Question 1

Answers below ?

Allotted time: 25 minutes (plus 5 minutes to submit)

An online company is hoping to sell a new product by placing a pop-up advertisement on their website. There are two different designs for the advertisement, and the company would like to determine which one is more effective, as measured by clicks and purchases. For the first 200 visitors to the updated website, half were randomly assigned to receive advertisement 1 and half to receive advertisement 2. The two-way table summarizes the results:

Customer Behavior

	Did not click	Clicked, no purchase	Clicked, made purchase	Total
Advertisement 1	70	8	22	100
Advertisement 2	64	20	16	100
Total	134	28	38	200

(a) Is this study an observational study or an experiment? Explain your answer.

(b) i. Provide one piece of evidence for why advertisement 1 is more effective.

ii. Provide one piece of evidence for why advertisement 2 is more effective.

(c) One customer from the study will be selected at random. Are the events "advertisement 1" and "made purchase" independent? Justify your answer based on probabilities calculated from the table above.

The online company conducted a test of the hypotheses

$$H_0 : p_1 - p_2 = 0$$
$$H_a : p_1 - p_2 \neq 0,$$

where p_1 is the proportion of customers similar to those in the study given advertisement 1 that would click and make a purchase and p_2 is the proportion of customers similar to those in the study given advertisement 2 that would click and make a purchase. The conditions for inference have been met.

(d) One of the conditions for inference that was met is that $n\hat{p}_c \geq 10$ and $n(1-\hat{p}_c) \geq 10$ for each group, where $\hat{p}_c$ is the combined (or pooled) proportion. Explain why it is necessary to satisfy this condition.

(e) The test resulted in a *p*-value of 0.2795. Interpret what this *p*-value measures in the context of this study.

(f) Based on the *p*-value, what conclusion should the online company make?

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An online company is hoping to sell a new product by placing a pop-up advertisement on their website. There are two different designs for the advertisement, and the company would like to determine which one is more effective, as measured by clicks and purchases. For the first 200 visitors to the updated website, half were randomly assigned to receive advertisement 1 and half to receive advertisement 2. The two-way table summarizes the results:

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Total	134	28	38	200

(a) Is this study an observational study or an experiment? Explain your answer.

This is an experiment. The customers were randomly assigned to a treatment of advertisement 1 or advertisement 2.
context.

(b) i. Provide one piece of evidence for why advertisement 1 is more effective.

Advertisement 1 had a higher proportion of customers who mad a purchase $\left(\frac{22}{100} = 0.22\right)$ than advertisement 2 $\left(\frac{16}{100} = 0.16\right)$

ii. Provide one piece of evidence for why advertisement 2 is more effective.

Advertisment 2 had a higher proportion of customers who clicked $\left(\frac{20+16}{100}\right) = 0.36$ than advertisment 1 $\left(\frac{8+22}{100} = 0.30\right)$

(c) One customer from the study will be selected at random. Are the events "advertisement 1" and "made purchase" independent? Justify your answer based on probabilities calculated from the table above.

$P(\text{purchase}) = \frac{38}{200}$

$P(\text{purchase} \mid \text{ad 2}) = \frac{16}{100} = 0.16.$

$P(\text{purchase} \mid \text{advertisement 1}) = \frac{P(\text{purchase and ad 1})}{P(\text{ad 1})}$

$= \frac{22}{100} = 0.22.$

we can see that the probability of a customer purchasing an item changes after conditioning for the ad. Therefore the events are dependent.

The online company conducted a test of the hypotheses

$$H_0 : p_1 - p_2 = 0$$
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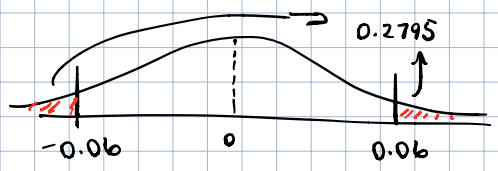
where p_1 is the proportion of customers similar to those in the study given advertisement 1 that would click and make a purchase and p_2 is the proportion of customers similar to those in the study given advertisement 2 that would click and make a purchase. The conditions for inference have been met.

(d) One of the conditions for inference that was met is that $n\hat{p}_c \geq 10$ and $n(1-\hat{p}_c) \geq 10$ for each group, where $\hat{p}_c$ is the combined (or pooled) proportion. Explain why it is necessary to satisfy this condition.

This is necessary so that the sampling distribution of $\hat{p}_1 - \hat{p}_2$ is approximately normal, and we may use a z-test statistic to calculate a p-value.

(e) The test resulted in a *p*-value of 0.2795. Interpret what this *p*-value measures in the context of this study.



Sampling distribution of $\hat{p}_1 - \hat{p}_2$

$\hat{p}_1 = 0.22$ $\hat{p}_2 = 0.16$

$\hat{p}_1 - \hat{p}_2 = 0.06$

Assuming the difference between proportion of people who click and purchase is the same for both treatment groups, there is a 27.95% chance of find a difference in sample proportions of less than -0.06 or greater than 0.06, purely by chance in future samples.

(f) Based on the *p*-value, what conclusion should the online company make?

- considering the high p-value of $0.2795 > 0.05 = \alpha$, we fail to reject the null hypothesis that there is a difference in the proportion of people who click and purchase.
- In other words there is not sufficient evidence to suggest a statistically significant difference in the

proportion of customers like these who would make purchases between the two advertisements.