AP® STATISTICS
2010 SCORING GUIDELINES

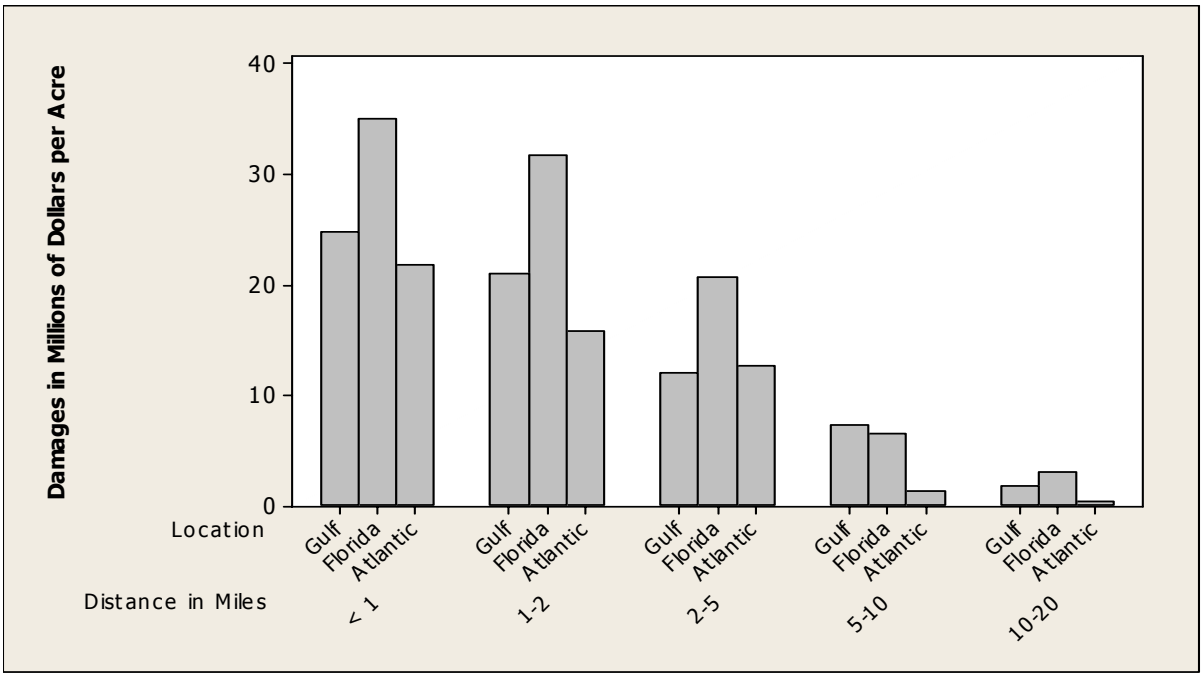
Question 6

Intent of Question

The primary goals of this investigative task were to assess students' ability to (1) produce and comment on a graphical display; (2) calculate a test statistic based on rank data; (3) use simulation results to draw an appropriate conclusion.

Solution

Part (a):



Part (b):

In all three regions (Gulf Coast, Florida, Lower Atlantic) the hurricane damage amounts tend to decrease as distance from the coast increases. For almost all given distances from the coast, the Florida region has the largest damage amounts. Also, for any given distance, the Gulf Coast and Lower Atlantic regions have similar damage amounts but with the Lower Atlantic damage amounts generally smaller.

Part (c):

For the "10 to 20 miles" distance category: The Florida region has the most damage (3.0 million dollars per acre) and so has rank 1. The region with the second-most damage is the Gulf Coast (1.7 million dollars), obtaining rank 2. The Lower Atlantic region has the least damage (0.3 million dollars) and so has rank 3. The last columns of the table should be filled in as follows:

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	10 to 20 miles	Average Rank
Gulf Coast	2	2.0
Florida	1	1.2
Lower Atlantic	3	2.8

The average ranks are computed $\frac{2+2+3+1+2}{5}=2.0$ for the five Gulf Coast damage ranks, $\frac{1+1+1+2+1}{5}=1.2$ for the five Florida damage ranks and $\frac{3+3+2+3+3}{5}=2.8$ for the five Lower Atlantic damage ranks.

Part (d):

The calculated value of the test statistic Q is

$$Q=5\left[(2.0-2)^2+(1.2-2)^2+(2.8-2)^2\right]=5[0+0.64+0.64]=6.4.$$

Part (e):

A Q value of 6.4 or larger occurred in $\frac{39}{1{,}000}=0.039$ (or 3.9 percent) of the 1,000 repetitions. All 1,000 repetitions of the simulation assumed there was no difference in the distribution of damage amounts among the three regions. This is a fairly small (approximate) p-value (less than 0.05), indicating that a test statistic as large or larger than the observed test statistic of $Q=6.4$ would be fairly unlikely to occur by chance alone if there really was no difference among the regions for each distance category. The sample data therefore provide reasonably strong evidence that there is a difference in the distributions of hurricane damage amounts among these three regions.

Scoring

This question is scored in four sections. Section 1 consists of part (a); section 2 consists of part (b); section 3 consists of parts (c) and (d); section 4 consists of part (e). Each of the four sections is scored as essentially correct (E), partially correct (P) or incorrect (I).

Section 1 is scored as follows:

Essentially correct (E) if the response includes a well-labeled, statistically valid graph that allows for comparing damage amounts both across regions *AND* at varying distances from the coast.

Partially correct (P) if the response includes a well-labeled, statistically valid graph that allows for comparing damage amounts across regions or at varying distances from the coast but not both *OR* if it includes a statistically valid graph that allows for both comparisons but lacks labels for either the regions or the distances (or both).

Incorrect (I) if the graph does not allow for either comparison *OR* if it is poorly labeled and allows for only one comparison.

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Section 2 is scored as follows:

Essentially correct (E) if the response includes *BOTH* of the following:

- Mention of a difference — a contrast among the three regions across distance categories (e.g., "Florida has greater damage than the other two regions at most distances")
- Mention of a similarity — a statement that in all regions hurricane damage decreases with greater distance from the coast

Partially correct (P) if the response includes a valid statement about only a difference or about only a similarity.

Incorrect (I) if the response has neither a valid statement about the difference nor a valid statement about the similarity.

Note: A statement that "Florida has more damage" is not sufficient to describe a difference if "at most distances" is not specified. Phrases that imply comparisons across distances such as "generally" or "for the most part" are acceptable for the "at most distances" specification.

Section 3 is scored as follows:

Essentially correct (E) if the response includes the correct ranks in part (c) *AND* the correct test statistic calculation in part (d).

Partially correct (P) if the response includes either of the following:

- The correct ranks in part (c) but not the correct test statistic calculation in part (d)
- Incorrect ranks in part (c) but the test statistic calculated correctly in part (d), using those incorrect ranks

Incorrect (I) otherwise.

Notes

- Calculation of the average ranks need not be shown to receive credit for correctly calculating Q.
- A miscalculation of Q results in no credit for part (d), but the severity of the miscalculation may be considered later in holistic scoring.

Section 4 is scored as follows:

Essentially correct (E) if the response includes *BOTH* of the following components:

- A valid quantification of the tail probability of the test statistic Q based on the simulated Q values
- A conclusion, in context, consistent with the rarity (or likelihood) of the calculated test statistic Q relative to the simulated Q values

Partially correct (P) if the response includes only one of these two components.

Incorrect (I) if the response does not include either of these two components.

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Each essentially correct (E) section counts as 1 point. Each partially correct (P) section 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 determine whether to score up or down, depending on the overall strength of the response and communication.