

Measuring Center and Variability in Data

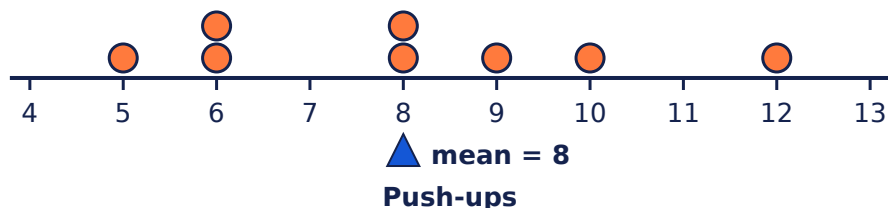
Grade 6 math · Lesson · Standards: 6.SP.A.3, 6.SP.B.5c, 6.SP.B.5d

Quick answer: The mean is the sum of the values divided by their count, and the median is the middle value in order. Range, interquartile range (IQR) and mean absolute deviation (MAD) measure variability. Use the median and IQR when data are skewed or have outliers, and the mean and MAD when data are symmetric.

Standards: 6.SP.A.3, 6.SP.B.5c, 6.SP.B.5d · **Level:** Grade 6

How do the mean and median describe the center?

A measure of center names a typical value. The **mean** is the fair-share value: add all the values and divide by how many there are. The **median** is the middle value of the ordered list, or the average of the two middle values when the count is even.



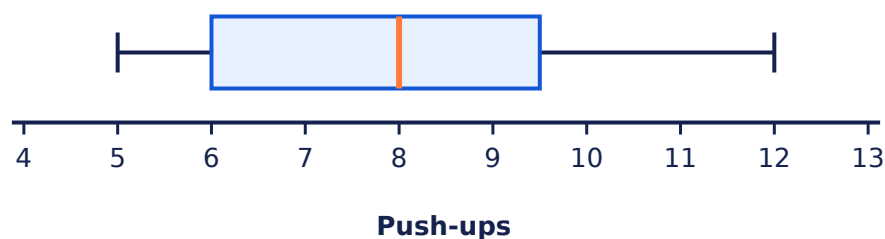
Push-ups completed by 8 club members; the triangle marks the mean.

The push-up data total 64 for 8 members, so the mean is $64 \div 8 = 8$. In order, the values are 5, 6, 8, 8, 9, 10, 12, and the two middle values are both 8, so the median is 8.

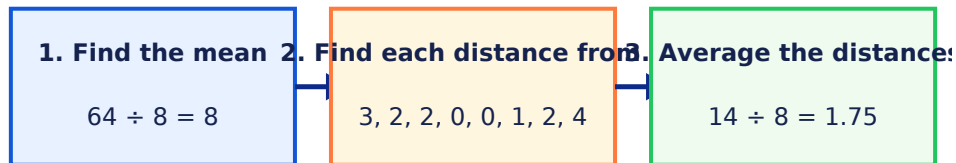
How do range, IQR and MAD describe variability?

Measures of variability

Range = maximum – minimum. **IQR** = $Q3 - Q1$, where $Q1$ and $Q3$ are the medians of the lower and upper halves. **MAD** is the mean of the distances of the values from the mean.



Box plot: $Q1 = 6$ and $Q3 = 9.5$, so the IQR is 3.5.



The three steps for the mean absolute deviation (MAD).

For the push-up data the range is $12 - 5 = 7$. The lower half 5, 6, 6, 8 has median 6 and the upper half 8, 9, 10, 12 has median 9.5, so $IQR = 9.5 - 6 = 3.5$.

How do outliers change the measures, and which should you choose?

An **outlier** is a value far from the rest. It pulls the mean and the range toward it, while the median and the IQR hardly move.

Situation	Center	Variability
Symmetric, no outliers	mean	MAD
Skewed or has outliers	median	IQR

Method: choose and compute

1. Order the data and look for outliers or skew.
2. Find the center that fits the shape.
3. Find the matching measure of variability.
4. Write the result with its unit and say what it means.

Worked example

The distances from the mean 8 are 3, 2, 2, 0, 0, 1, 2 and 4, which total 14. The MAD is $14 \div 8 = 1.75$ push-ups: members are typically about 2 push-ups from the mean.

Common mistake

Skipping the ordering step before finding the median or quartiles. Always list the values from least to greatest first.

Mathbot's tip

Median and IQR go together, and so do mean and MAD. Pick the pair that survives an outlier.

Key points to remember

- Mean = sum of values $\div$ number of values; median = middle value of the ordered list.
- Range = maximum – minimum; IQR = $Q3 - Q1$.
- MAD is the average distance of the values from the mean.
- Outliers pull the mean and the range, but barely move the median and IQR.
- Use median with IQR for skewed data, and mean with MAD for symmetric data.

Measuring Center and Variability in Data: frequently asked questions

How do I find the median when the count is even?

Order the values and average the two middle ones. For 9, 12, 15, 18 the middle values are 12 and 15, so the median is 13.5.

What does the IQR tell me?

The IQR is the length of the box in a box plot and covers the middle half of the data. A small IQR means the middle values are close together.

How is MAD different from range?

The range uses only the two extreme values. The MAD uses every value, so it shows how far the data typically are from the mean.

Why does an outlier change the mean more than the median?

The mean adds every value, so one very large value raises the total. The median depends only on the middle position, so one extreme value barely changes it.

How do I choose the best measure of center?

Look at the shape. If the data are symmetric, the mean and median are close and either works. If the data are skewed or have an outlier, the median describes a typical value better.