

Are YOU Ready?

Complete these exercises to review skills you will need for this module.



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Remainders

EXAMPLE

$$\begin{array}{r} 7.25 \\ 12 \overline{)87.00} \\ \underline{84} \\ 30 \\ \underline{-24} \\ 60 \\ \underline{-60} \\ 0 \end{array}$$

Write a decimal point and a zero in the dividend.

Place a decimal point in the quotient.

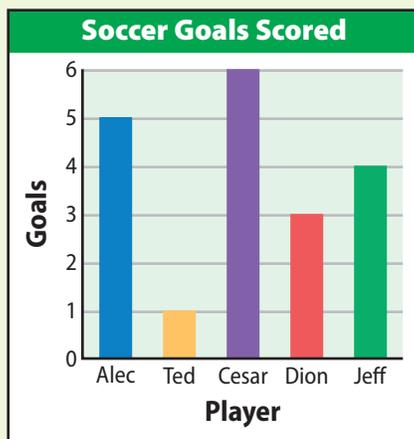
Add more zeros to the dividend if necessary.

Find the quotient. Write the remainder as a decimal.

1. $15 \overline{)42}$ _____ 2. $75 \overline{)93}$ _____ 3. $52 \overline{)91}$ _____ 4. $24 \overline{)57}$ _____

Read Bar Graphs

EXAMPLE How many goals did Alec score?



The first bar shows how many goals Alec scored.

The bar extends to a height of 5.

Alec scored 5 goals.

5. How many goals did Dion score? _____
6. Which two players together scored the same number of goals as Jeff? _____
7. How many fewer goals than Cesar did Alec score? _____

Reading Start-Up

Visualize Vocabulary

Use the review words to complete the chart.

Introduction to Statistics		
Definition	Example	Review word
A group of facts	The grades of all of the students in a school	
A tool used to gather information from individuals	A questionnaire given to all students to find the number of hours each student spends studying in 1 week	
A value that summarizes a set of unequal values, found by addition and division	Results of the survey show that students typically spend 5 hours a week studying	

Understand Vocabulary

Complete the sentences using the checked preview words.

1. The average of a data set is the _____.
2. The _____ is the middle value of a data set.
3. The number or category that occurs most frequently in a data set is the _____.

Vocabulary

Review Words

average (*promedio*)
data (*datos*)
survey (*encuesta*)

Preview Words

box plot (*diagrama de caja*)
categorical data (*datos categóricos*)
dot plot (*diagrama de puntos*)
histogram (*histograma*)
interquartile range (*rango entre cuartiles*)
lower quartile (*cuartil inferior*)
✓ mean (*media*)
mean absolute deviation (MAD) (*desviación absoluta media, (DAM)*)
✓ median (*mediana*)
measure of center (*medida central*)
measure of spread (*medida de dispersión*)
✓ mode (*moda*)
range (*rango*)
statistical question (*pregunta estadística*)
upper quartile (*cuartil superior*)

Active Reading

Layered Book Before beginning the module, create a layered book to help you learn the concepts in this module. Label each flap with lesson titles from this module. As you study each lesson, write important ideas, such as vocabulary and formulas under the appropriate flap. Refer to your finished layered book as you work on exercises from this module.





GETTING READY FOR

Displaying Analyzing, and Summarizing Data

Understanding the standards and the vocabulary terms in the standards will help you know exactly what you are expected to learn in this module.

CA CC 6.SP.5C

Summarize numerical data sets in relation to their context, such as by giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

What It Means to You

You will use measures of center to describe a data set.

EXAMPLE 6.SP.5C

Several students' scores on a history test are shown. Find the mean score and the median score. Which measure better describes the typical score for these students? Explain.

History Test Scores						
73	48	88	90	90	81	83

$$\text{Mean: } \frac{73 + 48 + 88 + 90 + 90 + 81 + 83}{7} = \frac{553}{7} = 79$$

To find the median, write the data values in order from least to greatest and find the middle value.

Median: 48 73 81 **83** 88 90 90

The median better describes the typical score.

The mean is affected by the low score of 48.

CA CC 6.SP.4

Display numerical data in plots on a number line, including dot plots, histograms, and box plots.

