Spread, the IQR and the Standard Deviation

IQR = Q3 – Q1, the spread of the middle half; resists extreme values. Standard deviation: square each distance from the mean, average, square root. Divide by n for σ (everyone), by n – 1 for s (a sample).

1 THE VOCABULARY
Words we use

Range max – min.

Quartiles the medians of the two halves (leave out the overall median when n is odd).

IQR Q3 – Q1: the middle half's spread.

Standard deviation a typical distance from the mean: square, average, square root.

σ, s population (divide by n); sample (divide by n – 1).

- Watch out for these.
- Averaging the distances without squaring, then calling it the standard deviation (that is the MAD).
- Forgetting the square root at the end.
- Including the overall median in a half when n is odd.
- Using s for a whole group or σ for a sample.

2 THE METHOD
Standard deviation by hand

1. **MEAN** add and divide.
2. **DISTANCES** each value minus the mean.
3. **SQUARE AND ADD** signs disappear.
4. **DIVIDE** by n for σ; by n – 1 for s.
5. **SQUARE ROOT** back to the original units.

WHY SQUARE, THEN SQUARE ROOT

Squaring removes the signs so distances cannot cancel, and it counts big distances more. The square root undoes the squaring so the answer is in the same units as the data.

3 BY HAND
2, 4, 6, 8, 10

mean 6; distances –4, –2, 0, 2, 4	each value minus the mean
squares 16, 4, 0, 4, 16; sum 40	square and add
$40/5 = 8$; $\sigma = \sqrt{8} \approx 2.83$	the whole group
$40/4 = 10$; $s = \sqrt{10} \approx 3.16$	a sample
MAD = 2.4, for comparison	distances averaged without squaring

SAME MEAN, DIFFERENT SPREAD

4, 5, 6, 7, 8: IQR 3, $\sigma \approx 1.41$. 1, 3, 6, 9, 11: IQR 8, $\sigma \approx 3.69$. Same mean 6; the second is more spread out.

SAY IT OUT LOUD

Square, add, square root. Bigger means more spread out; zero means all the same.