AP® STATISTICS
2011 SCORING GUIDELINES (Form B)

Question 4

Intent of Question

The primary goals of this question were to assess students' ability to (1) specify hypotheses for the chi-square test of independence; (2) state and check the appropriate conditions for inference; (3) interpret standard statistical output; (4) identify and describe the type of error that could have been made.

Solution

Part (a):

H_0 : There is no association between perceived effect of part-time work on academic achievement and average time spent on part-time jobs.
H_a : There is an association between perceived effect of part-time work on academic achievement and average time spent on part-time jobs.

Part (b):

The following conditions for inference are met:
1. The students were randomly selected.
2. The expected cell counts should be at least 5. The computer output indicates that all expected counts are greater than 5. The smallest expected cell count is 6.825.

Part (c):

Because the p-value 0.007 is less than 0.05, H_0 should be rejected. There is convincing evidence that there is an association between the perceived effect of part-time work on academic achievement and average time spent on part-time jobs.

Part (d):

Because the null hypothesis was rejected, a Type I error may have been made. A Type I error is concluding that there is an association between the perceived effect of part-time work on academic achievement and the average time spent on part-time jobs when, in reality, there is no association between the two variables.

Scoring

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

Part (a) is scored as follows:

Essentially correct (E) if the response includes the following three components:
1. The statement of no association (or independence) is in the null hypothesis, and the statement of association (or dependence) is in the alternative hypothesis.
2. The hypotheses do not imply a cause-and-effect relationship.
3. Acceptable terms are used for the two variables in the hypotheses.

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Question 4 (continued)

Partially correct (P) if the response includes exactly two of the three components above.

Incorrect (I) if the response fails to meet the criteria for E or P.

Part (b) is scored as follows:

Essentially correct (E) if the response includes *BOTH* conditions necessary for the test and indicates that *BOTH* conditions are met for these data.

Partially correct (P) if only one of the necessary conditions is included *AND* the response indicates that the condition is met for these data, *OR* both conditions are stated, *BUT* the response does not indicate that the conditions are met for these data.

Incorrect (I) if response fails to meet the criteria for E or P.

Note: If the response also includes conditions that are not required for the chi-square test, the response should be scored no higher than P for this part.

Part (c) is scored as follows:

Essentially correct (E) if the response includes a correct conclusion, in context, *AND* provides a justification based on linkage between the p-value and the conclusion.

Partially correct (P) if the response includes a correct conclusion, with linkage to the p-value, *BUT* the conclusion is not in context, *OR* the response includes a correct conclusion, in context, *BUT* linkage to the p-value is missing.

Incorrect (I) if response fails to meet the criteria for E or P.

Notes

- The conclusion should be scored based on the hypotheses given in the response to part (a).
- If both an α and a p-value are given together, the linkage between the p-value and the conclusion is implied. If no α is given, the solution must be explicit about the linkage by giving a correct interpretation of the p-value or explaining how the conclusion follows from the size of the p-value.
- A response that reaches a cause-and-effect conclusion cannot earn an E, unless this was already penalized in part (a). A response that includes a cause-and-effect conclusion should be scored as P, provided that the conclusion is in context and there is linkage to the p-value. It should be scored as I if it lacks either context or linkage to the p-value.

Part (d) is scored as follows:

Essentially correct (E) if a Type I error is identified and described in the context of the question.

Partially correct (P) if a Type I error is identified and a generic description of a Type I error, without context, is provided, *OR* correct statements are provided, in context, with an incorrect error name (Type II error).

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Question 4 (continued)

Incorrect (I) if a Type II error is described, *OR* no description or an incorrect description is provided.

Note: Part (d) should be scored based on the hypotheses given in the response to part (a) and the conclusion in part (c).

Each essentially correct (E) part counts as 1 point. Each partially correct (P) part counts as ½ point.

4 **Complete Response**

3 **Substantial Response**

2 **Developing Response**

1 **Minimal Response**

If a response is between two scores (for example, 2½ points), use a holistic approach to decide whether to score up or down, depending on the overall strength of the response and communication.