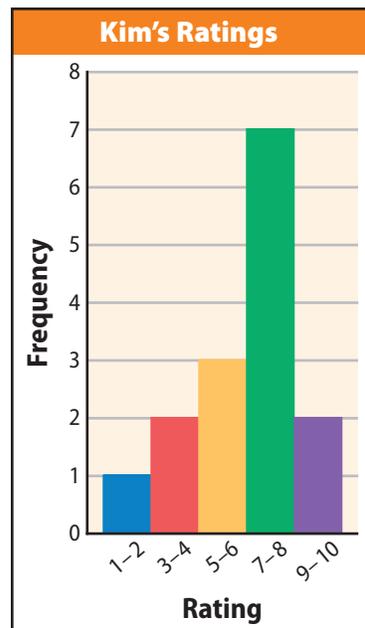
What It Means to You

You will interpret the data from a dot plot, histogram, or box plot.

EXAMPLE 6.SP.4

Kim has started rating each movie she sees using a scale of 1 to 10 on an online site. She made a histogram that shows how she rated the movies. What does the shape of the distribution tell you about the movies Kim has rated?

Of the 15 movies that Kim rated, she rated almost half a 7 or an 8 and did not generally give extreme ratings.



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LESSON 16.1 Measures of Center

CA CC 6.SP.5
Summarize numerical data sets in relation to their context. Also 6.SP.3, 6.SP.5a, 6.SP.5b, 6.SP.5c, 6.SP.5d



ESSENTIAL QUESTION

How can you use measures of center to describe a data set?

EXPLORE ACTIVITY 1

CA CC 6.SP.5c, 6.SP.3, 6.SP.5a

Finding the Mean

A **measure of center** is a single number used to describe a set of numeric data. A measure of center describes a typical value from the data set.

One measure of center is the *mean*. The **mean**, or average, of a data set is the sum of the data values divided by the number of data values in the set.

Tami surveyed five of her friends to find out how many brothers and sisters they have. Her results are shown in the table.

Number of Siblings				
Amy	Ben	Cal	Don	Eva
2	3	1	1	3

- A** Model each person's response as a group of counters.

Amy	Ben	Cal	Don	Eva
●	●	●	●	●
●	●			●
	●			●

- B** Now rearrange the counters so that each group has the same number of counters.

--	--	--	--	--

Each group now has _____ counter(s). This value is the mean. This model demonstrates how the mean "evens out" the data values.

- C** Use numbers to calculate the mean.

The sum of the data values is $2 + 3 + \square + \square + \square = \square$.

How many data values are in the set? _____

EXPLORE ACTIVITY 1 (cont'd)

$$\text{Mean} = \frac{\text{sum of data values}}{\text{number of data values}} = \frac{\square}{\square} = \square$$

Math Talk
Mathematical Practices

Suppose you have a data set in which all of the values are 2. What is the mean?

Reflect

- Can the mean be greater than the greatest value in a data set? Why or why not?



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Finding the Median

Another measure of center is the *median*. The **median** represents the middle value of an ordered data set.

EXAMPLE 1



6.SP.5c, 6.SP.5b

- A** A coach records the distances that some cross-country team members ran last week. Find the median.

Write the data values in order from least to greatest.

3 4 5 5 6 7 7 8 10 10 10

This value is the median.

Equal number of values on either side of the median

The median is 7.

- B** Find the median of these test scores: 87, 90, 77, 83, 99, 94, 93, 90, 85, 83.

Write the data values in order from least to greatest.

77 83 83 85 87 90 90 93 94 99

This data set has two middle values: 87 and 90.

The median is the average of these two values:

$$\text{Median} = \frac{87 + 90}{2} = 88.5$$

The median is 88.5.

Distances Run	
Cara	3 mi
Rob	5 mi
Maria	7 mi
Olivia	10 mi
Paul	10 mi
Chris	4 mi
Amir	7 mi
Iris	5 mi
Alex	8 mi
Tara	10 mi
Ned	6 mi

Math Talk
Mathematical Practices

Why does the data set in **A** have one middle value while the data set in **B** has two middle values?

Reflect

2. **What If?** Which units are used for the data in **A**? If the coach had recorded some distances in kilometers and some in miles, can you still find the median of the data? Explain.

YOUR TURN

3. Charlotte recorded the number of minutes she spent exercising in the past ten days: 12, 4, 5, 6, 8, 7, 9, 8, 2, 1. Find the median of the data.



