A value that describes the center/middle of data

**MEASURES OF CENTRAL TENDENCY**

<table>
<thead>
<tr>
<th>Main Ideas/Questions</th>
<th>Notes/Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean (μ)</strong>:</td>
<td>the average</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>the middle value</td>
</tr>
<tr>
<td><strong>Mode(s)</strong></td>
<td>the most repeated value</td>
</tr>
</tbody>
</table>

**Directions:** Find the mean, median, and mode(s) for each data set.

1. \{58, 59, 51, 46, 51, 51, 58, 59, 60\}
   - Mean = \(\bar{x} = \frac{58 + 59 + 51 + 46 + 51 + 51 + 58 + 59 + 60}{9} = 52.3\)
   - Median = 52
   - Mode(s) = 51, 58

2. \{21, 10, 27, 24, 15, 7, 19, 24, 31\}
   - Mean = \(\bar{x} = \frac{21 + 10 + 27 + 24 + 15 + 7 + 19 + 24 + 31}{9} = 22.3\)
   - Median = 22
   - Mode(s) = 24

**MEASURES OF VARIATION**

A value that describes how spread out the data is.

**(measures dispersion)**

**Mean Absolute Deviation (MAD)**

the average distance of each value to the mean

**Directions:** Find the mean absolute deviation for each data set.

3. \{55, 74, 88, 90, 92, 60\}
   - Mean = \(\bar{x} = \frac{55 + 74 + 88 + 90 + 92 + 60}{6} = 79.83\)
   - MAD = \(\frac{\sum|\bar{x} - x|}{n} = \frac{|55 - 79.83| + |74 - 79.83| + |88 - 79.83| + |90 - 79.83| + |92 - 79.83| + |60 - 79.83|}{6} = 8.56\)

4. \{14, 18, 16, 19, 21, 14, 15, 23, 21, 19\}
   - Mean = 18
   - MAD = \(\frac{\sum|\bar{x} - x|}{n} = \frac{|14 - 18| + ... + |21 - 18|}{10} = 2.6\)
Variance ($\sigma^2$)  
the average squared distance of each value to the mean  
$$\sigma^2 = \frac{1}{n} \sum_{i=1}^{n} (x_i - \mu)^2$$

Standard Deviation ($\sigma$)  
square root of the variance  
$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \mu)^2}$$  
*most important measure

What do the numbers mean?  
- A lower standard deviation indicates that the values are closer together  
- A higher standard deviation indicates that the values are more spread out

Examples

Directions: Find the variance and standard deviation for each data set.

5. $\{85, 88, 91, 96, 100\}$  
$$\text{mean } \mu = \frac{85 + 88 + 91 + 96 + 100}{5} = 92$$  
$$\text{Variance } (\sigma^2) = \frac{1}{5} \sum_{i=1}^{5} (x_i - 92)^2 = \frac{29.2}{5} = 5.84$$  
$$\text{Standard Deviation } (\sigma) = \sqrt{5.84}$$

6. $\{3, 4, 7, 8, 11, 12, 15, 19\}$  
$$\text{Variance } (\sigma^2) = \frac{1}{8} \sum_{i=1}^{8} (x_i - 9)^2 = 23.62$$  
$$\text{Standard Deviation } (\sigma) = \sqrt{23.62}$$

7. $\{52, 47, 60, 55, 58, 53, 59, 63\}$  
$$\text{Variance } (\sigma^2) = \frac{1}{8} \sum_{i=1}^{8} (x_i - 57)^2 = 23.14$$  
$$\text{Standard Deviation } (\sigma) = \sqrt{23.14}$$

8. $\{127, 81, 135, 100, 97, 115, 72, 152, 63, 164\}$  
$$\text{Variance } (\sigma^2) = \frac{1}{10} \sum_{i=1}^{10} (x_i - 116.5)^2 = 1938.56$$  
$$\text{Standard Deviation } (\sigma) = \sqrt{1938.56}$$

9. $\{25, 27, 21, 32, 35, 29, 23, 26, 24, 25, 28, 31\}$  
$$\text{Variance } (\sigma^2) = \frac{1}{12} \sum_{i=1}^{12} (x_i - 26)^2 = 15.98$$  
$$\text{Standard Deviation } (\sigma) = \sqrt{15.98}$$

Statistics:  
- Enter list: 121, 65, 45, 130, 150, 83  
- Menu $\rightarrow$ 4: Statistics $\rightarrow$ 1:Stat Calculations $\rightarrow$ 1: One-Variable Statistics $\rightarrow$ OK $\rightarrow$ OK

Lists & Spreadsheet  
- Enter list: 121, 65, 45, 130, 150, 83  
- Menu $\rightarrow$ 4: Statistics $\rightarrow$ 1:Stat Calculations $\rightarrow$ 1: One-Variable Statistics $\rightarrow$ OK $\rightarrow$ OK
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Data Distribution</strong></td>
<td><strong>the way data values are clustered</strong></td>
</tr>
<tr>
<td><img src="image" alt="Positive Skew" /></td>
<td><img src="image" alt="Negative Skew" /></td>
</tr>
</tbody>
</table>

**Normal Distribution**
- A symmetrical bell-shaped curve defined by the mean ($\mu$) and the standard deviation ($\sigma$) of the data set.
- The area under the curve represents probability, with the total area equal to 100%.

**The Empirical Rule**
In a normal distribution with mean $\mu$ and standard deviation $\sigma$:
- Approximately $68\%$ of the data falls within 1$\sigma$ of the mean.
- Approximately $95\%$ of the data falls within 2$\sigma$ of the mean.
- Approximately $99.7\%$ of the data falls within 3$\sigma$ of the mean.

Directions: Draw and label normal distribution curves, then answer the questions.

