

# Measures of Central Tendency

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# Goals and Objectives

After reviewing mean, median, mode, range and outliers, students will be able to calculate Interquartile Range and Standard Deviation of two or more data sets.

# Why do we need this?

Data and how it is manipulated can be misused by the media. Consumers need to be able to interpret and understand the different ways to calculate tendencies. For example, having a mean average of 85% on an exam is very different than reporting a mode of 35%. Can these numbers appear for the same test? These are both ways to report measures of central tendency.

# Review

**Mean:** the average of a set of numbers. Add up the numbers and divide by the number of numbers.

**Median:** The number in the middle of the set of data when it is put in order. If two numbers are in the middle, take the average of those two numbers.

**Mode:** The number that appears most frequently in the data set.

# Review: Example

Example: Find the mean, median and mode of the following set of test scores:

78, 79, 81, 45, 71, 71, 95, 92, 95, 71, 85, 93, 78, 98, 96

Answer

# Review

Range: The difference between the highest and the lowest numbers in the set of data.

Outliers: Numbers that are significantly larger or smaller than the rest of the numbers.

# Review: Example

Find the range and identify any outliers of the following test scores:

78, 79, 81, 45, 71, 71, 95, 92, 95, 71, 85, 93, 78, 98, 96

Answer

# Review

The Spread of a set of data is used to describe the variability of the information. This looks at how different the numbers are.

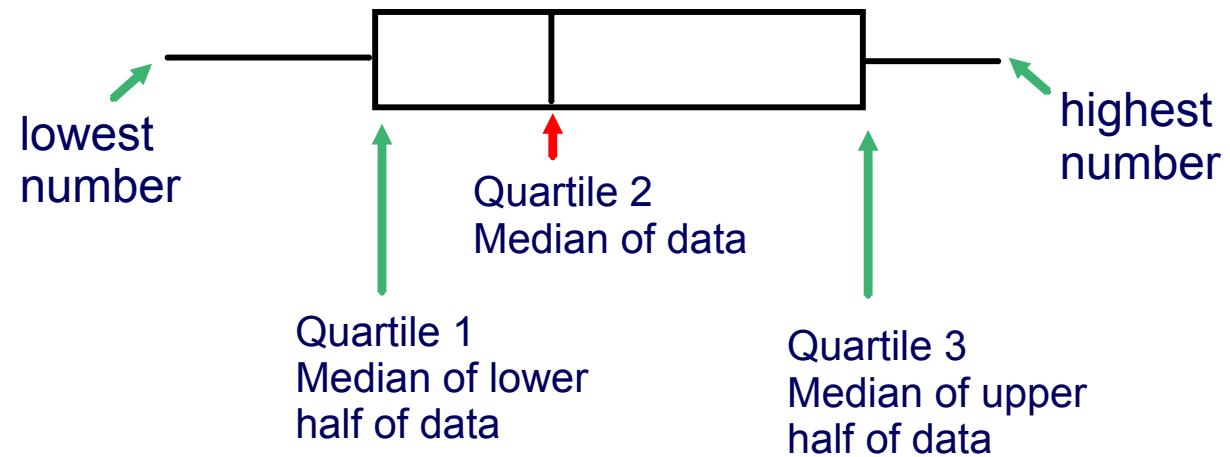
Interquartile Range is the difference of the value of quartile 3 and quartile 1. \*We will review quartiles in the next slide.

Standard Deviation is a measure of how close all of the data is to the mean.



# Interquartile Range

Remember making box plots in Algebra 1?



# Interquartile Range

Interquartile Range is the difference between Q2 and Q1, or  $Q3 - Q1$ .

Find all three quartiles and calculate the interquartile range for the following test scores.

78, 79, 81, 45, 71, 71, 95, 92, 95, 71, 85, 93, 78, 98, 96

Answer

# Standard Deviation

Standard Deviation looks a bit more complicated, but do not be afraid, it is actually fairly straightforward.

$$\sigma = \sqrt{\frac{(x_n - x_m)^2 + (x_{n-1} - x_m)^2 + (x_{n-2} - x_m)^2 + \dots + (x_1 - x_m)^2}{n}}$$

$\sigma = \textit{sigma}$

$x_m = \textit{mean}$

$x_n = \textit{data points}$

$n = \textit{number of pieces of data}$

This formula is itemized on the next slide 

# Standard Deviation

$$\sigma = \sqrt{\frac{(x_n - x_m)^2 + (x_{n-1} - x_m)^2 + (x_{n-2} - x_m)^2 + \dots + (x_1 - x_m)^2}{n}}$$

Steps for finding Standard Deviation:

1. Find the mean for the set of numbers ( $x_m$ ).
2. Subtract the mean from each number to find the difference ( $x_n - x_m$ ).
3. Square each difference ( $(x_n - x_m)^2$ ).
4. Add up the squared numbers.
5. Divide by the number of data points ( $n$ ).
6. Finally, take the square root of that number. This is the standard deviation ( $\sigma$ ).

