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# AP<sup>®</sup> Statistics

## Sample Student Responses and Scoring Commentary

### Inside:

#### Free-Response Question 6

- Scoring Guidelines
- Student Samples
- Scoring Commentary

**Question 6: Investigative Task****4 points****General Scoring Notes**

- Each part of the question (indicated by a letter) is initially scored by determining if it meets the criteria for essentially correct (E), partially correct (P), or incorrect (I). The response is then categorized based on the scores assigned to each letter part 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 part of the question, and the scoring criteria identify the specific components of the model solution that are used to determine the score.

**Model Solution**

- (a) (i) The relative frequencies of successful and unsuccessful treatments in each clinic are presented in the following table:

	Clinic A	Clinic B
Unsuccessful Treatment	$\frac{51}{139} \approx 0.3669$	$\frac{33}{68} \approx 0.4853$
Successful Treatment	$\frac{88}{139} \approx 0.6331$	$\frac{35}{68} \approx 0.5147$

- (ii) Clinic A appears to be more successful in treating allergy sufferers than Clinic B. Clinic A was successful for 63.3% of the allergy sufferers it treated, while Clinic B was successful for only 51.5% of the allergy sufferers it treated.

**Scoring**

**Essentially correct (E)** if the response satisfies the following two components:

- The response to part (a-i) provides correct numerical values for the relative frequencies in all four cells of the table
- The response to part (a-ii) identifies the clinic that is more successful in treating allergy sufferers and includes a justification based on the relative frequencies reported in part (a-i)

**Partially correct (P)** if the response satisfies only one of the two components  
*OR*

if the response provides correct numerical values for the relative frequencies in only two or three of the cells of the table, and correctly identifies the clinic that has greater success, with or without providing adequate justification based on the values of the reported relative frequencies.

**Incorrect (I)** if the response does not meet the criteria for E or P.

**Additional Notes:**

- Responses may be given as proportions or percentages.
- To satisfy component 1, numerical values for relative frequencies must be accurately reported to at least two decimal places, e.g., 0.36 or 0.37, 0.48 or 0.49, 0.63 or 0.64, 0.51 or 0.52.
- If a response in part (a-i) reports the relative proportions of the total (dividing the count in each of the four cells by 207) instead of the conditional relative frequencies, then component 2 may be satisfied in either of the following ways:
  - Concluding that Clinic A is more successful in treating allergies based on the larger proportion of successful cases (0.43 vs. 0.17)
  - Concluding that Clinic B is more successful in treating allergies based on the smaller proportion of unsuccessful cases (0.16 vs. 0.25).

- If a response reports incorrect values in part (a-i), then the justification in component 2 may use either the relative frequencies reported in the table in part (a-i) OR the correct conditional relative frequencies given in the model solution.
  - To satisfy component 2, the response must make it clear that Clinic A is being compared to Clinic B, either by explicitly mentioning both clinics OR by reporting both relative frequencies that are being compared.
-

Model Solution	Scoring
<p>(b) No. This is an observational study; it is not a randomized experiment. Cause and effect can only be established with a well-designed, randomized experiment. There may be other variables, besides where a patient was treated, that affect the success rates for treating allergies. For example, Clinic A may mostly treat mild allergy cases that are easy to treat successfully, while Clinic B may mostly treat severe allergy cases that are more difficult to treat successfully.</p>	<p><b>Essentially correct (E)</b> if the response satisfies the following two components:</p> <ol style="list-style-type: none"> <li>1. Indicates “no,” a causal inference is not justified</li> <li>2. Provides at least one of the following explanations: <ul style="list-style-type: none"> <li>• Notes that this is an observational study</li> <li>• Indicates that this is not a randomized experiment</li> <li>• Identifies a plausible confounding variable that could affect the success rates for treating allergies at the two clinics</li> </ul> </li> </ol> <p><b>Partially correct (P)</b> if the response satisfies component 2 but fails to indicate that researchers are not justified in making a causal inference <i>OR</i> if the response satisfies component 1 AND includes one of the following as justification:</p> <ul style="list-style-type: none"> <li>• A statement that association does not imply causation</li> <li>• A statement that there may be a confounding variable without specifying a reasonable confounding variable.</li> </ul> <p><b>Incorrect (I)</b> if the response does not satisfy the criteria for E or P.</p>

**Additional Notes:**

- A response that states that treatments (Clinic A, Clinic B) are not assigned (randomly assigned, imposed) to the patients satisfies component 2.
- A response that identifies a reasonable confounding variable does not need to explain why it is a confounding variable in order to satisfy component 2.
- The strength of the response in part (b) should be considered if holistic scoring is necessary.

