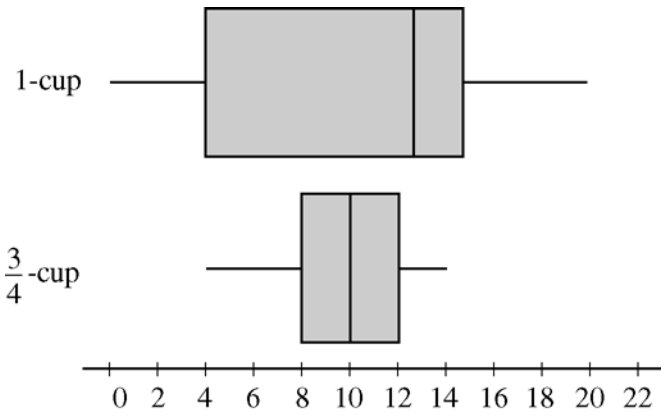
STATISTICS
SECTION II
Part A
Questions 1-5
Spend about 65 minutes on this part of the exam.
Percent of Section II score—75

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

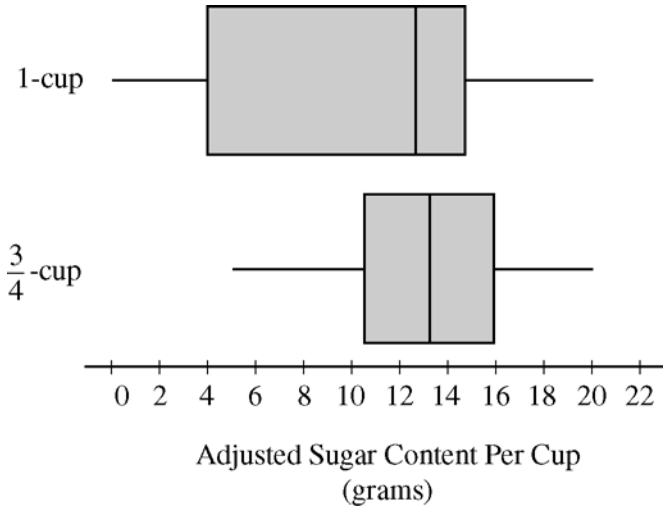
1. To determine the amount of sugar in a typical serving of breakfast cereal, a student randomly selected 60 boxes of different types of cereal from the shelves of a large grocery store.

   The student noticed that the side panels of some of the cereal boxes showed sugar content based on one-cup servings, while others showed sugar content based on three-quarter-cup servings. Many of the cereal boxes with side panels that showed three-quarter-cup servings were ones that appealed to young children, and the student wondered whether there might be some difference in the sugar content of the cereals that showed different-size servings on their side panels. To investigate the question, the data were separated into two groups. One group consisted of 29 cereals that showed one-cup serving sizes; the other group consisted of 31 cereals that showed three-quarter-cup serving sizes. The boxplots shown below display sugar content (in grams) per serving of the cereals for each of the two serving sizes.



   (a) Write a few sentences to compare the distributions of sugar content per serving for the two serving sizes of cereals.

After analyzing the boxplots on the preceding page, the student decided that instead of a comparison of sugar content per recommended serving, it might be more appropriate to compare sugar content for equal-size servings. To compare the amount of sugar in serving sizes of one cup each, the amount of sugar in each of the cereals showing three-quarter-cup servings on their side panels was multiplied by $\frac{4}{3}$. The bottom boxplot shown below displays sugar content (in grams) per cup for those cereals that showed a serving size of three-quarter-cup on their side panels.



(b) What new information about sugar content do the boxplots above provide?

(c) Based on the boxplots shown above on this page, how would you expect the mean amounts of sugar per cup to compare for the different recommended serving sizes? Explain.

2. A local school board plans to conduct a survey of parents' opinions about year-round schooling in elementary schools. The school board obtains a list of all families in the district with at least one child in an elementary school and sends the survey to a random sample of 500 of the families. The survey question is provided below.

   A proposal has been submitted that would require students in elementary schools to attend school on a year-round basis. Do you support this proposal? (Yes or No)

   The school board received responses from 98 of the families, with 76 of the responses indicating support for year-round schools. Based on this outcome, the local school board concludes that most of the families with at least one child in elementary school prefer year-round schooling.

