

AP[®] STATISTICS 2007 SCORING GUIDELINES

Question 1

Intent of Question

The goals of this question are to assess a student's ability to: (1) explain how a commonly used statistic measures variability; (2) use a graphical display to address the research question of interest in a simple comparative experiment; and (3) use a confidence interval to make an appropriate inference.

Solution

Part (a):

Roughly speaking, the standard deviation ($s = 2.141$) measures a “typical” or “average” distance between the individual discoloration ratings and the mean discoloration rating for the strawberries in the control group.

Part (b):

The preservative does appear to have been effective in lowering the amount of discoloration in strawberries. The discoloration ratings for the strawberries that received the preservative, shown in the top dotplot, are clearly centered at a value that is lower than the center of the discoloration rating distribution for the control group, shown in the bottom dotplot. In addition, the dotplots can be used to find all five statistics in the five-number summary (min, Q1, median, Q3, and max) for both groups. In fact, four of the five statistics (the maximum is the only exception) are lower for the strawberries that received the preservative.

Part (c):

Since zero is not contained in the 95 percent confidence interval for the difference $\mu_c - \mu_t$, we can conclude that there is a significant difference between the mean ratings for the two groups at the $\alpha = 0.05$ level. The population mean discoloration rating for untreated strawberries is estimated to be between 0.16 and 2.72 units higher than the population mean discoloration rating for treated strawberries. Thus, we think there would be a difference in the population mean discoloration ratings for treated and untreated strawberries.

Scoring

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

Part (a) is scored as essentially correct (E) if the standard deviation is interpreted correctly in the context of this experiment.

Part (a) is scored as partially correct (P) if:

a standard textbook description of the standard deviation is provided without any reference to context, e.g., the standard deviation is described as the square root of an average squared deviation, or a “typical” or “average” deviation from the mean;

OR

the student provides evidence that the distribution of discoloration ratings in the control group is approximately normal, then correctly applies the 68-95-99.7 rule.

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Question 1 (continued)

Part (a) is scored as incorrect (I) if:

the formula for the standard deviation is copied from the formula sheet and no further explanation is provided;

OR

the student uses the 68-95-99.7 rule without justifying that the distribution of discoloration ratings in the control group is approximately normal.

Part (b) is scored as essentially correct (E) if the student indicates that the preservative appears to be effective and explicitly links this decision to comparison of a characteristic of relative standing from the dotplots for the two groups.

Part (b) is scored as partially correct (P) if:

the student says that the preservative appears to be effective because the discoloration ratings appear to be lower for the treatment group, but the student does not explicitly link this decision to comparison of a characteristic of relative standing for the two groups;

OR

the student correctly compares one or more characteristics of relative standing for the two groups but never states that the preservative was effective in lowering discoloration.

Part (b) is scored as incorrect (I) if:

the student says that the preservative is not effective because the centers of the two distributions are roughly the same;

OR

the student says that the preservative is effective, with incorrect or no justification.

Part (c) is scored as essentially correct (E) if the student indicates that zero is not included in the confidence interval, so there is a difference (in population means), AND states the conclusion in the context of this experiment.

Part (c) is scored as partially correct (P) if:

the student indicates that zero is not included in the confidence interval, so there is a difference (in population means), but does not state the conclusion in the context of this experiment;

OR

the student correctly interprets the 95 percent confidence interval in context and indicates that there is a difference (in population means), without indicating that zero is not included in the confidence interval.

Part (c) is scored as incorrect (I) if the student concludes that the preservative is not effective *OR* says that no conclusion can be made based on the confidence interval, *OR* the student states a conclusion that refers to sample means instead of population means.

Notes:

- The student is not required to specify the significance level in part (c), but if it is specified, it must be correct.

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Question 1 (continued)

- An adjustment could be made to formally conduct a one-sided test, but in general, confidence intervals are used to conduct two-sided tests. The fact that the lower endpoint of the confidence interval is positive does provide evidence that the preservative is effective in lowering the amount of discoloration in strawberries. The correct formal statement is: The 97.5 percent lower confidence bound for the difference in the means is above zero (0.16), so at the 0.025 level we would conclude that the mean rating for the treated berries is significantly lower than the mean for the untreated strawberries.

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 two parts partially correct

OR

Three parts partially correct

1 Minimal Response

One part essentially correct and either zero or one part partially correct

OR

No parts essentially correct and two parts partially correct