	Model Solution	Scoring
<p>(c) (i)</p> <p><b>Clinic A:</b> More successful in treating mild allergies. Clinic A successfully treated 75.0% of mild allergy sufferers, while Clinic A successfully treated only 28.6% of severe allergy sufferers.</p> <p><b>Clinic B:</b> More successful in treating mild allergies. Clinic B successfully treated 91.7% of mild allergy sufferers, while Clinic B successfully treated only 42.9% of severe allergy sufferers.</p> <p>(ii)</p> <p><b>Clinic A:</b> More likely to treat mild allergy sufferers than severe allergy sufferers. Of the 139 allergy sufferers treated at Clinic A, 104 (74.8%) suffered from mild allergies, while only 35 (25.2%) suffered from severe allergies.</p> <p><b>Clinic B:</b> More likely to treat severe allergy sufferers than mild allergy sufferers. Of the 68 allergy sufferers treated at Clinic B, 56 (82.4%) suffered from severe allergies, while only 12 (17.6%) suffered from mild allergies.</p>	<p><b>Essentially correct (E)</b> if the response satisfies the following four components:</p> <ol style="list-style-type: none"> <li>The response to part (c-i) indicates that both Clinic A and Clinic B are more successful in treating mild allergies than treating severe allergies</li> <li>The response to part (c-i) provides a justification based on correctly reported proportions (or percentages) of successfully treated allergy sufferers of each severity for each clinic</li> <li>The response to part (c-ii) indicates that Clinic A is more likely to treat mild allergy sufferers, while Clinic B is more likely to treat severe allergy sufferers</li> <li>The response to part (c-ii) provides a justification based on correctly reported frequencies or proportions (or percentages) of severe or mild allergy sufferers treated by each clinic</li> </ol> <p><b>Note:</b> See the Q6 Correct Relative Frequencies tables at the end of this scoring guideline for the relative frequencies that should be used in each designated part.</p> <p><b>Partially correct (P)</b> if the response satisfies two or three of the four components.</p> <p><b>Incorrect (I)</b> if the response does not meet the criteria for E or P.</p>	

**Additional Notes:**

- A response to part (c-i) may satisfy component 2 in either of the following ways:
  - For each clinic, reports the correct proportion (or percentage) of severe allergy sufferers successfully treated AND the correct proportion (or percentage) of mild allergy sufferers successfully treated.
  - Makes a correct reference to the mosaic plot, comparing the ratio of shaded area to open area within the “Mild” rectangle to the ratio of shaded area to open area within the “Severe” rectangle for each clinic. Numerical values are not required.
- A response to part (c-ii) may satisfy component 4 in any of the following ways:
  - For each clinic, reports the correct proportion (or percentage) of treated allergy sufferers with severe allergies. (Clinic A: 0.252, Clinic B: 0.824)
  - For each clinic, reports the correct proportion (or percentage) of treated allergy sufferers with mild allergies. (Clinic A: 0.748, Clinic B: 0.176)

- Reports the correct proportion (or percentage) of treated allergy sufferers with severe allergies for one clinic AND reports the correct proportion (or percentage) of treated allergy sufferers with mild allergies for the other clinic.
  - For each clinic, reports the correct frequency of treated allergy sufferers with mild allergies and the correct frequency of treated allergy sufferers with severe allergies. (Clinic A: 104 mild and 35 severe; Clinic B: 12 mild and 56 severe)
  - Makes a correct reference to the mosaic plot, comparing the area or width of the “Mild” rectangle to the area or width of the “Severe” rectangle within each clinic. Numerical values are not required.
-

