2024

AP® Statistics
Sample Student Responses and Scoring Commentary

Inside:

Free-Response Question 6

☑ **Scoring Guidelines**

☑ **Student Samples**

☑ **Scoring Commentary**

Question 6: Investigative Task   4 points

General Scoring Notes

- Each part of the question (indicated by a letter) is initially scored by determining if it meets the criteria for essentially correct (E), partially correct (P), or incorrect (I). The response is then categorized based on the scores assigned to each letter part and awarded an integer score between 0 and 4 (see the table at the end of the question).

- The model solution represents an ideal response to each part of the question, and the scoring criteria identify the specific components of the model solution that are used to determine the score.

Model Solution	Scoring
(a) (i) The inference procedure that should be used to estimate the mean price, in dollars $(\$)$, of this type of whistle at all stores that sell the whistle is a one-sample t-interval for a population mean. (ii) The parameter of interest is the mean whistle price, in dollars $(\$)$, of this type of whistle at all stores that sell the whistle.	**Essentially correct (E)** if the response satisfies the following three components: 1. In part (a-i) the response identifies a one-sample t-interval for a population mean by name (e.g., "one sample t-interval") 2. In part (a-ii) the response identifies the correct parameter by including reference to the mean 3. In part (a-ii) the response provides sufficient context for the parameter by including reference to the population (all stores that sell the whistle) and the variable of interest (the price of this type of whistle) **Partially correct (P)** if the response only satisfies one or two of the three components required for E. **Incorrect (I)** if the response does not meet the criteria for E or P.

Additional Notes:

- In part (a-i) a response that refers to a "test" does not satisfy component 1.
- In part (a-i) a response that refers to "a mean," singular, satisfies the one-sample aspect of component 1. If the response states "one-sample," it is not required to also include "for a mean" to satisfy component 1.
- A response that addresses "mean" in part (a-i) does not satisfy component 2 unless it is also addressed in part (a-ii).
- In part (a-ii) a response may satisfy the variable of interest aspect of component 3 with a minimum of "price" and "whistle."
- In part (a-ii) a response may satisfy the population aspect of component 3 by using words such as: "population," "all," or "true," or by using the symbol μ.
- In part (a-ii) if the response clearly refers to the sample mean instead of the population mean using words or symbols (e.g., $\bar{x}$), then component 3 is not satisfied unless the symbol used is defined as the population mean.

- For responses that are scored P, the number of components satisfied should be considered if holistic scoring is required.

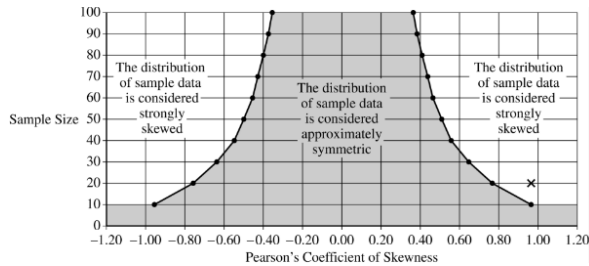| Model Solution	Scoring
(b) (i) The distribution of the sample of whistle prices appears slightly skewed to the right, because the mean is slightly higher than the median. (ii) Based on the $1.5 \times \text{IQR}$ rule, there are not whistle prices in this sample that would be considered outliers. A whistle price is an outlier using this method if it is more than $1.5 \times \text{IQR}$ below the first quartile (Q_1) or more than $1.5 \times \text{IQR}$ above the third quartile (Q_3). Because $Q_1 - 1.5 \times \text{IQR}$ $= 4.51 - 1.5(5.475 - 4.51)$ $= 3.0625,$ and the minimum value (4.25) is greater than $3.0625,$ there are no outliers to the left. Because $Q_3 + 1.5 \times \text{IQR}$ $= 5.475 + 1.5(5.475 - 4.51)$ $= 6.9225,$ and the maximum value (6.58) is less than $6.9225,$ there are no outliers to the right.	**Essentially correct (E)** if the response satisfies the following four components: 1. In part (b-i) the response indicates the distribution is skewed to the right or approximately symmetric 2. In part (b-i) the response justifies the response to component 1 with appropriate reasoning based on the summary statistics 3. In part (b-ii) the response provides a justification for stating there are no outliers by correctly calculating the lower and upper outlier criteria with work shown 4. In part (b-ii) the response states whether there are outliers based on the calculated lower and upper outlier criteria **Partially correct (P)** if the response satisfies three of the four components required for E. *OR* satisfies components 1 and 2 *OR* components 3 and 4 of components 1–4 required for E. **Incorrect (I)** if the response does not meet the criteria for E or P.

