Section 5.2

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"You can forget facts but you cannot forget understanding."

- Eric Mazur

(1) Do you believe that yawning is contagious?

A Yes, and I'm confident.

B Yes, but I'm not sure.

C No, but I'm not sure.

D No, and I'm confident.

- The gang at the TV show *Mythbusters* investigated whether yawning was contagious.

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- The gang at the TV show *Mythbusters* investigated whether yawning was contagious.
- Fifty people attending a flea market in San Francisco were recruited to participate.
- Let's watch the video clip from the show.

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(2) How about after watching the *Mythbusters* video: do you believe that yawning is contagious?

A Yes, and I'm confident.

B Yes, but I'm not sure.

C No, but I'm not sure.

D No, and I'm confident.

(3) What is the population in this study?

A How many times Kari would yawn in the long-run

B All American adults

C All San Francisco residents

D None of the above.

(4) Identify the correct statement about the explanatory &
response variables in this study.

A Explanatory - Whether the subject yawned, Response -
exposure to yawning "seed"

B Explanatory is categorical, response is quantitative

C Explanatory - Whether Kari yawned, Response - Whether
the subject yawned

D Two of the above are true

E None of the above

(5) What are the two competing hypotheses?

A H_0: Yawning is contagious, H_a: Yawning is not contagious

B $H_0 : \pi_{yawn} = \pi_{no\_yawn}$, $H_a : \pi_{yawn} > \pi_{no\_yawn}$

C $H_0 : \hat{p}_{seed} = \hat{p}_{no\_seed}$, $H_a : \hat{p}_{seed} > \hat{p}_{no\_seed}$

D Two of the above are true

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The researchers found that 10 of 34 subjects who had been given a yawn seed actually yawned themselves, compared with 4 of 16 subjects who had not been given a yawn seed. Organize this information into a 2×2 table.

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	Yawn seed planted	Yawn seed not planted	Total
Subject yawned	10	4	14
Subject did not yawn	24	12	36
Total	34	16	50

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(6) Calculate the appropriate statistic based on the table above.

A 0.42857

B -0.20879

C 0.08333

D 0.2800

E None of the above

- The key to our simulation analysis is to assume that if yawning is not contagious (null hypothesis), then the 14 yawners would have yawned regardless of whether or not they had seen the yawn seed.

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- Similarly, we'll assume that the 36 non-yawners would not have yawned, no matter which group they had been assigned.
- In other words, our simulation assumes the null hypothesis is true—that there is no association, no connection, between the yawn seed and actual yawning.

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- Shuffle the cards well, and randomly deal out 34 to be the yawn seed group (the rest go to the control group).

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- Count how many yawners (blue cards) you have in each group and how many non-yawners (green cards) you have in each group.

Simulation Process

- Take a set of 50 cards, with 14 blue cards (to represent the yawners) (the total of the first row) and 36 green cards (to represent those who did not yawn) (the total of the second row).
- Shuffle the cards well, and randomly deal out 34 to be the yawn seed group (the rest go to the control group).
- Count how many yawners (blue cards) you have in each group and how many non-yawners (green cards) you have in each group.
- Construct the two-way table to show the number of yawners and non-yawners in each group (where clearly nothing different happened to those in "group A" and those in "group B" - any differences between the two groups that arise are due purely to the random assignment process).

We need to perform a large number of repetitions (say, 1000 or more) in order to assess whether the *MythBusters*' result is typical or surprising when yawning is not contagious. To do this we will use the **Two Proportions** applet and click on **Show Shuffle Options**.

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Use this applet to conduct 1000 repetitions of this simulation. Change the **Number of shuffles** to 1000 and press **Shuffle**. The applet produces a dotplot showing the null distribution.

(**7**) What does each dot in this dotplot represent?

A The probability of obtaining a value as extreme as the observed statistic

B One simulated proportion of successes for the yawn group

C A simulated difference in sample proportions

D A sample average number of yawns

E None of the above

(8) We can compute a *p*-value by entering _____ in the box next to **Count** and selecting _____ from the dropdown menu.

(9) We can compute a *p*-value by entering _____ in the box next to **Count** and selecting _____ from the dropdown menu.

A 0, Greater Than

B 0.5, Greater Than

C 0.044, Beyond

D -0.044, Greater Than

E None of the above

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Correct Conclusion?

The *MythBusters*' hosts concluded from their study that there is "little doubt, yawning seems to be contagious." Based on your simulation analysis of their data, considering the issue of statistical significance, do you agree with this conclusion? Explain your answer, as if to the hosts. Be sure to explain why you conducted the simulation analysis and what the analysis revealed about the research question.

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- No, it is true that a higher proportion (29.4%) of people yawned when viewing the yawn "seed" than compared to the proportion of yawners without a yawn seed (25%).

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- But, the difference (4.4%) is very small and happens quite easily just by random chance.

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- But, the difference (4.4%) is very small and happens quite easily just by random chance.
- The simulation we conducted helped to quantify that a difference like 4.4% or larger happens about 50% of the time just by chance (even when yawning is NOT contagious).