Model Solution	Scoring
<p>(d) The more successful clinic identified in part (a-ii) is Clinic A, which is different from the physician’s conclusion that Clinic B is better when taking allergy severity into account. This happens because for both clinics the success rate is much higher for mild allergy sufferers (75.0 percent versus 28.6 percent for Clinic A, and 91.7 percent versus 42.9 percent for Clinic B). Clinic A treats mostly mild allergy sufferers (74.8 percent of its patients) while Clinic B treats mostly severe allergy sufferers (82.4 percent of its patients). Therefore, when combining the results across allergy severity categories to obtain the table from part (a-i), the facts that Clinic A treats a larger proportion of mild allergy sufferers and mild allergy sufferers have a higher success rate make it appear as if Clinic A is better overall.</p>	<p><b>Essentially correct (E)</b> if the response satisfies the following two components:</p> <ol style="list-style-type: none"> <li>The response indicates that within each clinic, the proportion of successfully treated mild allergy sufferers is greater than the proportion of successfully treated severe allergy sufferers (0.75 vs. 0.286 for Clinic A and 0.917 vs. 0.429 for Clinic B) <i>OR</i> the response indicates that the overall proportion of successfully treated mild allergy sufferers (0.767) is much larger than the overall proportion of successfully treated severe allergy sufferers (0.374)</li> <li>The response indicates that the allergy sufferers treated by Clinic A include a much greater proportion of mild cases than the allergy sufferers treated by Clinic B (sample proportions: 0.748 vs. 0.176) <i>OR</i> the response indicates that the allergy sufferers treated by Clinic B includes a much greater proportion of severe cases than the allergy patients treated by Clinic A (sample proportions: 0.824 vs 0.252) <i>OR</i> the response indicates that of the allergy sufferers treated at Clinic A, a higher proportion are mild (0.748) than severe (0.252), and of the allergy sufferers treated by Clinic B, a higher proportion are severe (0.824) than mild (0.176)</li> </ol> <p><b>Partially correct (P)</b> if the response satisfies only one of the two components.</p> <p><b>Incorrect (I)</b> if the response does not meet the criteria for E or P.</p>

**Additional Notes:**

- A response that does not use the answer from (c-i) cannot satisfy component 1.
- A response that does not use the answer from (c-ii) cannot satisfy component 2.
- A response that compares successful treatments between clinics (0.75 vs. 0.917 or 0.286 vs. 0.429), does not satisfy component 1 or component 2.

- A response does not need to repeat the calculated values from part (c), but if it does, the numbers must be the same as those that were reported in part (c).
  - A response that only compares the proportion of successful (mild and severe) treatments at Clinic A to the proportion of successful (mild and severe) treatments at Clinic B should be scored I.
  - If the response in part (a-ii) concludes that Clinic B is more successful in treating allergies, then part (d) should be scored as follows:
    - **Essentially correct (E)** if the response includes the following four components:
      - (i) At least one of the two components listed for E above.
      - (ii) The response states that overall, Clinic B has a higher proportion of successfully treated allergy sufferers.
      - (iii) The response states that Clinic B has a higher proportion of successfully treated mild allergy sufferers.
      - (iv) The response states that Clinic B has a higher proportion of successfully treated severe allergy sufferers.
    - **Partially correct (P)** if the response satisfies component (i) AND two of the three remaining components (ii)–(iv) listed for E in this note.
  - If the response in part (a-ii) concludes that Clinic B is more successful, the response can be scored no higher than 3.
  - The strength of the response in part (d) should be considered if holistic scoring is necessary.
-



**Q6 Correct Relative Frequencies**

(a-i)

	Clinic A	Clinic B
Unsuccessful treatment	$\frac{51}{139} = 0.367$	$\frac{33}{68} = 0.485$
Successful treatment	$\frac{88}{139} = 0.633$	$\frac{35}{68} = 0.515$

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(c-i)

	Clinic A	Clinic B
Successful treatment - Mild	$\frac{78}{104} = 0.75$	$\frac{11}{12} = 0.917$
Successful treatment - Severe	$\frac{10}{35} = 0.286$	$\frac{24}{56} = 0.429$

(c-ii)

	Clinic A	Clinic B
Mild cases treated	$\frac{104}{139} = 0.748$	$\frac{12}{68} = 0.176$
Severe cases treated	$\frac{35}{139} = 0.252$	$\frac{56}{68} = 0.824$

NOTE: To satisfy the components in part (c), the comparison needs to be made by severity WITHIN each clinic (a vertical comparison), not Clinic A to Clinic B.

**Scoring for Question 6**

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.

Question 6

Begin your response to QUESTION 6 on this page.

STATISTICS

SECTION II, Part B

Suggested Time—25 minutes

1 Question

Directions: Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

- 6. To compare success rates for treating allergies at two clinics that specialize in treating allergy sufferers, researchers selected random samples of patient records from the two clinics. The following table summarizes the data.

	Clinic A	Clinic B	Total
Unsuccessful treatment	51	33	84
Successful treatment	88	35	123
<b>Total</b>	139	68	207

- (a) (i) Complete the following table by recording the relative frequencies of successful and unsuccessful treatments at each clinic.