Additional Notes:

- If the response states skewed right, to satisfy component 2 the response should refer to the median being less than the mean. If the response states approximately symmetric, the response should refer to the median and mean being close together.
- A response that indicates skewed left does not satisfy components 1 or 2.
- If the response says the distribution is skewed to the right, examples of responses that satisfy component 2 include:
  o the mean is higher than the median,
  o the ratio between the mean and median is greater than 1,
  o the difference between the maximum and median is greater than the difference between the median and minimum, and
  o the difference between the maximum and third quartile is greater than the difference between the first quartile and minimum.
- For responses that score P, the number of components satisfied should be considered if holistic scoring is required.

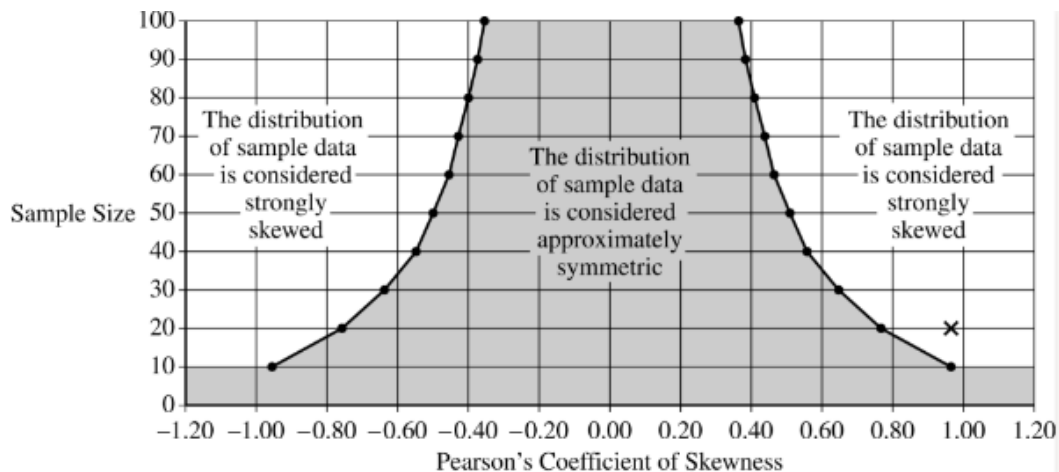| Model Solution	Scoring
(c) (i) Pearson's coefficient of skewness is $$\frac{3(5.12 - 4.885)}{0.743} \approx 0.949 .$$ (ii)	**Essentially correct (E)** if the response satisfies the following two components: 1. In part (c-i) the response calculates Pearson's coefficient of skewness with work shown 2. In part (c-ii) the response includes an x at approximately $(0.949, 20)$ or an x consistent with the calculation in part (c-i) **Partially correct (P)** if the response satisfies only one of the two components required for E. **Incorrect (I)** if the response does not meet the criteria for E or P.

Additional Notes:

- An arithmetic or transcription error in a response can be ignored if correct work is shown.
- Responses must include an x that is located on the line for sample size of 20 and located between 0.90 and 1.00 on the horizontal axis or be consistent with the value given in part (c-i) to satisfy component 2.

Pearson's Coefficient of Skewness

Model Solution	Scoring
(d) (i) Looking at the graph in part (c), for a sample size of 20, and a skewness coefficient of 0.949, this point falls in "the distribution of sample data is considered strongly skewed" region. Therefore, we would consider the shape of the distribution of the sample of whistle prices to be strongly skewed.	**Essentially correct (E)** if the response satisfies the following five components: 1. In part (d-i) the response indicates the sample is strongly skewed or makes a statement consistent with the graph in part (c) 2. In part (d-i) the response uses or refers to the graph or the Pearson coefficient of skewness to make the correct determination of skewness
(ii) No, based on the response to part (d-i), Julio's data would not satisfy the normality condition because neither of the criteria listed are met. Julio only has a sample size of 20, which is less than 30, and Pearson's coefficient of skewness indicates the distribution of sample data is strongly skewed.	3. In part (d-ii) the response states that the condition of normality is not met or makes a statement consistent with the explanation in part (d-i) 4. In part (d-ii) the response explains the sample size of 20 is less than 30 5. In part (d-ii) the response explains that the distribution of sample data is strongly skewed or makes a statement consistent with the explanation in part (d-i) **Partially correct (P)** if the response does not meet the criteria for E but satisfies three or four of components 1–5 required for E. **Incorrect (I)** if the response does not meet the criteria for E or P.

