Warm Up:
What is the difference between an observational study and an experiment?

4.3 Using Studies Wisely
Day 1

Learning Goals: Explain the concept of sampling variability when making an inference about a population and how sample size affects sampling variability. Explain the meaning of statistically significant in the context of an experiment and use simulation to determine if the results of an experiment are statistically significant.

Does Caffeine Increase pulse rate?

Mrs. Gallas and her students decided to perform the caffeine experiment. In their experiment 10 student volunteers were randomly assigned to drink cola with caffeine and the remaining 10 students were assigned to drink caffeine-free cola. Were their findings statistically significant?

The table shows the change in pulse rate for each student (Final pulse rate - Initial pulse rate), along with the mean change for each group.

<table>
<thead>
<tr>
<th></th>
<th>Change in pulse rate</th>
<th>Mean change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeine</td>
<td>8 3 5 1 4 0 1 4 0 3.2</td>
<td></td>
</tr>
<tr>
<td>No Caffeine</td>
<td>3 -2 4 -1 5 5 1 2 -1 4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

1.) Find the difference in mean pulse rate for the groups. Does your initial reaction lead you to believe that they found evidence that caffeine does or does not increase heart rate? Explain.

3.2 -2 = 1.2
No it is only 1 bpm faster.

2.) What are two possible explanations for the difference in mean pulse rate?

1.) caffeine caused change
2.) caffeine did not cause change
To try to decide if the difference in pulse rate is big enough to be convincing we will do a simulation with the data.

Simulation:

Step 1: Gather 20 index cards to represent the 20 students in this experiment. On each card, write one of the 20 outcomes listed in the table. For example, write “8” on the first card, “3” on the second card and so on.

Step 2: Shuffle the cards and deal two piles of 10 cards each. This represents randomly assigning the 20 students to the two treatments, assuming that the treatment received doesn’t affect the change in pulse rate. The first pile of 10 cards represents the caffeine group and the second pile of 10 cards represents the no-caffeine group.

Step 3: Fill in the table with your simulated data.

3.) Find the mean change for each group in your simulation and subtract the means (Caffeine - No caffeine).

4.) Add your difference in means to the dotplot on the board.

What does each dot represent?

mean change from 1 trial where caffeine has NO effect.

5.) What percentage of the dots are greater than or equal to the difference in means of 1.2 found in Mrs. Gallas’ experiment?

\[ \frac{1}{7} = 14.3\% \]

Interpret this percentage:

Assuming caffeine has no effect on heart rate there is a 14.3% probability of getting a difference of 1.2 or more purely by chance.

6.) Do you think the difference in means we found from our experiment is due to the caffeine or has it occurred purely by chance? Explain.

NO, it's not unlikely it could be a coincidence.

\[ \leq 5\% \Rightarrow \text{Statistically Significant} \]

\[ \geq 5\% \Rightarrow \text{Not Statistically Significant} \]
You have 8 minutes to complete the Check Your Understanding and then we will go over it!

Coursework:
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