	Clinic A	Clinic B
Unsuccessful treatment	0.366	0.485
Successful treatment	0.633	0.514

- (ii) Based on the relative frequency table in part (a-i), which clinic is more successful in treating allergy sufferers? Justify your answer.

Clinic A appears more successful in treating allergy sufferers, as demonstrated by their greater percentage of successful treatments. Clinic A saw 63.3% of treatments were successful, while clinic B only shows 51.4% of treatments were successful.



## Question 6

Continue your response to **QUESTION 6** on this page.

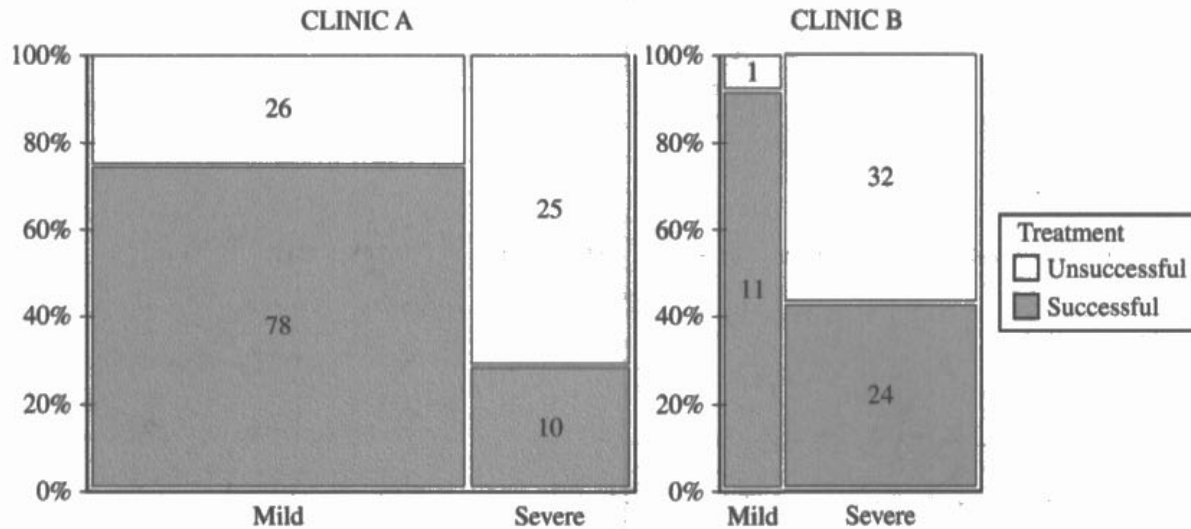
- (b) Based on the design of the study, would a statistically significant result allow the researchers to conclude that receiving treatments at the clinic you selected in part (a-ii) causes a higher percentage of successful treatments than at the other clinic? Explain your answer.

No, researchers could not conclude that receiving treatments at clinic A would cause a higher percentage of successful treatments because we are unaware if patients were randomly assigned to clinics. It is possible that far more severe patients go to clinic B and they have a correspondingly lower success rate. Although we are aware that patient records were randomly selected from one clinic, we are unaware whether the patients from clinic A are comparable to clinic B patients and therefore we cannot conclude a causal relationship between clinics and successes.

## Question 6

Continue your response to **QUESTION 6** on this page.

A physician who worked at both clinics believed that it was important to separate the patients in the study by severity of the patient's allergy (severe or mild). The physician constructed the following mosaic plot. The values in the mosaic plot represent the number of patients who were either successfully treated or unsuccessfully treated in each allergy severity group within each clinic. For example, the value 78 represents the number of patients successfully treated in the mild group within Clinic A.



Based on the mosaic plot, the physician concluded the following:

For mild allergy sufferers, **Clinic B** was more successful in treating allergies.

For severe allergy sufferers, **Clinic B** was more successful in treating allergies.

(c) (i) For each clinic, which allergy severity is treated more successfully? Justify your answer.

• Clinic A: Mild sufferers are treated more successfully because 75% of mild patients had successful treatments while only 28.6% of severe patients had successful treatments.

• Clinic B: Mild sufferers are also more successful, as 91.67% of mild allergies had successful treatments, while only 42.8% of severe cases had successful treatments.

## Question 6

Continue your response to **QUESTION 6** on this page.

(ii) For each clinic, which allergy severity is more likely to be treated? Justify your answer.