Additional Notes:

- A response that determines the sample is strongly skewed, but says the normality condition is satisfied, should be scored I.
- In part (d-i) a response that indicates the distribution is strongly skewed to the left does not satisfy component 1.
- If a response in part (c-ii) has an x on the curve, the response in part (d-i) must indicate the sample is skewed (not strongly skewed or approximately symmetric), or indicate it is not possible to choose whether it is strongly skewed or approximately symmetric to satisfy component 1.
- In part (d-i) a response that indicates the distribution is skewed, but not strongly skewed, because the Pearson coefficient of skewness is not that far from the curve on the graph satisfies component 1 and component 2.
- In part (d-i) a response that indicates the distribution is skewed, but not strongly skewed, may satisfy components 3–5 if in part (d-ii) the response indicates the conditions are met because the distribution is not very skewed and there are no outliers. The response does not need to indicate the sample size is less than 30.
- In part (d-ii) a response that indicates the sample size is small without explicitly referring to the values 20 and 30 may satisfy component 4.
- The quality of communication, or the number of components satisfied for responses with score P, should be considered if holistic scoring is required.

Scoring for Question 6

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

	Score
Complete Response	**4**
Substantial Response	**3**
Developing Response	**2**
Minimal Response	**1**

If a response is between two scores (for example, 2 ½ points), use a holistic approach to decide whether to score up or down, depending on the strength of the response and quality of the communication.

Question 6

Begin your response to **QUESTION 6** on this page.

SECTION II, Part B

Suggested Time—25 minutes

1 Question

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

6. A company sells a certain type of whistle. The price of the whistle varies from store to store. Julio, a statistician at the company, wants to estimate the mean price, in dollars ($), of this type of whistle at all stores that sell the whistle.

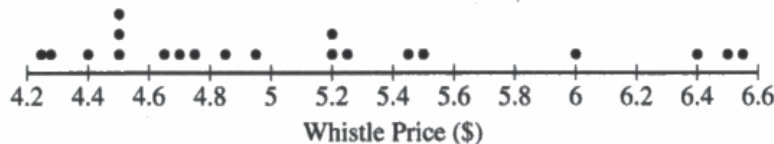(a) (i) Identify the appropriate inference procedure for Julio to use.

1 sample t interval for the mean (μ)

(ii) Describe the parameter for the inference procedure you identified in part (a-i) in context.

μ = true mean price (in $) of this type of whistle at all stores that sell said whistle

Julio called the managers of 20 randomly selected stores that sell the whistle and recorded the price of the whistle at each store. Following is a dotplot of Julio's data.

Price of the Whistle at 20 Stores

Whistle Price ($)

GO ON TO THE NEXT PAGE.

Use a pencil or a pen with black or dark blue ink. Do NOT write your name. Do NOT write outside the box.

0152529

Q5261/12

Question 6

Continue your response to **QUESTION 6** on this page.

The summary statistics for Julio's data are shown in the following table.

Summary Statistics for Julio's Data

Sample Size	Mean	Standard Deviation	Minimum	Q_1	Median	Q_3	Maximum
20	5.12	0.743	4.25	4.51	4.885	5.475	6.58

(b) Julio wants to examine some characteristics of the distribution of the sample of whistle prices.

(i) Describe the shape of the distribution of the sample of whistle prices. Justify your response using appropriate values from the summary statistics table.

the distribution of the sample of whistle prices appears to be skewed right. The mean (5.12) is greater than the median (4.885). Also, the median is closer to the Q_1 (4.51) value than to the Q_3 value.

(ii) Using the $1.5 \times$ IQR rule, determine whether there are any outliers in the sample of whistle prices. Justify your response.

$IQR = 5.475 - 4.51 = 0.965$

$5.475 + 1.5 (0.965) = 6.9225$
  └ max for not outliers

$4.51 - 1.5 (0.965) = 3.0625$
  └ min for not outliers

because there are no values that fall outside the range of 3.0625 to 6.9225, there are no outliers using the $1.5 \times IQR$ rule

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Q5261/13

Question 6

Continue your response to **QUESTION 6** on this page.

It can often be difficult to determine whether the distribution of sample data is skewed by looking at a graph of the data and the summary statistics, particularly when the sample size is small. Thus, statisticians sometimes measure how skewed a data set is. One such measure is Pearson's coefficient of skewness, which is calculated using the following formula.

$$\text{Pearson's Coefficient of Skewness} = \frac{3(\bar{x} - m)}{s}$$

In the formula, $\bar{x}$ is the sample mean, m is the sample median, and s is the sample standard deviation.

(c) (i) Calculate Pearson's coefficient of skewness for Julio's sample of 20 whistle prices. Show your work.

