

**AP<sup>®</sup> STATISTICS**  
**2009 SCORING GUIDELINES**

**Question 5**

**Intent of Question**

The primary goals of this statistical inference question were to assess a student's ability to (1) interpret a  $p$ -value in context; (2) make an appropriate conclusion about the study based on the  $p$ -value; and (3) based on the conclusion, identify the type of error that could have occurred and a possible consequence of this error in context.

**Solution**

**Part (a):**

The  $p$ -value of 0.0761 measures the chance of observing a difference between the two sample proportions ( $\hat{p}_{CC} - \hat{p}_{CC+MMR}$ ) as large as or larger than the one observed, if the survival rates for the two treatments (CC alone and CC + MMR) are in fact the same.

**Part (b):**

Because the  $p$ -value of 0.0761 is greater than 0.05, the null hypothesis should not be rejected. That is, there is not sufficient evidence to conclude that the treatment "CC alone" produces a higher survival rate than the standard treatment "CC + MMR."

**Part (c):**

Because the null hypothesis was not rejected, a Type II error could have occurred. A possible consequence is that CC + MMR would continue as the accepted practice when, in fact, CC alone would result in a higher survival rate.

**Scoring**

Parts (a), (b), and (c) are scored as essentially correct (E), partially correct (P), or incorrect (I).

**Part (a)** is scored as follows:

A correct interpretation must include the following three components:

- Correct probability phrase (e.g., "The  $p$ -value of 0.0761 measures the chance of . . .") that includes the words "as large as" (or something similar).
- Correct conditional phrase (e.g., "if the survival rates for the two treatments are in fact the same").
- Correct context.

Essentially correct (E) if the response includes all three components.

Partially correct (P) if the response includes the first component and one of the other two components

OR

if the probability phrase is complete except for the omission of the words "as large as" (or something similar) and the other two components are included.

Incorrect (I) if the response includes no more than one component.

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**Question 5 (continued)**

**Part (b)** is scored as follows:

Essentially correct (E) if a correct conclusion (failure to reject  $H_0$ ) is provided in context with appropriate linkage to the  $p$ -value.

Partially correct (P) if a correct conclusion is provided but either the context or linkage is missing  
*OR*  
the student “accepts  $H_0$ ” (or something similar) and provides both context and linkage.

Incorrect (I) if the student rejects  $H_0$   
*OR*  
the student provides neither context nor linkage.

**Part (c)** is scored as follows:

A correct response must include the following two components:

- The type of error named is consistent with the conclusion in part (b).
- A consequence is provided (in context) that is consistent with the conclusion in part (b) and is specific with regard to the treatments. The consequence must address how heart attack patients will be treated as a result of the error.

Essentially correct (E) if the response includes both components.

Partially correct (P) if the response includes only the consequence component  
*OR*

the type of error named is consistent with the conclusion in part (b) *AND* a correct definition (either generic or in context) of that error is given, but the consequence component is either missing or incorrect.

Incorrect (I) if the response does not include the consequence component, apart from the exception given above as the second type of a partially correct response.

**4            Complete Response**

All three parts essentially correct

**3            Substantial Response**

Two parts essentially correct and one part partially correct

**2            Developing Response**

*OR* Two parts essentially correct and no part partially correct

*OR* One part essentially correct and one or two parts partially correct

*OR* Three parts partially correct

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**Question 5 (continued)**

**1 Minimal Response**

- One part essentially correct and no parts partially correct  
*OR*  
No parts essentially correct and two parts partially correct