- Clinic A:  
Mild cases made up for 104 of the 139 cases, or 74.82%,  
indicating that mild cases are more likely to be  
treated at clinic A.
- Clinic B:  
Severe cases made up for 50 of the 60 cases, or 82.35%,  
indicating that severe cases are more likely to be  
treated at clinic B.

(d) Using your answers from part (c), give a reasonable explanation of why the more successful clinic identified in part (a-ii) is the same as or different from the physician's conclusion that Clinic B is more successful in treating both severe and mild allergies.

Because Clinic A saw so many more mild patients, which both clinics treated more successfully, it appeared to have more successful treatments compared to the number of treatments. Clinic B saw more severe patients and although they were better at treating severe patients than Clinic A, they weren't better at treating severe patients than Clinic A was at treating mild patients, which is why Clinic A appeared more successful. This is an example of Simpson's paradox.

**Question 6**

Begin your response to **QUESTION 6** on this page.

**STATISTICS**

**SECTION II, Part B**

**Suggested Time—25 minutes**

**1 Question**

**Directions:** Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

6. To compare success rates for treating allergies at two clinics that specialize in treating allergy sufferers, researchers selected random samples of patient records from the two clinics. The following table summarizes the data.

	Clinic A	Clinic B	Total
Unsuccessful treatment	51	33	84
Successful treatment	88	35	123
<b>Total</b>	139	68	207

- (a) (i) Complete the following table by recording the relative frequencies of successful and unsuccessful treatments at each clinic.

	Clinic A	Clinic B
Unsuccessful treatment	$\frac{51}{139}$	$\frac{33}{68}$
Successful treatment	$\frac{88}{139}$	$\frac{35}{68}$
	↓ .633	↓ .515

- (ii) Based on the relative frequency table in part (a-i), which clinic is more successful in treating allergy sufferers? Justify your answer.

Clinic A is more effective because it has a higher relative frequency in treating allergy sufferers.  $\frac{88}{139} > \frac{35}{68}$



**Question 6**

Continue your response to **QUESTION 6** on this page.

- (b) Based on the design of the study, would a statistically significant result allow the researchers to conclude that receiving treatments at the clinic you selected in part (a-ii) causes a higher percentage of successful treatments than at the other clinic? Explain your answer.

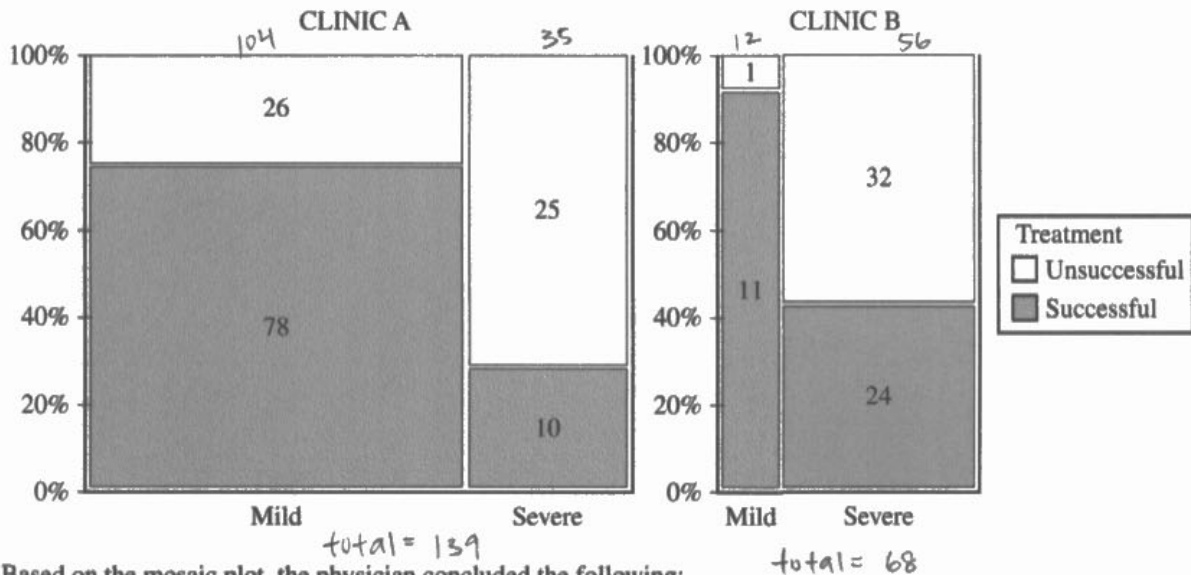
No, because the study was an observational study, not an experiment. Causation can only be determined from experiments.