1. The weights of the 50 football players are normally distributed with a mean of 178 pounds and a standard deviation of 8 pounds.

   a) What percent of the players weigh between 170 lbs and 194 lbs?
   b) What is the probability that a player weighs at most 170 lbs?
   c) What is the probability that a player weighs less than 162 lbs or greater than 194 lbs?
   d) How many players weigh between 170 lbs and 186 lbs?
2. A set of 120 test scores are normally distributed with a mean of 82 and a standard deviation of 5.

<table>
<thead>
<tr>
<th>a) What percent of the scores are between 72 and 87?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
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<tr>
<th>b) What is the probability that a score is greater than 77?</th>
</tr>
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<tbody>
<tr>
<td><img src="image2.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
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<tr>
<th>c) What is the probability that a score is less than 82 or greater than 92?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>d) About how many students scored outside two standard deviations of the mean?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4.png" alt="Diagram" /></td>
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</table>

3. The price of a gallon of regular gasoline at 75 gas stations across the state is normally distributed with a mean of $2.05 and a standard deviation of 49.

<table>
<thead>
<tr>
<th>a) What percent of gas stations sell a gallon of regular gas for less than $1.97?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>b) What percent of gas stations sell a gallon of regular gas for at least $2.17?</th>
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</thead>
<tbody>
<tr>
<td><img src="image6.png" alt="Diagram" /></td>
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</table>

<table>
<thead>
<tr>
<th>c) What is the probability that a gas station sells a gallon of regular gas for less than $1.97 or greater than $2.05?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
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<tr>
<th>d) About how many stations sell a gallon of regular gas for no more than $2.05?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image8.png" alt="Diagram" /></td>
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</table>

4. Mrs. Fuller recently tested her 120 keyboarding students to see how many words per minute they can type. The results were normally distributed with a mean of 45 and a standard deviation of 6.

<table>
<thead>
<tr>
<th>a) About how many students can type 40 or more words per minute?</th>
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<tr>
<td><img src="image9.png" alt="Diagram" /></td>
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<table>
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<tr>
<th>b) About how many students can type within one standard deviation of the mean?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image10.png" alt="Diagram" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>c) Students need to be in the top 25% in order to be eligible for the national typing competition. If Chris can type 56 words, is he in the top 25%?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image11.png" alt="Diagram" /></td>
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</table>
Calculator How to:

- Enter list: 85, 88, 91, 96, 100, while in new box click
- In the table, find the average
- Standard deviation: (5.40)^2 = var

Desmos
Directions: Find the mean, median, and mode of each data set below.

1. \{11, 14, 11, 5, 17, 28, 3\}
   
   Mean = 
   Median = 
   Mode(s) = 

2. \{24, 29, 31, 16, 49, 52, 29, 35, 62, 29\}
   
   Mean = 
   Median = 
   Mode(s) = 

3. The following data shows the number of fish caught by a seven boy scouts on their camping trip:
   \{1, 2, 2, 4, 5, 6, 8\}
   \[\text{Mean} = 4\]
   
   \[\frac{3 + 2 + 2 + 0 + 1 + 2 + 4}{7}\]
   
   \[\text{MAD} = 2\]
   
   \[\text{Variance: } \sigma^2 = 5.43\]
   
   \[\text{Standard Deviation: } \sigma = 2.33\]

4. The following data shows the points scored by a football team during their first ten games of the season:
   \{27, 32, 41, 9, 14, 20, 31, 33, 20, 13\}
   
   \[\text{MAD} = \]
   
   \[\text{Variance: } \sigma^2 = \]
   
   \[\text{Standard Deviation: } \sigma = \]

5. The following data shows the high temperature for the past eight days:
   \{56, 46, 53, 50, 52, 47, 45, 49\}
   
   \[\text{MAD} = \]
   
   \[\text{Variance: } \sigma^2 = \]
   
   \[\text{Standard Deviation: } \sigma = \]

6. The following data shows the price of six different jars of pasta sauce at the grocery store:
   \{\$2.79, \$1.99, \$4.29, \$2.49, \$2.29, \$3.49\}
   \[\text{Mean} = 2.89\]
   
   \[\frac{1.10 + .90 + 1.40 + .40 + .60 + .60}{6}\]
   
   \[\text{MAD} = 0.67\]
   
   \[\text{Variance: } \sigma^2 = 0.51\]
   
   \[\text{Standard Deviation: } \sigma = 0.78\]
For questions 7 and 8, draw the normal distribution curve, then answer the questions.

7. A set of 125 golf scores are normally distributed with a mean of 76 and a standard deviation of 3.

   a) What percent of the scores are between 67 and 85? 
      \[ 99.8\% \]
   
   b) What is the probability that a score is no more than 79? 
      \[ 84.1\% \]
   
   c) About how many scores fell between one standard deviation of the mean? 
      \[ \mu \pm 1 \sigma \] of 125 = 85.25 
      \[ \text{About 85 scores} \]

8. The talk-time battery life of a group of cell phones is normally distributed with a mean of 5 hours and a standard deviation of 15 minutes.

   a) What percent of the phones have a battery life of at least 4 hours and 45 minutes? 

   b) What percent of the phones have a battery life between 4.5 hours and 5.25 hours? 

   c) What percent of the phones have a battery life less than 5 hours or greater than 5.5 hours? 

9. The number of hours that the employees at the grocery store worked last week is normally distributed with a mean of 24 and a standard deviation of 6. If there are 60 total employees, approximately how many worked at least 30 hours last week?

10. The grade point average (GPA) of the students at Lakeview High School is normally distributed with a mean of 3.1 and a standard deviation of 0.3. If there are 1800 students enrolled at the school, approximately how many have a GPA between 2.5 and 3.7?