The respiratory system can be a limiting factor in maximal exercise performance. Researchers studied the effect of two breathing frequencies on 10 male collegiate swimmers. The time in seconds was recorded for each swimmer to swim 200m at 90% race pace breathing every second stroke in the front crawl.

151.6 159.2 163.5 164.1 165.1

171.4 173.2 174.3 174.8 177.6

**1.** Mean: 167.48

**2.** Median: 168.25

**3.** Five Number Summary: MIN (151.6), Q1 (163.5), M (168.25), Q3 (174.3), MAX (177.6)

**4.** IQR: 10.8

**5.** 1.5 × IQR: 16.2

**6.** Lower and upper bounds for outliers:  
Q1-16.2=147.3  
Q3+16.2=190.5

OUTLIER < 147.3 ≤ NOT an outlier ≤ 190.5 < OUTLIER

**7.** Are there any outliers? No

**8.** Standard Deviation: 8.1939

**9.** What values can the standard deviation take?  
\* a. sx ≥ 0.

b. -∞ ≤ sx ≤ ∞.

c. 0 ≤ sx ≤ 1.

d. -1 ≤ sx ≤ 1.

**10.** What do you need to know to make a boxplot?  
 a. The mean and standard deviation.

b. The mean and median.

\* c. The five number summary.

d. All of the above.



**11**. Based on this boxplot, which of the following statements is true?

a. The distribution of times is skewed right.

\* b. The distribution of times is skewed left.

c. The distribution of times is symmetric.

d. The shape cannot be determined by the boxplot.

**12**. If each swimmer decreased his or her time by 2 seconds then

a. the third quartile would decrease by 2 seconds.

b. the median score would decrease by 2 seconds.

c. the interquartile range would remain unchanged.

\* d. All of the above.

**13.** What percent of swim times lie between Q1 and Q3?

a. 25%

\* b. 50%

c. 75%

d. 100%

**14**. About 25% of the times exceeded

a. 151 seconds

b. 163 seconds

c. 168 seconds

\* d. 174 seconds

**15**. Which value(s) is/are most affected by extreme outliers?

\* a. The mean and standard deviation.

b. The mean and median.

c. The median and quartiles.

d. No values are affected by extreme outliers.

**16**. Which of the following statements are true if 5 seconds were added to **each** score?

a. The mean and standard deviation would increase.

b. The mean and standard deviation would decrease.

c. The mean would decrease and the standard deviation would increase.

\* d. The mean would increase and the standard deviation would remain unchanged.

|  |  |
| --- | --- |
|  |  |
| *Original Distribution* | *Distribution with consistent increase in times* |

***Note*** *the distribution is exactly the same except that the classes shifted up by 5 seconds.*

**17.** Which of the following statements are true if the fastest time was even faster at 148.6?

a. The mean and standard deviation would increase.

b. The mean and standard deviation would decrease.

\* c. The mean would decrease and the standard deviation would increase.

d. The mean would increase and the standard deviation would remain unchanged.

|  |  |
| --- | --- |
|  |  |
| *Original Distribution* | *Distribution with decrease in the fastest swimmer’s time* |

***Note*** *there are 7 classes now instead of 6 which means the spread increased*

**18.** If the distribution of swim times were skewed right, how would that change the relationship between the mean and the median?

a. The mean and median would be equal.

b. The relationship between the mean and median would not change.

\* c. The mean would be greater than the median.

d. Cannot be determined from the information.