## Question 6

Continue your response to **QUESTION 6** on this page.

A physician who worked at both clinics believed that it was important to separate the patients in the study by severity of the patient's allergy (severe or mild). The physician constructed the following mosaic plot. The values in the mosaic plot represent the number of patients who were either successfully treated or unsuccessfully treated in each allergy severity group within each clinic. For example, the value 78 represents the number of patients successfully treated in the mild group within Clinic A.



Based on the mosaic plot, the physician concluded the following:

For mild allergy sufferers, Clinic B was more successful in treating allergies.

For severe allergy sufferers, Clinic B was more successful in treating allergies.

(c) (i) For each clinic, which allergy severity is treated more successfully? Justify your answer.

- Clinic A: Mild, because  $\frac{78}{104}$  mild allergy cases were treated successfully as opposed to  $\frac{10}{35}$  severe allergy cases.
- Clinic B: Mild, because  $\frac{11}{12}$  mild allergy cases were treated successfully as opposed to  $\frac{24}{56}$  severe allergy cases.

## Question 6

Continue your response to **QUESTION 6** on this page.

(ii) For each clinic, which allergy severity is more likely to be treated? Justify your answer.

- Clinic A: Mild, because  $\frac{104}{139}$  of the allergy cases are mild severity (more than half)
- Clinic B: Severe, because  $\frac{56}{68}$  of the allergy cases are severe severity (more than majority)

(d) Using your answers from part (c), give a reasonable explanation of why the more successful clinic identified in part (a-ii) is the same as or different from the physician's conclusion that Clinic B is more successful in treating both severe and mild allergies.

This is an example of Simpson's paradox. When looking at the numbers, it's easy to assume that Clinic B is more successful because it has higher proportions. However, the fact that there are more cases in Clinic A is not considered. Each clinic must be compared against itself to get a more accurate data to compare.

**Question 6**

Begin your response to **QUESTION 6** on this page.

**STATISTICS**

**SECTION II, Part B**

**Suggested Time—25 minutes**

**1 Question**

**Directions:** Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

6. To compare success rates for treating allergies at two clinics that specialize in treating allergy sufferers, researchers selected random samples of patient records from the two clinics. The following table summarizes the data.

	Clinic A	Clinic B	Total
Unsuccessful treatment	51	33	84
Successful treatment	88	35	123
<b>Total</b>	139	68	207

- (a) (i) Complete the following table by recording the relative frequencies of successful and unsuccessful treatments at each clinic.

0.25   0.16

	Clinic A	Clinic B
Unsuccessful treatment	<del>0.25</del>	<del>0.16</del>
Successful treatment	<del>0.43</del>	<del>0.17</del>

0.43   0.17

- (ii) Based on the relative frequency table in part (a-i), which clinic is more successful in treating allergy sufferers? Justify your answer.

*Clinic A is more successful because it has the highest relative frequency (0.43) for successful treatment, rather than Clinic B's (0.17).*



## Question 6

Continue your response to **QUESTION 6** on this page.

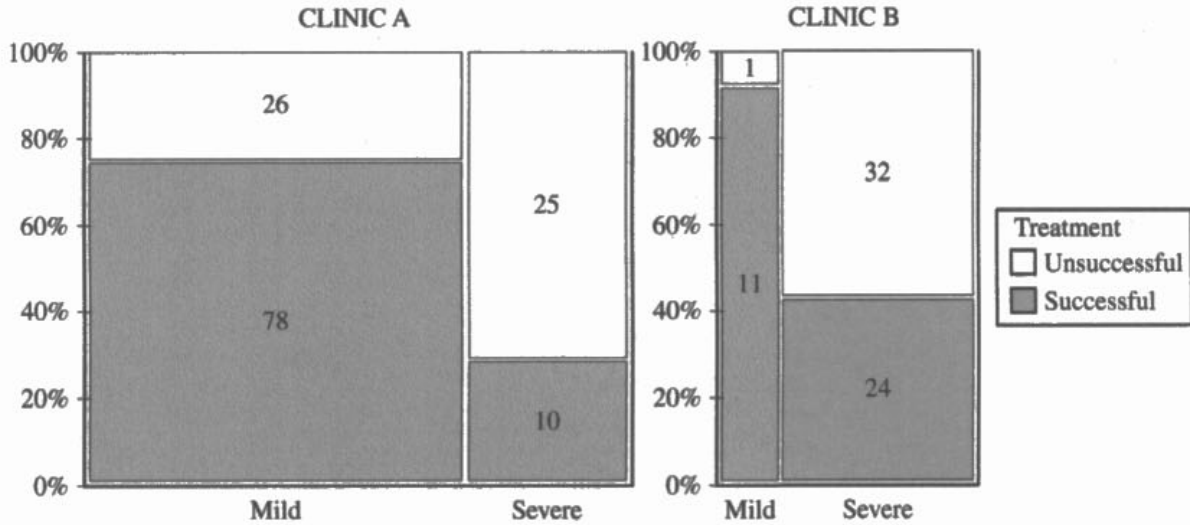
- (b) Based on the design of the study, would a statistically significant result allow the researchers to conclude that receiving treatments at the clinic you selected in part (a-ii) causes a higher percentage of successful treatments than at the other clinic? Explain your answer.