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EXPLORE ACTIVITY 2



CA CC 6.SP.5d, 6.SP.5c

Comparing the Mean and the Median

The mean and median of a data set may be equal, very close to each other, or very different from each other. For data sets where the mean and median differ greatly, one likely describes the data set better than the other.

The monthly earnings of several teenagers are \$200, \$320, \$275, \$250, \$750, \$350, and \$310.



- A** Find the mean. Round to the nearest tenth.

$$\frac{\boxed{} + \boxed{} + \boxed{} + \boxed{} + \boxed{} + \boxed{} + \boxed{}}{\boxed{}} = \frac{\boxed{}}{\boxed{}} \approx \boxed{}$$

- B** Write the data values in order from least to greatest and find the median.

- C** The mean and the median differ by about \$_____. Why?

- D** Which measure of center better describes the typical monthly earnings for this group of teenagers—the mean or the median? Explain.

EXPLORE ACTIVITY 2 (cont'd)

Reflect

4. **Communicate Mathematical Ideas** Luka's final exam scores for this semester are 70, 72, 99, 72, and 69. Find the mean and median. Which is a better description of Luka's typical exam score? Explain your thinking.

Guided Practice

1. Spencer surveyed five of his friends to find out how many pets they have. His results are shown in the table. What is the mean number of pets? (*Explore Activity 1*)

Number of Pets				
Lara	Cody	Sam	Ella	Maria
3	5	2	4	1

$$\text{Mean} = \frac{\text{sum of data values}}{\text{number of data values}} = \frac{\square}{\square} = \square$$

The mean number of pets is _____

2. The following are the weights, in pounds, of some dogs at a kennel: 36, 45, 29, 39, 51, 49. (*Example 1*)
- a. Find the median. _____
- b. Suppose one of the weights were given in kilograms. Can you still find the median? Explain.

3. a. Find the mean and the median of this data set: 9, 6, 5, 3, 28, 6, 4, 7. (*Explore Activity 2*)

- b. Which better describes the data set, the mean or the median? Explain.



ESSENTIAL QUESTION CHECK-IN

4. How can you use measures of center to describe a data set?

16.1 Independent Practice



6.SP.3, 6.SP.5, 6.SP.5a, 6.SP.5b, 6.SP.5c, 6.SP.5d



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Several students in Ashton’s class were randomly selected and asked how many text messages they sent yesterday. Their answers were 1, 0, 10, 7, 13, 2, 9, 15, 0, 3.

5. How many students were asked? How do you know?

6. Find the mean and the median for these data.

Mean = _____ Median = _____

The points scored by a basketball team in its last 6 games are shown. Use these data for 7 and 8.

Points Scored					
73	77	85	84	37	115

7. Find the mean score and the median score.

Mean = _____ Median = _____

8. Which measure better describes the typical number of points scored? Explain.

Some people were asked how long it takes them to commute to work. Use the data for 9–11.

9. What units are used for the data? What should you do before finding the mean and median number of minutes?

10. Find the mean and median number of minutes.

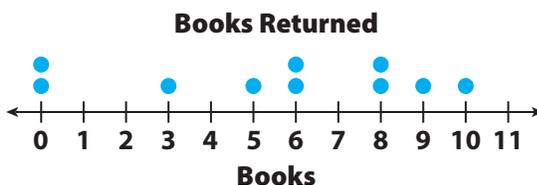
Mean = _____ Median = _____

11. Which measure do you think is more typical of the data?

16 min	5 min
7 min	8 min
14 min	12 min
0.5 hr	1 hr



- 12. Critique Reasoning** For two weeks, the school librarian recorded the number of library books returned each morning. The data are shown in the dot plot. The librarian found the mean number of books returned each morning.



$$\frac{8 + 6 + 10 + 5 + 9 + 8 + 3 + 6}{8} = \frac{55}{8} = 6.875$$

Is this the correct mean of this data set? If not, explain and correct the answer.

- 13. Critical Thinking** Lauren's scores on her math tests are 93, 91, 98, 100, 95, 92, and 96. What score could Lauren get on her next math test so that the mean and median remain the same? Explain your answer.

- 14. Persevere in Problem Solving** Yuko wants to take a job selling cars. Since she will get a commission for every car she sells, she finds out the sale price of the last four cars sold at each company.