$\bar{x} = 5.12$

$m = 4.885$

$s = 0.743$

$\dfrac{3 (5.12 - 4.885)}{0.743} = \boxed{0.949}$

The following graph shows conclusions that can be made about the shape of the distribution of sample data based on Pearson's coefficient of skewness and sample size.

Conclusion from Pearson's Coefficient of Skewness
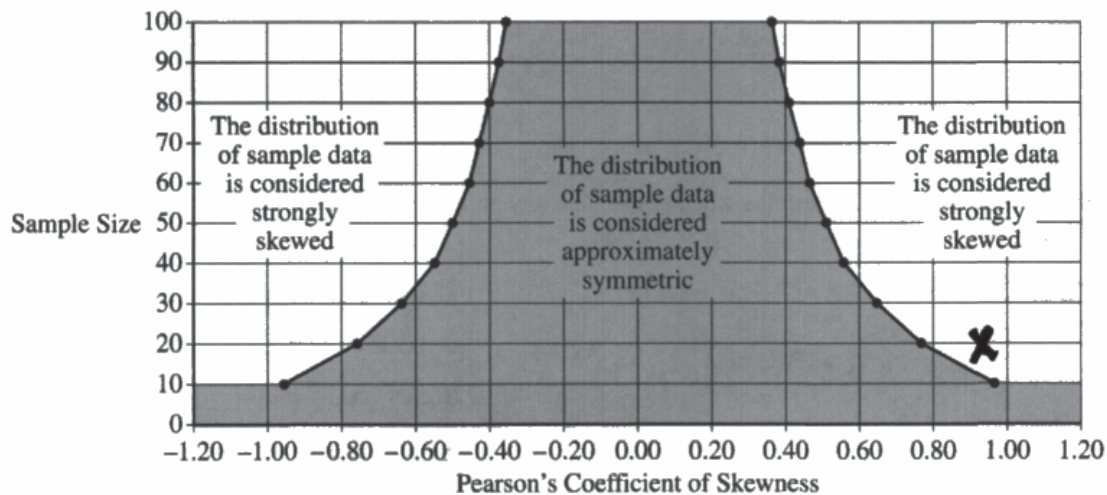
(ii) Indicate the value of the Pearson's coefficient of skewness you calculated in part (c-i) for the appropriate sample size by marking it with an "X" on the preceding graph.

$(0.949, 20)$

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0152529

Q5261/14

Question 6

Continue your response to **QUESTION 6** on this page.

(d) Consider your work in part (c).

(i) What should you conclude about the shape of the distribution of the sample of whistle prices? Justify your response.

we should conclude the shape of the distribution of the sample of whistle prices is |strongly| |skewed| b/c the point (X) falls in the unshaded region.

Julio's inference procedure in part (a-i) needs one of the following requirements to be satisfied to verify the normality condition.

- The sample size is greater than or equal to 30.
- If the sample size is less than 30, the distribution of the sample data is <u>not</u> strongly skewed and does <u>not</u> have outliers.

(ii) Using your response to (d-i) and the preceding requirements, is the normality condition satisfied for Julio's data? Explain your response.

|no,| because the sample size (n) = 20 < 30, so it fails the 1ST bullet point. As mentioned in bII, the distribution doesn't contain outliers, but as mentioned in dI there is a strong skew of the data. Therefore, the normality condition is not satisfied for Julio's data regarding whistle prices.

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Q5261/15

Question 6

Begin your response to **QUESTION 6** on this page.

SECTION II, Part B

Suggested Time—25 minutes

1 Question

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

6. A company sells a certain type of whistle. The price of the whistle varies from store to store. Julio, a statistician at the company, wants to estimate the mean price, in dollars ($), of this type of whistle at all stores that sell the whistle.

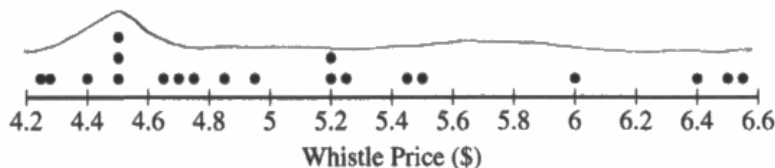   (a) (i) Identify the appropriate inference procedure for Julio to use.

   ~~t sample~~ + **Interval**

   (ii) Describe the parameter for the inference procedure you identified in part (a-i) in context.

   μ is the true population mean price in ($) dollars of a type of whistle sold at stores

Julio called the managers of 20 randomly selected stores that sell the whistle and recorded the price of the whistle at each store. Following is a dotplot of Julio's data.