Yes because the researchers had selected random samples of patients which tests randomness, also  $207 < 10\%$  of all treatments which tests independence of study, and it is assumed that it is normally distributed due to every expected count  $\geq 5$ .

Question 6

Continue your response to **QUESTION 6** on this page.

A physician who worked at both clinics believed that it was important to separate the patients in the study by severity of the patient's allergy (severe or mild). The physician constructed the following mosaic plot. The values in the mosaic plot represent the number of patients who were either successfully treated or unsuccessfully treated in each allergy severity group within each clinic. For example, the value 78 represents the number of patients successfully treated in the mild group within Clinic A.



Based on the mosaic plot, the physician concluded the following:

For mild allergy sufferers, **Clinic B** was more successful in treating allergies.

For severe allergy sufferers, **Clinic B** was more successful in treating allergies.

(c) (i) For each clinic, which allergy severity is treated more successfully? Justify your answer.

- Clinic A: The Mild allergy for clinic A because the successful result was 0.75 or 75% which is higher than severe success which was 28.5% or 0.2857.
- Clinic B: The Mild allergy is because success result was 0.916 ≈ 92% and severe allergy was 42.8%.

## Question 6

Continue your response to **QUESTION 6** on this page.

(ii) For each clinic, which allergy severity is more likely to be treated? Justify your answer.

- Clinic A: Mild allergy because it has the higher success rate 75% than severe success rate, which is 28.5%.
- Clinic B: Mild allergy because it has higher success rate 92% than severe success rate, 42.8%.

(d) Using your answers from part (c), give a reasonable explanation of why the more successful clinic identified in part (a-ii) is the same as or different from the physician's conclusion that Clinic B is more successful in treating both severe and mild allergies.

- Clinic B is the more successful clinic, which is the same as physician's conclusion, because Clinic B in comparison to Clinic A is higher in both severe and mild.
- The mild success rate is higher in Clinic B which is 92% in comparison to mild success rate in Clinic A which is 75%.
- Also the severe success rate was higher in Clinic B which is 43% in comparison to severe success rate in Clinic A which is only 29%.

## Question 6

**Note:** Student samples are quoted verbatim and may contain spelling and grammatical errors.

### Overview

The primary goals of the question were to assess a student’s ability to (1) use information presented as a table of counts to compute relative frequencies of successful and unsuccessful treatment of allergies at each of two clinics; (2) use the computed relative frequencies to determine which of two clinics is more successful in treating allergy sufferers; (3) recognize that the data were obtained from an observational study; (4) justify a decision about whether a causal inference may be made based on the type of study that produced the data; (5) use information presented in two mosaic plots to compute and compare relative frequencies of successfully treating mild and severe allergy sufferers for each of two clinics; (6) use information presented in two mosaic plots to determine whether mild or severe allergy sufferers are more likely to be treated for each clinic; and (7) use previous answers to explain why two conclusions about which clinic is more successful may be different (or the same).

This question primarily assesses skills in skill category 2: Selecting Statistical Methods, and skill category 4: Statistical Argumentation. Skills required for responding to this question include (2.B) Construct numerical or graphical representations of distributions, (2.D) Compare distributions or relative positions of points within a distribution, and (4.A) Make an appropriate claim or draw an appropriate conclusion.

This question covers content from Unit 1: Exploring One-Variable Data, Unit 2: Exploring Two-Variable Data, and Unit 3: Introductions to Planning a Study of the course framework in the AP Statistics Course and Exam Description. Refer to topics 1.3, 2.2, and 3.2 and learning objectives UNC-1.A, DAT-2.B, and UNC-1.P.