Company A: \$16,000; \$20,000; \$25,000; \$35,000;

Company B: \$21,000, \$23,000, \$36,000, \$48,000

- a.** Find the mean selling price at each company.

- b.** Find the median selling price at each company.

- c. Communicate Mathematical Ideas** At either company, Yuko will get paid a commission of 20% of the sale price of each car she sells. Based on the data, where do you recommend she take a job? Why?

LESSON 16.2 Mean Absolute Deviation

 CA CC 6.SP.5c

Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.



ESSENTIAL QUESTION

How can you determine and use the mean absolute deviation of a set of data points?

EXPLORE ACTIVITY



 CA CC 6.SP.5c

Understanding Mean Absolute Deviation

A **measure of variability** is a single number used to describe the spread of a data set. It can also be called a measure of spread. One measure of variability is the **mean absolute deviation (MAD)**, which is the mean of the distances between the data values and the mean of the data set.

The data represent the height, in feet, of various buildings. Find the mean absolute deviation for each data set.

- A** 60, 58, 54, 56, 63, 65, 62, 59, 56, 58

Calculate the mean. Round to the nearest whole number.

Complete the table.

Height (ft)	60	58	54	56	63	65	62	59	56	58
Distance from mean										

Calculate the MAD by finding the mean of the values in the second row of the table. Round to the nearest whole number.

- B** 46, 47, 56, 48, 46, 52, 57, 52, 45

Find the mean. Round to the nearest whole number.

EXPLORE ACTIVITY (cont'd)

Complete the table.

Height (ft)	46	47	56	48	46	52	57	52	45
Distance from mean									

Calculate the MAD. Round to the nearest whole number.

Math Talk
Mathematical Practices

What is the difference between a measure of center and a measure of variability?

Reflect

- Analyze Relationships** Compare the MADs. How do the MADs describe the distribution of the heights in each group?



Using Mean Absolute Deviation

The mean absolute deviation can be used to answer statistical questions in the real world. Many of these questions may have implications for the operation of various businesses.

EXAMPLE 1



CA CC 6.SP.5c

A chicken farmer wants her chickens to all have about the same weight. She is trying two types of feed to see which type produces the best results. All the chickens in Pen A are fed Premium Growth feed, and all the chickens in Pen B are fed Maximum Growth feed. The farmer records the weights of the chickens in each pen in the tables below. Which chicken feed produces less variability in weight?



Pen A: Premium Growth Weights (lb)

5.8	6.1	5.5	6.6	7.3	5.9	6.3	5.7	6.8	7.1
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Pen B: Maximum Growth Weights (lb)

7.7	7.4	5.4	7.8	6.1	5.2	7.5	7.9	6.3	5.6
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

STEP 1

Find the mean weight of the chickens in each pen. Round your answers to the nearest tenth.

Pen A: $\frac{5.8 + 6.1 + 5.5 + 6.6 + 7.3 + 5.9 + 6.3 + 5.7 + 6.8 + 7.1}{10} \approx 6.3$

Pen B: $\frac{7.7 + 7.4 + 5.4 + 7.8 + 6.1 + 5.2 + 7.5 + 7.9 + 6.3 + 5.6}{10} \approx 6.7$

STEP 2

Find the distance from the mean for each of the weights.

The distances from the mean for Pen A are the distance of each weight from 6.3 lb.

Pen A: Premium Growth										
Weight (lb)	5.8	6.1	5.5	6.6	7.3	5.9	6.3	5.7	6.8	7.1
Distance from mean	0.5	0.2	0.8	0.3	1.0	0.4	0	0.6	0.5	0.8

The distances from the mean for Pen B are the distance of each weight from 6.7 lb.

