Spread, the IQR and the Standard Deviation

Students measure spread with the range and the IQR, build the standard deviation from the mean absolute deviation by squaring, averaging, and taking the square root, work it once by hand, learn when to use sigma and when to use s, and interpret the size of a standard deviation.

TIME	45 minutes (one student with a parent or tutor, or a small group)
WHO	Math 1 (algebra readiness), about age 12. Follows Unit 12, Lesson 2.
MATERIALS	Student worksheet (PDF), the Deep Dive 5 interactive page for this lesson (step-by-step table), pencil, calculator with a square root key
PRIOR KNOWLEDGE	Quartiles and the IQR (6th grade). The mean absolute deviation (7th grade). Square, add, square root from the distance formula (Unit 11). Inverses (Unit 1).
STANDARDS	NC.M1.S-ID.2.
KEEP OUT	Variance as a named statistic. Why n minus 1 works, beyond the simple reason. The normal curve.

Learning goals

1. Find the range, the quartiles the calculator way, and the IQR by hand.
2. Compute a standard deviation by hand once, with the table, and explain each step.
3. Choose sigma for a whole group and s for a sample.
4. Interpret a standard deviation: bigger means more spread out, 0 means all the same.

Vocabulary: say both, every time

The rule for the whole lesson: whenever the adult or the student says a math word, they follow it with the plain-English version. Proper term first, plain English second, until the student does it without being asked.

TERM	LOOKS LIKE	PLAIN ENGLISH
IQR	Q3 – Q1	The middle half.
Mean absolute deviation	average distance	7th grade.
Standard deviation	square, average, square root	A typical distance from the mean.
σ, s	everyone; a sample	Divide by n; divide by n – 1.

> THE ONE SENTENCE TO SAY OUT LOUD
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> Square, add, square root, like the distance formula. Sigma for everyone, s for a sample.

Lesson timeline (45 minutes)

0:00 to 0:05	Warm-up: same mean. 4, 5, 6, 7, 8 and 1, 3, 6, 9, 11 both have mean 6. Ask what is different.
0:05 to 0:14	Range and IQR. Quartiles the calculator way. IQR as the box width. The MAD from 7th grade on 2, 4, 6, 8, 10.
0:14 to 0:28	The standard deviation. The table by hand: distances, squares, sum 40, divide by 5, square root. Then n minus 1 and s. Tie to the distance formula and the undo idea. Run the step-by-step tool.
0:28 to 0:34	What it means. Compare the two sets: 1.41 against 3.69. Zero means all the same.
0:34 to 0:41	Practice. The practice problems or Worksheet Parts A to C. Same buttons: Hint, Show next step, Reveal answer, Hide help.
0:41 to 0:45	Exit ticket. Worksheet Part E. Success looks like 4.5, 7.5, 3; 2.83 and 3.16; and n minus 1 for a sample.

Misconceptions to listen for

- **The standard deviation is the MAD.** It squares first and takes a square root last.
- **Skip the square root.** Then the units are squared.
- **Include the median in both halves.** Leave it out when n is odd.
- **A bigger standard deviation means a bigger mean.** It means more spread, not a higher center.

Support and stretch

Support

Keep the three-column table template on the desk. Say the five steps aloud each time: mean, distances, square and add, divide, square root.

Stretch

Ask what happens to σ if every value is doubled (it doubles) or if 10 is added to every value (it does not change). Ask for a data set of five values with mean 6 and σ as small as possible.

Where this goes next

Lesson 4: outliers. The 1.5 IQR rule, and what an outlier does to each statistic.

> THE HABIT TO BUILD
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> Square, add, square root. Then say what the size of the number means.