8th Grade Math

Unit 2: Statistics with univariate data

8.11B, 8.11C

Let’s describe data! This unit teaches students to describe data sets using the mean and mean absolute deviation as well as evaluate study designs. Students will see many examples of problems in real-world contexts.

- Calculate the **mean absolute deviation** of a data set
- Determine whether sampling methods are **random**

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<th>TEKS standards</th>
<th>Common misconceptions</th>
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<td>8.11.B: Determine the mean absolute deviation and use this quantity as a measure of the average distance data are from the mean using a data set of no more than 10 data points.</td>
<td>&quot;The mean is the middle number in a data set&quot;</td>
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<td><strong>How to help:</strong> In this unit, students will be working with the mean, not the median. However, they still might get them confused. Remind students that the mean is the numerical average where we add up all of the data points and divide by the number of data points. You can give warm ups or practice problems where students find the mean and the median of sets of data to give them practice distinguishing between the two.</td>
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<td>8.11.C: Simulate generating random samples of the same size from a population with known characteristics to develop the notion of a random sample being representative of the population from which it was selected.</td>
<td>&quot;The mean is always a number in the data set&quot;</td>
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<td><strong>How to help:</strong> Give students lots of examples to work through. You can use problems in context to give students an intuitive understanding. For example, you can ask 5-6 students how many siblings they have and then find the mean. It is likely that you will get a decimal answer, which doesn’t actually make sense since you can’t have a fraction of a person, but that’s how it works out mathematically.</td>
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<td>&quot;The MAD can be negative&quot;</td>
<td>Since the mean absolute deviation (MAD) describes spread and is a measure of distance, it can only be zero or positive.</td>
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A mean can be negative, but not the MAD.

**How to help:** It is important that students understand that the MAD is a measure of spread. Do examples with students. A discussion about what data could look like if the MAD were negative could be productive (what would it look like?).

“The MAD is the range” | The MAD and the range are two different measures of spread. The MAD measures the spread of data by calculating the mean distance of each point from the mean of the entire set. The range is simply the distance between the largest and smallest data points.

**How to help:** This unit doesn’t explicitly discuss the range, so students may not bring it up. If they do, give them some problems where they find both the MAD and the range so they can get practice and see the difference between the two. They are both helpful measures of spread, but they provide different information.
Unit resources

- For the videos in this unit, use the Learning summary video notetaking guide.
- For the articles in this unit, use the Article notetaking guide.
- For the exercises in this unit, use the Blank workspace template.
- To record key terms and information, use the Vocabulary and notation notetaker.

Lesson overview

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| Lesson 1: Mean absolute deviation (MAD) | Students will be able to calculate the mean absolute deviation (MAD) given a set of data. | - Give a warm up where students find the mean of sets of numbers. They are expected to be able to find the mean at the start of this lesson.  
  - Reiterate with students that finding a mean is helpful because it finds us an average while a MAD is helpful because it tells you how spread out the data are.  
  - There are many steps in these problems so students might need help with the procedures. There are many places where students can make simple mistakes, so encourage them to work carefully. |
| Lesson 2: Simulating samples from populations | Students will be able to determine whether a sample from a population is random or not.  
Students will be able to determine whether a sample is representative of the population. | - Students will have to think critically here about what makes a sample random.  
  - Some students may struggle with the idea that a random sample can be representative of an entire population. Talk about polling that they are likely to have seen, like political polling and marketing surveys. |
| Lesson 3: Simulating random samples | Students will be able to simulate a random sample using a random digit generator. | - This lesson gives students an opportunity to simulate random samples using a random digit generator.  
  - Students may need extra support figuring out how many digits to look at each time (must always be the same number!) and remembering to skip numbers that are outside the desired range. |
Best practices

Students have been finding the mean of a set of data for a few years at this point, but the mean absolute deviation (MAD) will be new. Similar to standard deviation, the MAD is a measure of how spread out the data are. Students will see standard deviation in high school, so for now focus on MAD. Since MAD may be new to you, here is more information.

Mean Absolute Deviation (MAD)

Students will get plenty of experience finding the mean of data sets when they calculate the MAD! To find the MAD, you will first calculate the mean of a data set, then find the absolute distances from each data point to the mean, and take the mean of those distances.

Let’s do an example together, looking at two different data sets to be able to compare their MADs.

Data Set #1: 4, 4, 5, 6, 6

First, we want to find the mean of the set. To do this, we add up all of the numbers and divide by the number of numbers.

\[
\frac{4 + 4 + 5 + 6 + 6}{5} = \frac{25}{5} = 5
\]

Now that we know the mean, we can find the MAD. To find the MAD, we find the distance between each data point and the mean, and then take the mean of those distances.

When we find the distance between each data point and the mean, the direction doesn’t matter, so we are essentially taking the absolute value of the difference between the data point and the mean.

\[
\frac{|4 - 5| + |4 - 5| + |5 - 5| + |6 - 5| + |6 - 5|}{5}
\]

\[
\frac{1 + 1 + 0 + 1 + 1}{5} = \frac{4}{5} = 0.8
\]

The MAD for this data set is 0.8.
Data Set #2: 1, 2, 4, 8, 10

For this data set, we’ll go through the same steps.

1. Calculate the mean

\[
\frac{1 + 2 + 4 + 8 + 10}{5} = \frac{25}{5} = 5
\]

2. Calculate the MAD

\[
\frac{|1 - 5| + |2 - 5| + |4 - 5| + |8 - 5| + |10 - 5|}{5} = \frac{16}{5} = 3.2
\]

Now, let’s compare these two data sets. They both have the same mean, but their MADs are different. The graphs of the data will help to explain why the MADs are so different.

| Data Set #1: 4, 4, 5, 6, 6 | Mean = 5  
|---------------------------|-----------  
| Data Set #2: 1, 2, 4, 8, 10 | MAD = 0.8  
|---------------------------|-----------  
| Data Set #1: 4, 4, 5, 6, 6 | Mean = 5  
|---------------------------|-----------  
| Data Set #2: 1, 2, 4, 8, 10 | MAD = 3.2  

In Data Set #1 the points are all clustered around the mean but in Data Set #2 they are spread farther apart. That is why the MAD is larger in Data Set #2 than in Data Set #1, because the points are more spread out.

CLASSROOM ACTIVITIES

Collect your own class data
You can create Mean Absolute Deviation (MAD) problems easily by collecting data from students. You can ask 4-6 students how tall they are, how many books they read in the last month, how many pencils they have, etc. and then find the MAD of each data set.

Design their own study
Have students design their own study by creating a question and designing the random sampling method. They can simulate the random sample or conduct their study on a small scale with a reasonable sample size. This is a great opportunity for posters or presentations.
GENERAL CLASSROOM IMPLEMENTATION RESOURCES:

- **Weekly Khan Academy Quick Planning Guide**: Use this template to plan your week using Khan Academy.
- **Using Khan Academy in the Classroom**: Learn teaching techniques and strategies to support your students and save time with Khan Academy.
- **Differentiation Strategies for the Classroom**: Discover strategies to support the learning of all students.