Pen B: Maximum Growth										
Weight (lb)	7.7	7.4	5.4	7.8	6.1	5.2	7.5	7.9	6.3	5.6
Distance from mean	1.0	0.7	1.3	1.1	0.6	1.5	0.8	1.2	0.4	1.1

STEP 3

Calculate the MAD for the chickens in each pen. Round your answers to the nearest tenth.

$$\text{Pen A: } \frac{0.5 + 0.2 + 0.8 + 0.3 + 1.0 + 0.4 + 0 + 0.6 + 0.5 + 0.8}{10} \approx 0.5 \text{ lb}$$

$$\text{Pen B: } \frac{1.0 + 0.7 + 1.3 + 1.1 + 0.6 + 1.5 + 0.8 + 1.2 + 0.4 + 1.1}{10} \approx 1.0 \text{ lb}$$

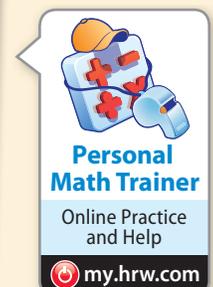
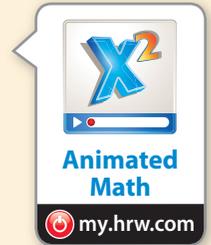
Since Pen A's MAD is less, Premium Growth feed produces less variability in weight.

YOUR TURN

2. Two waiters at a cafe each served 10 large fruit smoothies. The amounts in each waiter's smoothies are shown below. Which waiter's smoothies showed less variability?

Amounts in Waiter A's Large Smoothies (oz)									
19.1	20.1	20.9	19.6	20.9	19.5	19.2	19.4	20.3	20.9

Amounts in Waiter B's Large Smoothies (oz)									
20.1	19.6	20.0	20.5	19.8	20.0	20.1	19.7	19.9	20.4





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Using a Spreadsheet to Find MAD

Spreadsheets can be used to find the mean absolute deviation of a data set.

EXAMPLE 2



CA CC 6.SP.5c

A paper mill is testing two paper-cutting machines. Both are set to produce pieces of paper with a width of 8.5 inches. The actual widths of 8 pieces of paper cut by each machine are shown. Use a spreadsheet to determine which machine has less variability and, thus, does a better job.

Widths of Pieces of Paper Cut by Machine A (in.)

8.502	8.508	8.499	8.501	8.492	8.511	8.505	8.491
-------	-------	-------	-------	-------	-------	-------	-------

Widths of Pieces of Paper Cut by Machine B (in.)

8.503	8.501	8.498	8.499	8.498	8.504	8.496	8.502
-------	-------	-------	-------	-------	-------	-------	-------

STEP 1

Enter the data values for Machine A into row 1 of a spreadsheet, using cells A to H.

	A	B	C	D	E	F	G	H
1	8.502	8.508	8.499	8.501	8.492	8.511	8.505	8.491
2								
3								

STEP 2

Enter "mean =" into cell A2 and the formula =AVERAGE(A1:H1) into cell B2.

	A	B	C	D	E	F	G	H
1	8.502	8.508	8.499	8.501	8.492	8.511	8.505	8.491
2	mean =	8.501125						
3								

STEP 3

Enter "MAD =" into cell A3 and the formula =AVEDEV(A1:H1) into cell B3.

	A	B	C	D	E	F	G	H
1	8.502	8.508	8.499	8.501	8.492	8.511	8.505	8.491
2	mean =	8.501125						
3	MAD =	0.005375						

The MAD for Machine A is about 0.0054 in.

STEP 4

Repeat Steps 1–3 with the data values for Machine B.

	A	B	C	D	E	F	G	H
1	8.503	8.501	8.498	8.499	8.498	8.504	8.496	8.502
2	mean =	8.500125						
3	MAD =	0.002375						

The MAD for Machine B is about 0.0024 in.

Machine B has less variability, so it does a better job.

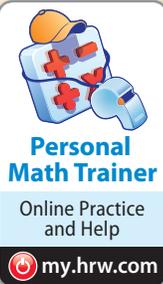
My Notes

YOUR TURN

3. Two aspirin-making devices are set to make tablets containing 0.35 gram of aspirin. The actual amounts in 8 tablets from each device are shown. Use a spreadsheet to determine which device has less variability.

Amounts of Aspirin in Tablets Made by Device A (g)							
0.353	0.351	0.350	0.352	0.349	0.348	0.350	0.346

Amounts of Aspirin in Tablets Made by Device B (g)							
0.349	0.341	0.347	0.358	0.359	0.354	0.339	0.343



Guided Practice

1. A bus route takes about 45 minutes. The company's goal is a MAD of less than 0.5 minute. One driver's times for 9 runs of the route are shown. Did the bus driver meet the goal? ([Explore Activity and Example 1](#))

Times to Complete Bus Route (min)								
44.2	44.9	46.1	45.8	44.7	45.2	45.1	45.3	44.6

- a. Calculate the mean of the bus times. _____
- b. Calculate the MAD to the nearest tenth. _____

The bus driver **did / did not** meet the company's goal.

