Section 3–1C: Measures of the Center: Finding the Mode and the Median

The Mode

The **Mode** is the number in the data set that occurs **the most number of times (most frequently).** If two different values both occur most often then there are 2 modes. We call a data set with two modes **"Bimodal".**

Example 1

The data set **{ 3 3 3 3 3 4 4 5 6 7 2 }** has a **mode of 3**

Example 2

The data set { 2 2 2 3 4 5 8 9 9 9 } has a **mode of 2 and 9 (bimodal)**

Example 3

Age at Graduation	Freq (x)
15	3
16	4
17	**7**
18	3
19	2

The data set has a **mode of 17**

Note: The mode is x value that occurs the most often not the frequency

Example 3

Units taken at school	Freq (x)
12	**8**
13	3
14	7
15	3
16	**8**

The data set has a **mode of 12 and 16 (bimodal)**

The Mode of a Class Frequency Table

Do not use the class limits as the mode. The mode is the class midpoint of the class with the highest frequency.

Example 1

Class Midpoint	Age of child in years	Freq (x)
1	0 – 2	2
4	3 – 5	8
7	6 – 8	4
10	9 – 11	6

The mode for the class Frequency Table is the midpoint of the 3 – 5 class. The mode is 4.

Example 2

Do not use the class limits as the mode. The mode is the class midpoint of the class with the highest frequency.

Class Midpoint	Units taken at school	Freq (x)
2.5	1 – 4	2
6.5	5 – 8	7
10.5	9 – 12	5
14.5	13 – 16	7
18.5	17 – 19	2

The mode for the class Frequency Table is the midpoint of the 5 – 8 and the midpoint of the 13 – 16 class. The modes are 6.5 and 14.5.

The Median

Median: If the numerical data is **SORTED** into order from low to high (or high to low) the median is the **number in the middle LOCATION** in the sorted list.

Finding the Median of an odd number of data points

If there is an **ODD Number of data points** then the middle location falls at a single location. One way to find the number in the middle location is to **count in from each end** of the **sorted list** until you get to the middle number.

Example 1

an odd number of data points ordered low to high

1 2 5 7 9 | 12 | 13 13 15 18 21
bottom 5 | median | top 5

Example 2

an odd number of data points ordered high to low

5 8 12 13 | 16 | 27 28 27 31
bottom 4 | median | top 4

Example 3

an unsorted list MUST BE sorted first

3 12 30 29 22 21 16

you MUST SORT the list first

3 12 16 | 21 | 22 29 30
bottom 3 | median | top 3

Finding the Median of an even number of data points

If there are an **even number of data points** in the ordered list then there will be **two numbers that are both in the middle** of the ordered list. The median is the number that is **the average of the two numbers in the two middle middle locations.**

Example 1

an even number of data points ordered low to high

$$\underbrace{3 \quad 5 \quad 6 \quad 7 \quad 9 \quad 15}_{\text{Bottom 6}} \quad \underbrace{20 \quad 21}_{\substack{\text{2 middle}\\\text{numbers}}} \quad \underbrace{25 \quad 27 \quad 27 \quad 31 \quad 31 \quad 50}_{\text{top 6}}$$

Median

$$= \frac{20+21}{2} = 20.5$$

Example 2

an even number of data points ordered high to low

$$\underbrace{1 \quad 2 \quad 3 \quad 5}_{\text{bottom 4}} \quad \underbrace{6 \quad 8}_{\substack{\text{2 middle}\\\text{numbers}}} \quad \underbrace{9 \quad 10 \quad 12 \quad 14}_{\text{top 4}}$$

Median

$$= \frac{8+6}{2} = 7$$

Example 3

data points in an unsorted list MUST BE sorted first

13 20 7 18 3 14 15 8

you MUST SORT the list first

13 20 7 18 3 14 15 8

$$\underbrace{3 \quad 7 \quad 8}_{\text{bottom 3}} \quad \underbrace{13 \quad 14}_{\substack{\text{2 middle}\\\text{numbers}}} \quad \underbrace{15 \quad 18 \quad 20}_{\text{top 3}}$$

Median

$$= \frac{13+14}{2} = 13.5$$

The median is not the location of the middle but the number in the middle location.

The median is based on the location of the middle number in the list. If two different lists both have 7 data points in their ordered list **both sorted from low to high** than each list's median will be the data point in the **4th location**.

The median is the number in the 4th location and not the location

The location will be the same but the data point that is the median may be different.

Example 1

$$\underbrace{1\quad 4\quad 4}_{\text{lowest } 3}\quad \underbrace{27}_{\text{median}}\quad \underbrace{29\quad 30\quad 31}_{\text{higest } 3}$$

$$\underbrace{2\quad 4\quad 8}_{\text{lowest } 3}\quad \underbrace{12}_{\text{median}}\quad \underbrace{14\quad 15\quad 10}_{\text{higest } 3}$$

The median of the first data set is 27. The median of the second data set is 12. The number in the forth location is not the same.

The median is not as sensitive to an extreme value as the mean

Example 2

If we increase just the highest number in a data set the median does not change at all

Find the median of the sample { 1, 3, 5, 9, 14, 17, 18, 20, 25 }

$$\underbrace{1\quad 3\quad 5\quad 9}_{\text{bottom } 4}\quad \underbrace{14}_{\text{median}}\quad \underbrace{17\quad 18\quad 20\quad 25}_{\text{top } 4}$$

Now **change the 25 to a 85** (perhaps a typo when inputting the data)

{ 1, 3, 5, 9, 14, 17, 18, 20, 85 }

$$\underbrace{1\quad 3\quad 5\quad 9}_{\text{bottom } 4}\quad \underbrace{14}_{\text{median}}\quad \underbrace{17\quad 18\quad 20\quad 85}_{\text{top } 4}$$

the median is still 14

Example 3

If we chance a large number in the set to a low number the median does not change very much

Find the median of the sample { 2, 4, 6, 7, 9 }

$$\underbrace{2 \quad 4}_{\text{bottom 2}} \quad \underbrace{6}_{\text{median}} \quad \underbrace{7 \quad 9}_{\text{top 2}}$$

Now **change the 7 to a 1** (perhaps a typo when inputting the data)

{ 1, 2, 4, 6, 9 }

$$\underbrace{1 \quad 2}_{\text{bottom 2}} \quad \underbrace{4}_{\text{median}} \quad \underbrace{6 \quad 9}_{\text{top 2}}$$

median = 4

the median moved one spot lower on the new list