Price of the Whistle at 20 Stores

Whistle Price ($)

Use a pencil or a pen with black or dark blue ink. Do NOT write your name. Do NOT write outside the box.

0084530

Q5261/12

Question 6

Continue your response to **QUESTION 6** on this page.

The summary statistics for Julio's data are shown in the following table.

Summary Statistics for Julio's Data

Sample Size	Mean	Standard Deviation	Minimum	Q_1	Median	Q_3	Maximum
20	5.12	0.743	4.25	4.51	4.885	5.475	6.58

(b) Julio wants to examine some characteristics of the distribution of the sample of whistle prices.

(i) Describe the shape of the distribution of the sample of whistle prices. Justify your response using appropriate values from the summary statistics table.

- the distribution is roughly uniform
- the center of the distribution ~~is at~~ can be described by the mean 5.12 or the median 4.885
- there are no outliers in the distribution as calculated in step (ii)
- the spread of the distribution can be measured by the range, 2.33, which is the maximum minus the minimum value

(ii) Using the $1.5 \times$ IQR rule, determine whether there are any outliers in the sample of whistle prices. Justify your response.

$$IQR = 5.475 - 4.51 = .965$$

$$.965 (1.5) = 1.4475$$

$$Q_1 - 1.5(IQR) \qquad Q_3 + 1.5(IQR)$$
$$4.51 - 1.4475 = \qquad 5.475 + 1.4475 =$$
$$3.0625 \qquad\qquad 6.9225$$

the minimum of the sample is 4.25, which is greater than $Q_1 - 1.5*IQR$, and the maximum of the sample is 6.58, which is less than $Q_3 + 1.5*IQR$ so there are no outliers in the sample

　　　Page 13　　　**GO ON TO THE NEXT PAGE.**

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Q5261/13

Question 6

Continue your response to **QUESTION 6** on this page.

It can often be difficult to determine whether the distribution of sample data is skewed by looking at a graph of the data and the summary statistics, particularly when the sample size is small. Thus, statisticians sometimes measure how skewed a data set is. One such measure is Pearson's coefficient of skewness, which is calculated using the following formula.

$$\text{Pearson's Coefficient of Skewness} = \frac{3(\bar{x} - m)}{s}$$

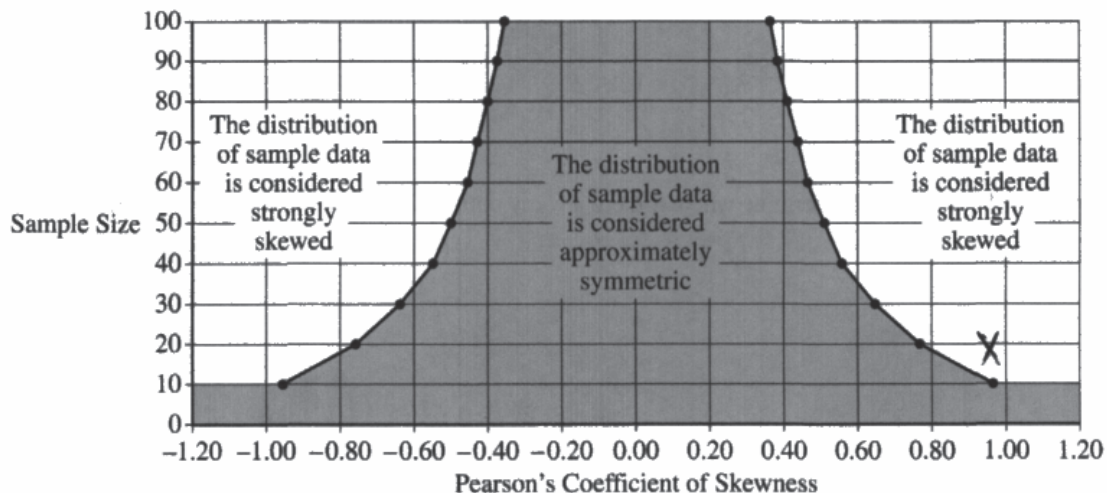In the formula, $\bar{x}$ is the sample mean, m is the sample median, and s is the sample standard deviation.

(c) (i) Calculate Pearson's coefficient of skewness for Julio's sample of 20 whistle prices. Show your work.

$$\frac{3\left(5.12 - 4.885\right)}{.743} = .948856$$

rounds to
.949

The following graph shows conclusions that can be made about the shape of the distribution of sample data based on Pearson's coefficient of skewness and sample size.

Conclusion from Pearson's Coefficient of Skewness

(ii) Indicate the value of the Pearson's coefficient of skewness you calculated in part (c-i) for the appropriate sample size by marking it with an "X" on the preceding graph.

