used these data to conclude that yawning is contagious. Do you agree?

No, it could have happened that people who got the yawn seed yawned more often purely by chance.

TheStatsMedic

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In this Activity, your class will investigate whether the results of the experiment are statistically significant OR if they could have occurred purely by chance due to random assignment.

4. What is the null hypothesis?

$H_0: P_1 - P_2 = 0 \rightarrow$ The treatment doesn't affect whether or not the person yawns.

The 50 people in the experiment are represented by the cards. A person is either a yawner or a non-yawner, no matter which treatment they are randomly assigned.

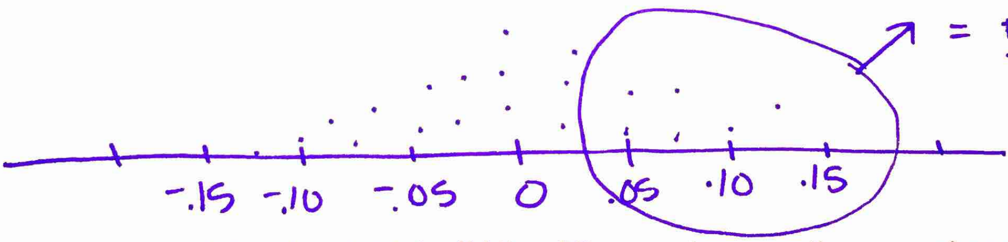
5. Shuffle the 50 cards and put them into two piles, one group of 34 that gets the yawn seed and one group of 16 that does not get the yawn seed. Record the proportion of people who yawned in each group. You will do this three times.

Trial	Proportion who yawned in yawn seed group, $\hat{p}_1$	Proportion who yawned no yawn seed group, $\hat{p}_2$	Difference in proportions, $\hat{p}_1$ - $\hat{p}_2$
1	$\hat{P}_1 =$	$\hat{P}_2 =$	$\hat{P}_1 - \hat{P}_2 =$
2			
3			

6. Make a class dotplot of the difference in proportions. Sketch below:

Randomization Distribution of $\hat{P}_1 - \hat{P}_2$

P-value $= \dfrac{\text{\# circled dots}}{\text{total \# of dots}}$



7. In what percent of the class's trials did the difference in proportions equal or exceed 29% - 25% = 4% (what *Mythbusters* got in their experiment)?

P-value $= \dfrac{\text{\# circled}}{\text{\# total}}$

8. What conclusion can you draw about whether yawning is contagious?

We don't have convincing evidence that yawning is contagious.

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Lesson 10.1 Day 1: Sampling Distribution for a Difference in Proportions

Important ideas:

LT#1 Shape, center, spread of the sampling distribution of $\hat{p}_1 - \hat{p}_2$.

Shape: Approx. Normal

Large counts

$n_1 \times p_1$, $n_1 \times (1-p_1) \geq 10$ $n_2 \times p_2$, $n_2 \times (1-p_2) \geq 10$

Center: $\mu_{\hat{p}_1-\hat{p}_2} = p_1 - p_2$

Spread: $\sigma_{\hat{p}_1-\hat{p}_2} = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$

Check Your Understanding

Your teacher brings two bags of colored goldfish crackers to class. Bag 1 has 25% red crackers and Bag 2 has 35% red crackers. Each bag contains more than 1000 crackers. Using a paper cup, your teacher takes an SRS of 50 crackers from Bag 1 and a separate SRS of 40 crackers from Bag 2. Let $\hat{p}_1 - \hat{p}_2$ be the difference in the sample proportions of red crackers.

p_2 p_1 n_2 n_1

(a) What is the shape of the sampling distribution of $\hat{p}_1 - \hat{p}_2$? Why?

Large Counts:

$50 \times .25 = 12.5$ $40 \times .35 = 14$

$50 \times .75 = 37.5$ $40 \times .65 = 26$

≥ 10 ✓

Approx. Normal

(b) Find the mean of the sampling distribution.

$\mu_{\hat{p}_1-\hat{p}_2} = .25 - .35 = -.10$

(c) Calculate and interpret the standard deviation of the sampling distribution.

$$\sigma_{\hat{p}_1-\hat{p}_2} = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

$$= \sqrt{\frac{.25 \times .75}{50} + \frac{.35 \times .65}{40}} = .097$$

The difference in sample proportions typically varies by .097 from the true diff. in prop. of $-.10$.