2. Below are a different driver's times on the same route. Find the mean and the MAD using a spreadsheet. Enter the data values into row 1 using cells A to I. Enter "mean =" into cell A2 and "MAD =" into cell A3. ([Example 2](#))

Times to Complete Bus Route (min)								
44.4	43.8	45.6	45.9	44.1	45.6	44.0	44.9	45.8

The mean is _____ minutes, and the MAD is _____ minutes.

This time, the bus driver **did / did not** meet the company's goal.



ESSENTIAL QUESTION CHECK-IN

3. What is the mean absolute deviation and what does it tell you about data sets?

16.2 Independent Practice

 **CA CC** 6.SP.5c



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Frank wants to know how many people live in each household in his town. He conducts a random survey of 10 people and asks how many people live in their household. His results are shown in the table.

Number of People per Household									
1	6	2	4	4	3	5	5	2	8

4. Calculate the mean number of people per household. _____
5. Calculate the MAD of the number of people per household. _____
6. What conclusions can you draw about the “typical” number of people in each household? Explain.

Each yogurt treat served at a shop must be the same size. A new worker spends his first week on the job learning to serve the correct amount. The tables show the sizes of 10 yogurt treats the worker served at the beginning of his first week, and of 10 yogurt treats he served at the end of his first week.

Serving Sizes, in Grams, at Beginning of Week 1									
76	81	85	79	89	86	84	80	88	79

Serving Sizes, in Grams, at End of Week 1									
79	82	84	81	77	85	82	80	78	83

7. Calculate the MADs for the two tables. Did the worker’s ability to serve same-sized yogurt treats improve? Explain.

8. **What If?** What would it mean if the serving sizes had a MAD of 0?

The annual rainfall for Austin, Texas, and San Antonio, Texas, in each of the years from 2002 to 2011 are shown in the tables. Use the data for 9–11.



Annual Rainfall for Austin, Texas (in.)									
36.00	21.41	52.27	22.33	34.70	46.95	16.07	31.38	37.76	19.68

Annual Rainfall for San Antonio, Texas (in.)									
46.27	28.45	45.32	16.54	21.34	47.25	13.76	30.69	37.39	17.58

9. Use a spreadsheet to find the mean for the two cities' annual rainfalls. In which city does it rain more in a year, on average?

10. Use your spreadsheet to find the MADs. Use the MADs to compare the distribution of annual rainfall for the two cities.

11. **Make a Conjecture** Does the information allow you to predict how the future amounts of rainfall for the two cities will compare? Explain.

12. **Critical Thinking** The life spans of 10 adult mayflies have a mean of 4 hours and a MAD of 2 hours. Fill in the table with possible values for the life spans. You can use the same value more than once.

Life Spans of Ten Mayflies (h)									

Can any one of the 10 mayflies in the group live for 1 full day? Justify your answer.



FOCUS ON HIGHER ORDER THINKING

Work Area

13. Multistep In a spreadsheet, before entering any data values, first enter “mean =” into cell A2 and the formula =AVERAGE(A1:J1) into cell B2. Next, enter “MAD =” into cell A3 and the formula =AVEDEV(A1:J1) into cell B3. You should see #DIV/0! in cell B2 and #NUM! in cell B3 as shown. Now do the following:

	A	B
1		
2	mean =	#DIV/0!
3	MAD =	#NUM!

- a. Enter “1” into cell A1. What do you get for the mean and the MAD of the data set? Explain why this makes sense.

- b. Enter “2” into cell B1. What do you get for the mean and the MAD of the data set this time? Explain why this makes sense.

- c. Enter the numbers 3 through 10 into cells C1 to J1 and watch the mean and the MAD change. Do they increase, decrease, or stay the same? Explain why this makes sense.

- 14. Make a Conjecture** Each of the values in a data set is increased by 10. Does this affect the MAD of the data set? Why or why not?

- 15. What If?** Suppose a data set contains all whole numbers. Would the MAD for the data set also be a whole number? Explain.