### Sample: 6A

#### Score: 4

The response earned the following: Part (a) – E; Part (b) – E; Part (c) – E; Part (d) – E.

In part (a-i) the response provides correct values for the relative proportions, satisfying component 1. In part (a-ii) the response identifies the clinic that is more successful in treating allergies and justifies it by reporting the proportion of successful cases for both clinics, satisfying component 2. Part (a) was scored essentially correct (E).

In part (b) the response states, “No, researchers could not conclude that receiving treatments at clinic A would cause a higher percentage of successful treatments,” satisfying component 1. The response continues by stating, “because we are unaware if patients were randomly assigned to clinics.” While the response does not definitively state that random assignment was not done, it is true that we don’t know how patients chose the clinic at which they were treated. However, the response shows an understanding that random assignment is a necessary condition for making a causal inference. Therefore, this statement satisfies component 2. In addition, the response indicates that there is a chance that more patients suffering from severe allergies go to Clinic B, identifying a plausible confounding variable and the effect it has on success rate. Part (b) was scored essentially correct (E).

In part (c-i) the response correctly identifies that mild allergies are treated more successfully for both clinics, satisfying component 1. This conclusion is justified by comparing appropriate proportions for both clinics, satisfying component 2. In part (c-ii) the response correctly identifies the allergy severity that is more likely to be treated at each clinic, satisfying component 3. The response justifies the choices with correct proportions of severe or mild allergy sufferers treated by each clinic (see the Additional Notes section of the Scoring Guidelines, bullet 2, sub-bullet 3). Part (c) was scored essentially correct (E).

In part (d) the response states, “more mild patients, which both clinics treated more successfully,” satisfying component 1. The response also states, “Because Clinic A saw so many more mild patients,” and later states, “Clinic B saw more severe patients,” satisfying component 2. Part (d) was scored essentially correct (E).

**Question 6 (continued)****Sample: 6B****Score: 3**

The response earned the following: Part (a) – E; Part (b) – E; Part (c) – E; Part (d) – I.

In part (a-i) the response provides correct values for the relative proportions, satisfying component 1. In part (a-ii) the response identifies the clinic that is more successful in treating allergies and justifies it by reporting the proportion of successful cases for both clinics, satisfying component 2. Part (a) was scored essentially correct (E).

In part (b) the response states, “No, because the study was an observational study,” satisfying both components 1 and 2. Part (b) was scored essentially correct (E).

In part (c-i) the response correctly identifies that mild allergies are treated more successfully for both clinics, satisfying component 1. This conclusion is justified by comparing appropriate proportions for both clinics, satisfying component 2. In part (c-ii) the response correctly identifies the allergy severity that is more likely to be treated at each clinic, satisfying component 3. The response justifies the choices with correct proportions of severe or mild allergy sufferers treated by each clinic (see the Additional Notes section of the Scoring Guidelines, bullet 2, sub-bullet 3). Part (c) was scored essentially correct (E).

In part (d) the response correctly states, “This is an example of Simpson’s paradox.” However, the response fails to satisfy either component 1 or component 2 in explaining the reason for the paradox. Part (d) was scored incorrect (I).

**Sample: 6C****Score: 1**

The response earned the following: Part (a) – P; Part (b) – I; Part (c) – P; Part (d) – I.

In part (a-i) the response uses the wrong proportions by dividing each cell by the overall total of patients (207), failing to satisfy component 1. However, in part (a-ii), the response chooses the clinic that is more successful in treating allergies by making a reasonable comparison of relative frequencies used in the table in part (a-i), satisfying component 2. Part (a) was scored partially correct (P).

In part (b) the response states “Yes,” and justifies the response by checking conditions for inference. The response fails to satisfy either component 1 or component 2. Part (b) was scored incorrect (I).

In part (c-i) the response correctly identifies that mild allergies are treated more successfully for both clinics, satisfying component 1. This conclusion is justified by comparing appropriate proportions for both clinics, satisfying component 2. In part (c-ii) the response identifies the correct severity for Clinic A but not for Clinic B, failing to satisfy component 3. The justification refers to successful treatments instead of the proportion of severe or mild allergy sufferers treated at each clinic, failing to satisfy component 4. The response satisfies two of the four components. Part (c) was scored partially correct (P).

In part (d) the response incorrectly indicates the physician’s conclusion is the same as the conclusion made in part (a-ii). The justification fails to meet the criteria to satisfy either component 1 or component 2. Part (d) was scored incorrect (I).