

**Section 3-1**  
**Measures of Center**

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**TWO TYPES OF STATISTICS**

- **Descriptive statistics** summarize or *describe* the important characteristics of data.
- **Inferential statistics** use sample data to make *inferences* (or generalizations) about a population.

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**MEASURE OF CENTER**

A **measure of center** is a value at the center or middle of a data set.

There are four measures of center that we will discuss in this class

- (Arithmetic) Mean
- Median
- Mode
- Midrange

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### THE MEAN

The **arithmetic mean**, or the **mean**, of a set of data is the measure of center found by adding all the data values and dividing by the total number of data values. This is what is commonly referred to as the *average*.

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### PROPERTIES OF THE MEAN

- Sample means drawn from the same population tend to vary less than other measures of center.
- The mean of the data set uses every data value.
- A disadvantage of the mean is that just one extreme value (outlier) can change the value of the mean substantially. (Using the following definition, we say that the mean is not a **resistant** measure of center.)
- A statistic is **resistant** if the presence of extreme values (outliers) do not cause it to change very much.

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### NOTATION

- $\Sigma$  – denotes the *summation* (addition) of a set of values.
- $x$  – is the *variable* usually used to represent the individual data values.
- $n$  – represents the *number of values* in a **sample**.
- $N$  – represents the *number of values* in a **population**.

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**MEAN OF A SAMPLE AND  
MEAN OF A POPULATION**

- $\bar{x} = \frac{\sum x}{n}$  is the mean of sample values.
- $\mu = \frac{\sum x}{N}$  is the mean of population values.

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**EXAMPLE**

The given values are the numbers of Dutchess County car crashes for each month in a recent year. Find the mean.

27 8 17 11 15 25 16 14 14 14 13 18

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**FINDING THE MEAN  
ON THE TI-83/84**

1. Press **STAT**; select **1:Edit...**
2. Enter your data values in **L1**. (You may enter the values in any of the lists.)
3. Press **2ND, MODE** (for **QUIT**).
4. Press **STAT**; arrow over to **CALC**. Select **1:1-Var Stats**.
5. Enter L1 by pressing **2ND, 1**.
6. Press **ENTER**.

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**FINDING THE MEAN ON THE TI-84 WITH THE NEW OS**

1. Press **STAT**; select **1:Edit...**
2. Enter your data values in **L1**. (You may enter the values in any of the lists.)
3. Press **2ND, MODE** (for **QUIT**).
4. Press **STAT**; arrow over to **CALC**. Select **1:1-Var Stats**.
5. For "List" enter L1 by pressing **2ND, 1**.
6. Leave "FreqList" blank.
7. Highlight "Calculate" and press **ENTER**.

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**MEDIAN**

The **median**, denoted by  $\tilde{x}$ , of a data set is the *middle value* when the original data values are arranged in order of increasing (or decreasing) magnitude.

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**PROPERTIES OF THE MEDIAN**

- The median does not change by large amounts when we include just a few extreme values (so the median is a **resistant** measure of center).
- The median does not use every data value.

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<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">6.72</td> <td style="padding: 2px;">3.46</td> <td style="padding: 2px;">3.60</td> <td style="padding: 2px;">6.44</td> </tr> <tr> <td style="padding: 2px;">3.46</td> <td style="padding: 2px;">3.60</td> <td style="padding: 2px;">6.44</td> <td style="padding: 2px;">6.72</td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center; padding: 2px;">↑</td> <td style="text-align: center; padding: 2px;">↑</td> </tr> <tr> <td colspan="2"></td> <td colspan="2" style="text-align: center; padding: 2px;">(even number of values)</td> </tr> <tr> <td colspan="4" style="padding: 2px;">no exact middle -- shared by two numbers</td> </tr> <tr> <td colspan="2" style="padding: 2px;"><math>\frac{3.60 + 6.44}{2}</math></td> <td colspan="2" style="padding: 2px;"><b>MEDIAN is 5.02</b></td> </tr> </table>	6.72	3.46	3.60	6.44	3.46	3.60	6.44	6.72			↑	↑			(even number of values)		no exact middle -- shared by two numbers				$\frac{3.60 + 6.44}{2}$		<b>MEDIAN is 5.02</b>	
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**EXAMPLE**

The given values are the numbers of Dutchess County car crashes for each month in a recent year. Find the median.

27 8 17 11 15 25 16 14 14 14 13 18

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**FINDING THE MEDIAN ON THE TI-83/84**

This is done in exactly the same way as finding the mean. After you have finished use the down arrow to scroll down and you will see **Med=**.

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### MODE

- The **mode**, denoted by  $M$ , of a data set is the number that occurs most frequently.
- When two values occur with the same greatest frequency, each one is a mode and the data set is said to be **bimodal**.
- When more than two values occur with the same greatest frequency, each is a mode and the data set is said to be **multimodal**.
- When no data value is repeated, we say that there is **no mode**.
- This is the *only* measure of center that can be used with *nominal* data.