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0084530

Q5261/14

Question 6

Continue your response to **QUESTION 6** on this page.

(d) Consider your work in part (c).

(i) What should you conclude about the shape of the distribution of the sample of whistle prices? Justify your response.

The distribution of sample data is strongly skewed. Based on the calculated Pearson's Coefficient of Skewness and the sample size of 20, the point on the graph of conclusions from ~~(ii)~~ shows that the data is strongly skewed. (C-ii)

Julio's inference procedure in part (a-i) needs one of the following requirements to be satisfied to verify the normality condition.

- The sample size is greater than or equal to 30.
- If the sample size is less than 30, the distribution of the sample data is <u>not</u> strongly skewed and does <u>not</u> have outliers.

(ii) Using your response to (d-i) and the preceding requirements, is the normality condition satisfied for Julio's data? Explain your response.

The normality condition isn't satisfied because the sample size of 20 is less than 30, and the distribution of the sample data is strongly skewed by the response in (d-i) that draws a conclusion from Pearson's Coefficient of skewness.

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Q5261/15

Question 6

Begin your response to **QUESTION 6** on this page.

SECTION II, Part B

Suggested Time—25 minutes

1 Question

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

6. A company sells a certain type of whistle. The price of the whistle varies from store to store. Julio, a statistician at the company, wants to estimate the mean price, in dollars ($), of this type of whistle at all stores that sell the whistle.

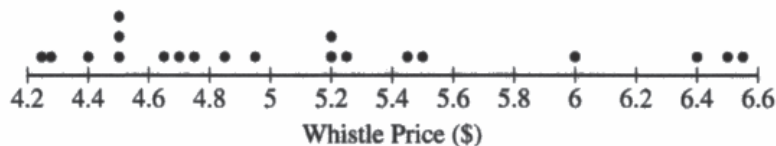(a) (i) Identify the appropriate inference procedure for Julio to use.

one Sample poplulation for mean.

(ii) Describe the parameter for the inference procedure you identified in part (a-i) in context.

$$\mu_{\bar{x}} = \mu \qquad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Julio called the managers of 20 randomly selected stores that sell the whistle and recorded the price of the whistle at each store. Following is a dotplot of Julio's data.

Price of the Whistle at 20 Stores

Whistle Price ($)

Use a pencil or a pen with black or dark blue ink. Do NOT write your name. Do NOT write outside the box.

0205106 ■　■■　■　　■　■■

Q5261/12

Question 6

Continue your response to **QUESTION 6** on this page.

The summary statistics for Julio's data are shown in the following table.

Summary Statistics for Julio's Data

Sample Size	Mean	Standard Deviation	Minimum	Q_1	Median	Q_3	Maximum
20	5.12	0.743	4.25	4.51	4.885	5.475	6.58

(b) Julio wants to examine some characteristics of the distribution of the sample of whistle prices.

(i) Describe the shape of the distribution of the sample of whistle prices. Justify your response using appropriate values from the summary statistics table.

The distribution is skewed to the right and has no low or high outliers. Julio should use meadian because the data is skewed.

IQR = .965

5.475 + (1.5 · .965
4.51 - (1.5 · .965

(ii) Using the 1.5 × IQR rule, determine whether there are any outliers in the sample of whistle prices. Justify your response.

5.475 + (1.5 · .965) = 6.92   No high outliers
4.51 - (1.5 · .965) = 3.06   No Low outliers

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Q5261/13

Question 6

Continue your response to **QUESTION 6** on this page.

It can often be difficult to determine whether the distribution of sample data is skewed by looking at a graph of the data and the summary statistics, particularly when the sample size is small. Thus, statisticians sometimes measure how skewed a data set is. One such measure is Pearson's coefficient of skewness, which is calculated using the following formula.