**\*\*The beauty of standard deviation is that it is in the same units as the original set of data.**

# Standard Deviation

Find the standard deviation ( $\sigma$ ) for this set of test scores.  
Remember, we already found the mean - 81.87%

78, 79, 81, 45, 71, 71, 95, 92, 95, 71, 85, 93, 78, 98, 96

Answer

# Standard Deviation

What do you think would happen to the standard deviation if we eliminated the outlier of 45?

Answer

# Standard Deviation

Find the standard deviation of the following set of numbers:

6.7, 7.1, 6.5, 7.2, 6.23, 6.9

Answer

# Standard Deviation

Discuss the standard deviations of both sets that we just calculated. How do each reflect the spread of the data?

78, 79, 81, 45, 71, 71,  
95, 92, 95, 71, 85, 93,  
78, 98, 96

$$\sigma = 13.65$$

6.7, 7.1, 6.5, 7.2, 6.23, 6.9

$$\sigma = 0.337$$

Answer



44 Find the Interquartile Range of the following set of numbers:

36, 37, 50, 22, 25, 26, 36, 36, 49, 48

**Answer**

45 Find the Standard Deviation of the following set of numbers:

36, 37, 50, 22, 25, 26, 36, 36, 49, 48

Answer

46 Find the Interquartile Range for the following set of data:

1.3, 4.6, 2.3, 5.7, 2.4, 1.6, 3.4, 2.6

**Answer**

47 Find the Standard Deviation of the following set of data:

1.3, 4.6, 2.3, 5.7, 2.4, 1.6, 3.4, 2.6

**Answer**

48 What does an IQR of 10 and a Standard Deviation of 2.1 say about a set of data? Assume that the numbers are in the 100's.

A The spread is small.

B The spread is large

Answer

# Calculators

When sets of information are very large, calculators can be very helpful.

We will reference operations on a TI-84 for this exercise. Please refer to the manuals of other calculators for alternative directions.

# Calculators

Input the following sets into your calculator:

$L_1$ : 1.3, 1.5, 1.7, 1.9, 0.9, 1.3, 1.4, 0.8, 2.1, 1.5, 1.6, 1.7, 1.4, 1.9, 1.3

$L_2$ : 1.2, 5.7, 0.1, 7.9, 2.0, 0.2, 9.8, 2.1, 4.6, 9.2, 1.1, 4.6, 7.2, 6.4, 9.1 To find  $L_1$  and  $L_2$ , go to **STAT** and then 1: Edit.

# Calculators

Now, calculate the Standard Deviation of each set.

1. Go to calculation screen (`2nd` , `Quit`).
2. Push `2nd` , `Stat`.
3. Go to Math.
4. Find 7: `stdDev()`.
5. Type `stdDev(L1)` and then `stdDev(L2)`.



# Calculators

$L_1$ : 1.3, 1.5, 1.7, 1.9, 0.9, 1.3, 1.4, 0.8, 2.1, 1.5, 1.6, 1.7, 1.4, 1.9, 1.3

$L_2$ : 1.2, 5.7, 0.1, 7.9, 2.0, 0.2, 9.8, 2.1, 4.6, 9.2, 1.1, 4.6, 7.2, 6.4, 9.1

For  $L_1$ , the standard deviation is 0.354. With  $L_2$ , the standard deviation is 3.450. Why is there such a large difference between the two numbers? What does it say about the data?

# Standard Deviation

Standard Deviation ( $\sigma$ ) is a number that represents how different the data is from the mean. The smaller the standard deviation, the closer the data is to the mean. The higher the standard deviation, the further the data is from the mean.

49 Using a calculator, find the standard deviation of the following set of data.

13.4, 14.6, 17.2, 21.3, 14.5, 17.8, 13.3, 22, 16.7,  
17.3, 17.6, 15, 21, 16.8, 19.2, 15.3

Answer

50 Find the standard deviation of the following set of data.

12, 7, 14, 16, 25, 17, 8, 20, 20, 30,  
12, 14, 17, 17, 25, 6, 6, 22, 25, 26,  
24, 16, 17, 19

Answer

51 Which set of numbers will have the smallest standard deviation?

A 1.1, 3.6, 12.2, 4.5, 19.3, 2.3, 4.3, 5.6, 13.7, 12.1, 2.4

B 1.2, 2.3, 1.5, 1.6, 2.1, 2.1, 1.7, 2.4, 1.5, 1.6, 1.6, 2.0

C 1, 2, 7, 3, 9, 20, 4, 3, 12, 5, 6, 6, 5, 12, 13, 17, 20

Answer