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### EXAMPLE

a. 5 5 5 3 1 5 1 4 3 5	↩ Mode is 5
b. 1 2 2 2 3 4 5 6 6 6 7 9	↩ Bimodal - 2 and 6
c. 1 2 3 6 7 8 9 10	↩ No Mode

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### EXAMPLE

The given values are the numbers of Dutchess County car crashes for each month in a recent year. Find the mode.

27 8 17 11 15 25 16 14 14 14 13 18

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**FINDING THE MODE  
ON THE TI-83/84**

The TI-83/84 will **NOT** calculate the mode of a data set. However, the data in a list can be easily sorted to help in finding the mode.

To sort L1 in *ascending* order: **STAT, 2:SortA, L1, )**, and **ENTER**.

To sort in *descending* order, use **3:SortD**.

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**MIDRANGE**

The **midrange** of a data set is the measure of center that is the value midway between the highest and lowest values of the original data set. It is found by adding the highest data value and the lowest data value and then dividing by 2; that is,

$$\text{midrange} = \frac{\text{maximum data value} + \text{minimum data value}}{2}$$

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**PROPERTIES OF THE MIDRANGE**

- Because the midrange uses only the maximum and minimum values, it is very sensitive to those extremes.
- In practice, the midrange is rarely used, but it has three redeeming features:
  1. The midrange is easy to compute.
  2. The midrange helps reinforce the very important point that there are several different ways to define the center of a data set.
  3. The value of the midrange is sometimes used incorrectly for the median, so confusion can be reduced by clearly defining the midrange along with the median.

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**EXAMPLE**

The given values are the numbers of Dutchess County car crashes for each month in a recent year. Find the midrange.

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**ROUND-OFF RULES FOR MEAN, MEDIAN, AND MIDRANGE**

**For the mean, median, and midrange, carry one more decimal place than is present in the original set of values.**

**For the mode, leave the value without rounding** (because values of the mode are the same as some of the original data values).

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**MEAN FROM A FREQUENCY DISTRIBUTION**

To compute the mean from a frequency distribution, we assume that all sample values are equal to the class midpoint.

$$\bar{x} = \frac{\sum(f \cdot x)}{\sum f}$$

$x$  = class midpoint

$f$  = frequency

$\sum f$  = sum of frequencies =  $n$

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**EXAMPLE**

The following table summarized the math SAT scores of Georgia students for 2017.

Score	Number (in thousands)
300-390	6.6
400-490	20.5
500-590	24.5
600-690	9.5
700-800	2.7

Source:  
<https://reports.collegeboard.org/pdf/2017-georgia-sat-suite-assessments-annual-report.pdf>

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**FINDING THE MEAN FROM A FREQUENCY TABLE ON TI-83/84**

1. Enter the class midpoints in **L1**.
2. Enter the frequencies in **L2**.
3. Press **STAT**, arrow over to **CALC**, and select **1:1-Var Stats**.
4. Press **L1,L2** followed by **ENTER**.
5. The mean will be the first item.

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**FINDING THE MEAN FROM A FREQUENCY TABLE ON TI-84 WITH NEW OS**

1. Enter the class midpoints in **L1**.
2. Enter the frequencies in **L2**.
3. Press **STAT**, arrow over to **CALC**, and select **1:1-Var Stats**.
4. For "List", enter **L1**
5. For "FreqList", enter **L2**.
6. Highlight "Calculate" and press **ENTER**.
7. The mean will be the first item.

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## WEIGHTED MEAN

In some cases, the values vary in their degree of importance, so we may want to weight them accordingly. We can compute the **weighted mean** for such values.

$$\bar{x} = \frac{\sum(w \cdot x)}{\sum w}$$

$x$  = value  
 $w$  = weight of value  
 $\sum w$  = sum of weights

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## EXAMPLE

Marissa just completed her first semester in college. She earned an "A" in her four-hour statistics course, a "B" in her three-hour sociology course, an "A" in her three-hour psychology course, a "C" in her five-hour computer programming course, and an "A" in her one-hour drama course. Determine Marissa's grade point average.

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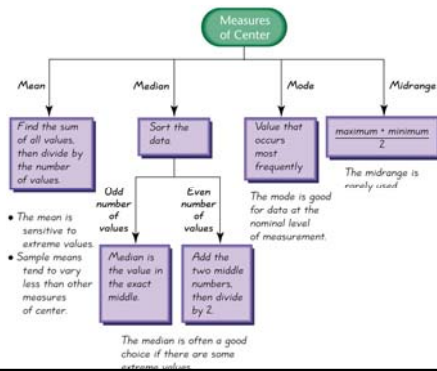
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## BEST MEASURE OF CENTER




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