$$\text{Pearson's Coefficient of Skewness} = \frac{3(\bar{x} - m)}{s}$$

In the formula, $\bar{x}$ is the sample mean, m is the sample median, and s is the sample standard deviation.
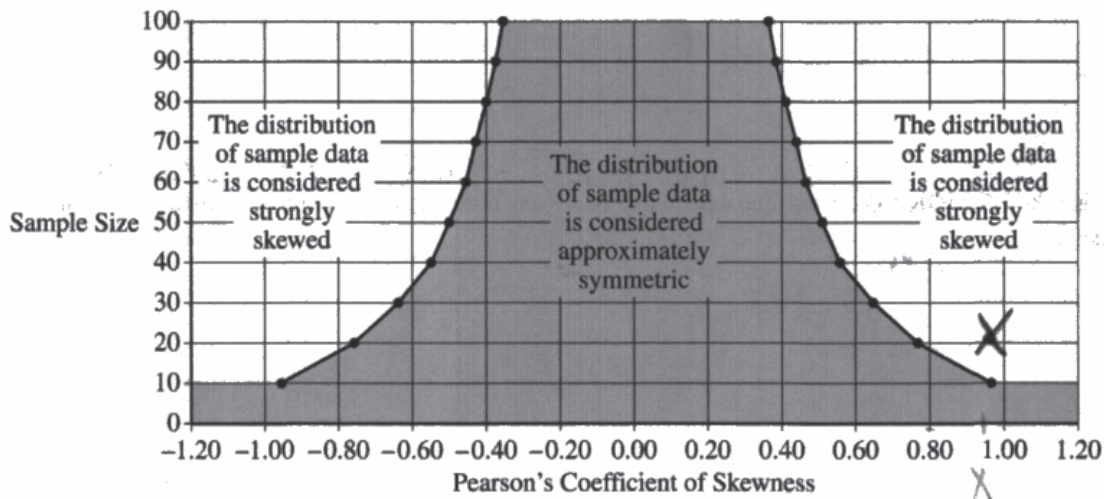
(c) (i) Calculate Pearson's coefficient of skewness for Julio's sample of 20 whistle prices. Show your work.

$$\frac{3(\bar{x} - m)}{s} \qquad \frac{3(5.12 - 4.885)}{.743}$$

$$\approx .949$$

The following graph shows conclusions that can be made about the shape of the distribution of sample data based on Pearson's coefficient of skewness and sample size.

Conclusion from Pearson's Coefficient of Skewness

(ii) Indicate the value of the Pearson's coefficient of skewness you calculated in part (c-i) for the appropriate sample size by marking it with an "X" on the preceding graph.

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0205106

Q5261/14

Question 6

Continue your response to **QUESTION 6** on this page.

(d) Consider your work in part (c).

(i) What should you conclude about the shape of the distribution of the sample of whistle prices? Justify your response.

The distribution of sample data is considered strongly skewed

Julio's inference procedure in part (a-i) needs one of the following requirements to be satisfied to verify the normality condition.

- The sample size is greater than or equal to 30.
- If the sample size is less than 30, the distribution of the sample data is not strongly skewed and does not have outliers.

(ii) Using your response to (d-i) and the preceding requirements, is the normality condition satisfied for Julio's data? Explain your response.

No, Julio only Sampled 20 stores so 30 > 20 and Julio data is strongly skewed so the normality condition is not satisfied for Julio's data?

Use a pencil or a pen with black or dark blue ink. Do NOT write your name. Do NOT write outside the box.

Q5261/15

Question 6

Note: Student samples are quoted verbatim and may contain spelling and grammatical errors.

Overview

The primary goals of the question were to assess a student's ability to (1) identify an appropriate procedure for conducting a one-sample t-interval for a population mean; (2) identify the parameter of interest for conducting a one-sample t-interval for a population mean; (3) describe the shape of the distribution of a sample using summary statistics for a sample of whistle prices; (4) use the $1.5 \times \text{IQR}$ rule to determine outliers from summary statistics for a sample of whistle prices; (5) calculate Pearson's coefficient of skewness using summary statistics for a sample of whistle prices; (6) locate the value of the calculated Pearson's coefficient of skewness on a graph; (7) conclude on the shape of the distribution for a sample of whistle prices based on the interpretation of the graph; and (8) explain if the normality condition for the one-sample t-interval is met.

This question primarily assesses skills in skill category 1: Selecting Statistical Methods, skill category 2: Data Analysis, and skill category 4: Statistical Argumentation. Skills required for responding to this question include (1.D) Identify an appropriate inference method for confidence intervals, (2.A) Describe data presented numerically or graphically, (2.B) Construct numerical or graphical representations of distributions, (2.C) Calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response, (4.B) Interpret statistical calculations and findings to assign meaning or assess a claim, and (4.C) Verify that inference procedures apply in a given situation.

This question covers content from Unit 1: Exploring One-Variable Data, Unit 2: Exploring Two-Variable Data, and Unit 7: Inference for Quantitative Data: Means of the course framework in the AP Statistics Course and Exam Description. Refer to topics 1.6, 1.7, 1.8, 2.2, 7.2, 7.3, and 7.5, and learning objectives UNC-1.H, UNC-1.K, UNC-1.M, UNC-4.O, UNC-4.P, and UNC-4.S.

Sample: 6A
Score: 4

The response earned the following: Part (a) – E; Part (b) – E; Part (c) – E; Part (d) – E.