   (a) What is a possible consequence of nonresponse bias for interpreting the results of this survey?

   (b) Someone advised the local school board to take an additional random sample of 500 families and to use the combined results to make their decision. Would this be a suitable solution to the issue raised in part (a) ? Explain.

   (c) Suggest a different follow-up step from the one suggested in part (b) that the local school board could take to address the issue raised in part (a).

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AP® STATISTICS
2008 SCORING GUIDELINES

Question 1

Intent of Question

The primary goals of this question were to assess a student's ability to (1) compare two distributions; (2) reevaluate shape, center, and spread for comparing the two distributions after one of the distributions is transformed by multiplying each of the data points by a constant; and (3) make a prediction about the means of the two distributions based on information derived about the behavior of the distributions from the boxplots.

Solution

Part (a):

The cereals that list a serving size of one cup have a median sugar amount larger than the median for the cereals that list a serving size of three-quarters of a cup. There is more variability (larger range and larger IQR) for the one-cup cereals. The shapes of the two distributions differ. The distribution of sugar content for three-quarter-cup cereals is reasonably symmetric: notice that the median is in the middle of the box. The distribution of sugar content for one-cup cereals is clearly skewed to the left (skewed toward the lower values): notice that the median is pulled to the right side of the central box closer to the third quartile.

Part (b):

The distribution of sugar content in the cereals that list one-cup serving sizes remains the same as in part (a) because no transformations were applied to this distribution. There is a noticeable shift toward higher sugar content for the cereals that list three-quarter-cup servings after the transformation was applied to this distribution. The two types of cereals (one-cup and three-quarter-cup) now have similar medians, and the two distributions now show similar maximum values. In addition, the variability in the sugar content for cereals with a three-quarter-cup serving size increased by a factor of $\frac{4}{3}$ after the transformation was applied to the data in this distribution.

Part (c):

Judging from the boxplots in part (b), we would expect the mean amounts of sugar per serving to be different. By the symmetry of the boxplot for the three-quarter-cup cereals, we would expect the mean and median to be similar. Because the boxplot for the one-cup cereals is skewed to the left, we would expect the mean to be lower than the median. Thus, because both types of cereal have similar medians, we would expect the mean amount of sugar per cup for cereals with a one-cup serving size to be lower than the mean amount of sugar per cup for cereals with a three-quarter-cup serving size.

Scoring

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

Part (a) is scored as follows:

Essentially correct (E) if the student correctly compares center, shape, and spread of the two distributions. Specific numerical values are not required.

Question 1 (continued)

Partially correct (P) if the student correctly compares any two of the three characteristics (center, shape, and spread) of the two distributions.

Incorrect (I) if the student compares no more than one of the three characteristics.

Note: If the student uses "normal," "mound-shaped," or "uniform" for "symmetric," then no credit is given for shape. If the student uses "mean" for "median," then no credit is given for center.

Part (b) is scored as follows:

Essentially correct (E) if the student correctly indicates that the three-quarter-cup cereals shift to higher values *AND* that the three-quarter-cup distribution becomes more variable.

Partially correct (P) if the student recognizes one of the two changes (shift to higher values or increase in variability) for the distribution of the three-quarter-cup cereals.

Incorrect (I) if the student identifies neither the shift to higher values nor the increased variability for the three-quarter-cup distribution.

Part (c) is scored as follows:

Essentially correct (E) if the student predicts that the mean for cereals with a one-cup serving size would be lower than the mean for cereals with a three-quarter-cup serving size *AND* provides a reasonable justification based on the left skewness of the distribution for the one-cup serving size.

Partially correct (P) if the student predicts that the mean will be lower for the one-cup serving size but provides a weak justification *OR* if the student correctly compares mean and median for each serving size with a justification based on the shapes of the distributions but fails to compare the means of the two serving sizes.

Incorrect (I) if the student predicts that the means will be different with no justification *OR* predicts that the means will be similar *OR* makes no prediction.

4 **Complete Response**

All three parts essentially correct

3 **Substantial Response**

Two parts essentially correct and one part partially correct

2 **Developing Response**

Two parts essentially correct and no parts partially correct

OR

One part essentially correct and one or two parts partially correct

OR

Three parts partially correct