

Begin your response to **QUESTION 4** on this page.

4. The manager of a large company that sells pet supplies online wants to increase sales by encouraging repeat purchases. The manager believes that if past customers are offered \$10 off their next purchase, more than 40 percent of them will place an order. To investigate the belief, 90 customers who placed an order in the past year are selected at random. Each of the selected customers is sent an e-mail with a coupon for \$10 off the next purchase if the order is placed within 30 days. Of those who receive the coupon, 38 place an order.
- (a) Is there convincing statistical evidence, at the significance level of $\alpha = 0.05$, that the manager's belief is correct? Complete the appropriate inference procedure to support your answer.

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Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

Continue your response to **QUESTION 4** on this page.

- (b) Based on your conclusion from part (a), which of the two errors, Type I or Type II, could have been made? Interpret the consequence of the error in context.

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Begin your response to **QUESTION 5** on this page.

5. A research center conducted a national survey about teenage behavior. Teens were asked whether they had consumed a soft drink in the past week. The following table shows the counts for three independent random samples from major cities.

	Baltimore	Detroit	San Diego	Total
Yes	727	1,232	1,482	3,441
No	177	431	798	1,406
Total	904	1,663	2,280	4,847

- (a) Suppose one teen is randomly selected from each city's sample. A researcher claims that the likelihood of selecting a teen from Baltimore who consumed a soft drink in the past week is less than the likelihood of selecting a teen from either one of the other cities who consumed a soft drink in the past week because Baltimore has the least number of teens who consumed a soft drink. Is the researcher's claim correct? Explain your answer.

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Question 4: Focus on Inference**4 points****General Scoring Notes**

- This question is scored in four sections. Each section is initially scored by determining if it meets the criteria for essentially correct (E), partially correct (P), or incorrect (I). The first section includes statements of the null and alternative hypotheses and identification of the appropriate hypothesis test in part (a). The second section includes verifying the conditions for the test identified in part (a) and calculating the value of the test statistic and the corresponding p -value. The third section includes the conclusion for the test identified in part (a). The fourth section includes the response to part (b). The response is then categorized based on the scores assigned to each section and awarded an integer score between 0 and 4 (see the table at the end of the question).
- The model solution represents an ideal response to each section of the question, and the scoring criteria identify the specific components of the model solution that are used to determine the score.

	Model Solution	Scoring
(a) Section 1	<p>Let p represent the proportion of all customers of the pet supply company who would place an order within 30 days after receiving an e-mail with a coupon for \$10 off the next purchase.</p> <p>The null hypothesis is $H_0: p = 0.40$, and the alternative hypothesis is $H_a: p > 0.40$.</p> <p>An appropriate test is a one-sample z-test for a population proportion.</p>	<p>Essentially correct (E) if the response satisfies the following three components:</p> <ol style="list-style-type: none"> States the correct equality for the null hypothesis for a proportion (e.g., $p = 0.40$) AND the correct direction of the one-sided alternative hypothesis for a proportion (e.g., $p > 0.40$) Provides sufficient context for the parameter by including reference to the <i>population</i> proportion AND the sampling units (customers) AND the response variable (placing an order after receiving a coupon) Identifies a one-sample z-test for a population proportion by name (e.g., “one-proportion z-test” but <u>not</u> merely “one-sample z-test”) or by formula <p>Partially correct (P) if the response does not meet the criteria for E but satisfies either component 1 and/or component 3.</p> <p>Incorrect (I) if the response does not meet the criteria for E or P.</p>

Additional Notes:

- The elements of component 2 do not have to be satisfied with the statement of the hypotheses. They may be satisfied by work presented anywhere in the response, most likely by the statement of the conclusion.
- If the statement of the hypotheses refers to population proportion and the conclusion refers to sample proportion (or vice versa), then the population aspect of component 2 is not satisfied.

	Model Solution	Scoring
Section 4	<p>(b) Because the null hypothesis was not rejected in part (a), a Type II error could have been made. A Type II error occurs when the null hypothesis is false and is not rejected. In this case, a Type II error is made by failing to reject the null hypothesis that 40 percent (or less) of all customers of the pet supply company would place an order within 30 days after receiving an e-mail with a coupon for \$10 off the next purchase, when in fact, more than 40 percent would do so.</p> <p>Consequently, the manager may decide not to use the coupon promotion when it actually would result in more than 40 percent of their customers making a purchase within 30 days.</p>	<p>Essentially correct (E) if the response satisfies the following two components:</p> <ol style="list-style-type: none"> 1. States that a Type II error could have been made 2. Provides a reasonable interpretation of the consequence of the stated error AND uses sufficient context, by including at minimum “those who would place an order” or “coupon” or “sales” (e.g., indicating the manager may not use the coupon promotion when it would actually lead to more than 40% of customers placing an order) <p>Partially correct (P) if the response satisfies only one of the two components.</p> <p>Incorrect (I) if the response does not meet the criteria for E or P.</p>

Additional Notes:

- If the response to part (a) rejects the null hypothesis, then
 - Component 1 is satisfied if the response states that a Type I error could have been made.
 - Component 2 is satisfied if the response provides a reasonable interpretation of the consequence of a Type I error AND uses sufficient context by including at minimum “those who would place an order” or “coupon” or “sales.”
- If the response states that a Type II error could have been made, followed by an incorrect description of a Type II error (e.g., “did not find convincing evidence that more than 40% of customers will place an order when there actually was evidence of more than 40%”), component 1 is not satisfied.
- The clarity and quality of the statement of the consequence may be used in a holistic approach to decide whether to score up or down (e.g., raising a score of 2.5 to 3 or reducing a score of 2.5 to 2).

Scoring for Question 4	
Each essentially correct (E) part counts as 1 point, and each partially correct (P) part counts as $\frac{1}{2}$ point.	
	Score
Complete Response	4
Substantial Response	3
Developing Response	2
Minimal Response	1
If a response is between two scores (for example, 2 $\frac{1}{2}$ points), use a holistic approach to decide whether to score up or down, depending on the strength of the response and quality of the communication.	