In part (a-i) the response states "1 sample t interval," satisfying component 1. In part (a-ii) the response states both "μ" and "mean," each separately satisfying component 2. The response states "μ," "true," and "all stores," each separately satisfying the population aspect of component 3. The response states "price … whistle," satisfying the variable of interest aspect of component 3. The response satisfies component 3. Part (a) was scored essentially correct (E).

In part (b-i) the response states the distribution "appears to be skewed right," satisfying component 1. The response states two appropriate reasons why the distribution is skewed right: "The mean (5.12) is greater than the median (4.885)" and "the median is closer to the Q_1 (4.51) value than to the Q_3 value." Either reason separately satisfies component 2. In part (b-ii) the response states the lower and upper outlier criteria with work shown, satisfying component 3. The response identifies that there are "no outliers," satisfying component 4. Part (b) was scored essentially correct (E).

In part (c-i) the response calculates Pearson's coefficient of skewness with work shown, satisfying component 1. In part (c-ii) the response includes an "x" at approximately $(0.949, 20)$, satisfying component 2. Part (c) was scored essentially correct (E).

Question 6 (continued)

In part (d-i) the response states the sample is "strongly skewed," satisfying component 1. The response states "b/c the point (X) falls in the unshaded region" to make the determination of skewness, satisfying component 2. In part (d-ii) the response states that the condition of normality is not met, satisfying component 3. The response states "the sample size $(n) = 20 < 30,$" satisfying component 4. The response states, "there is a strong skew of the data," satisfying component 5. Part (d) was scored essentially correct (E).

Sample: 6B
Score: 3

The response earned the following: Part (a) – P; Part (b) – P; Part (c) – E; Part (d) – E.

In part (a-i) the response states "t interval" but crossed out "1 sample," failing to satisfy component 1. In part (a-ii) the response states "mean," satisfying component 2. The response states "true" and "population," each separately satisfying the population aspect of component 3. The response states "price … whistle," satisfying the variable of interest aspect of component 3. The response satisfies component 3. Part (a) was scored partially correct (P).

In part (b-i) the response states the distribution is "roughly uniform," failing to satisfy component 1. The response does not provide appropriate reasoning based on summary statistics, failing to satisfy component 2. In part (b-ii) the response states the lower and upper outlier criteria with work shown, satisfying component 3. The response identifies there are "no outliers," satisfying component 4. The response satisfies components 3 and 4. Part (b) was scored partially correct (P).

In part (c-i) the response calculates Pearson's coefficient of skewness with work shown, satisfying component 1. In part (c-ii) the response includes an "*x*" at approximately $(0.949, 20),$ satisfying component 2. Part (c) was scored essentially correct (E).

In part (d-i) the response states the sample is "strongly skewed," satisfying component 1. The response uses "the calculated Pearson's Coefficient" to make the determination of skewness, satisfying component 2. In part (d-ii) the response states that the condition of normality "isn't satisfied," satisfying component 3. The response states "the sample size of 20 is less than 30," satisfying component 4. The response states, "the sample data is strongly skewed," satisfying component 5. Part (d) was scored essentially correct (E).

Sample: 6C
Score: 2

The response earned the following: Part (a) – I; Part (b) – P; Part (c) – E; Part (d) – P.

In part (a-i) the response does not identify the appropriate procedure, failing to satisfy component 1. In part (a-ii) the response does not identify the parameter as the mean, failing to satisfy component 2. The response does not include reference to the population or the variable of interest, failing to satisfy component 3. Part (a) was scored incorrect (I).

In part (b-i) the response states the distribution "is skewed to the right," satisfying component 1. The response does not justify component 1 based on summary statistics, failing to satisfy component 2. In part (b-ii) the response states the lower and upper outlier criteria with work shown, satisfying component 3. Note: showing the IQR calculation is not required for work shown. The response identifies that there are "No high outliers" and "No low outliers," satisfying component 4. Part (b) was scored partially correct (P).

Question 6 (continued)

In part (c-i) the response calculates Pearson's coefficient of skewness with work shown, satisfying component 1. In part (c-ii) the response includes an "*x*" at approximately $(0.949, 20)$, satisfying component 2. Part (c) was scored essentially correct (E).

In part (d-i) the response states the sample is "strongly skewed," satisfying component 1. The response does not refer to the graph or the Pearson coefficient of skewness, failing to satisfy component 2. In part (d-ii) the response states that the condition of normality is "not satisfied," satisfying component 3. The response states "$30 > 20$," satisfying component 4. The response states "strongly skewed," satisfying component 5. Part (d) was scored partially correct (P).