Unit 4: Statistics

Measures of Central Tendency &

Measures of Dispersion

Measures of Central Tendency

- a measure that tells us where the middle of a bunch of data lies
- most common are Mean, Median, and Mode.

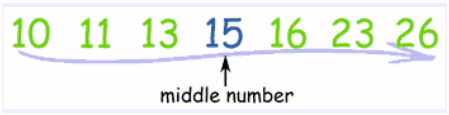
Mean

- The Mean is the ***average*** of the numbers or a calculated "central" value of a set of numbers.
- To calculate: Add up all the numbers, then divide by how many numbers there are.
- Example: find the Mean {3, 7, 5, 13, 20, 23, 39, 23, 40, 23, 14, 12, 56, 23, 29}
  - > The sum = 330
  - > There are fifteen numbers
  - > Mean = 330 / 15 = 22
- Example: find the Mean {3, -7, 5, 13, -2}
  - > The sum = 3 - 7 + 5 + 13 - 2 = 12
  - > There are 5 numbers
  - > Mean = 12 ÷ 5 = 2.4

Median

- The ***middle*** number (in a sorted list of numbers).

- To find: place the numbers you are given in numerical order and find the middle number.
  - > Example: find the Median of {13, 23, 11, 16, 15, 10, 26}
    - – First, order the numbers, least to greatest
    - – Next, identify the middle number



What if there isn't only ONE middle number?

- If there are an odd number of items in the list, there will be ONE definite Median or middle number

- If there are an even number of items in the list, there will be TWO middle number.
  - > You will add those two numbers and divide by two to determine the median in this case.
  - > Example:
    - – find the Median {3, 13, 7, 5, 21, 23, 23, 40, 23, 14, 12, 56, 23,}29
    - – First, order the numbers, least to greatest

      {3, 5, 7, 12, 13, 14, 21, 23, 23, 23, 23, 29, 40, 56}

    - – Next, identify the middle numbers

There are now fourteen numbers and so we don't have just one middle number, we have a pair of middle numbers:

3 5 7 12 13 14 21 23 23 23 23 29 40 56

- – Finally, average the two numbers

Add them together and divide by 2:

21 + 23 = 44

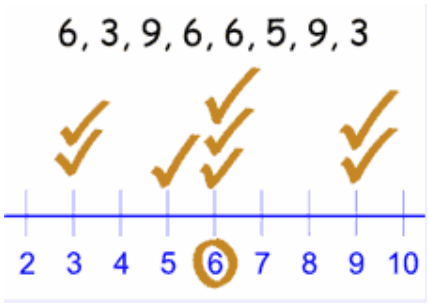
44 ÷ 2 = 22

Median in this example is 22

Mode

- The number which appears ***most often*** in a set of numbers.

  > Example: in {6, 3, 9, 6, 6, 5, 9, 3} the Mode is 6 (it occurs most often).



What if there is more than one mode?

- You CAN have more than one mode.
  > Example: {1, 3, 3, 3, 4, 4, 6, 6, 6, 9}
    - 3 appears three times, as does 6.
    - So there are two modes: at **3** and **6**

  > Having two modes is called "bimodal".

  > Having more than two modes is called "multimodal".

What if there is NO mode?

- You CAN have a set without a mode.
  > Example: {1, 3, 5, 7, 9}
    - No number appears more than once.
    - So there is NO mode.

Try the following:

Find the Mean, Median, and Mode for the following:

1) {2, 3, 5, 6, 13, 5, 1}

2) {201, 199, 201, 200, 199}

3) {8, 7, 5, 19}

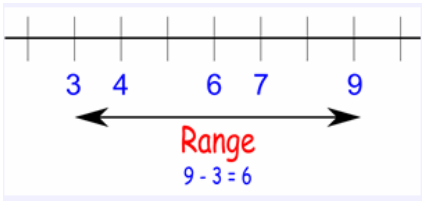
4) {3, 7, 21, 23, 63, 27, 29, 95, 23}

Measures of Dispersion

- Tell you how widely spread out the values are
- Most common are Range, Standard Deviation, and Variance

Range

- The range of a data set is the difference between the maximum and minimum values in the set
- Example:
  - > In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9.



The Range Can Be Misleading

The range can sometimes be misleading when there are extremely high or low values.

Example: In {8, 11, 5, 9, 7, 6, 3616}:

- > the lowest value is 5,
- > and the highest is 3616
- > Range = 3616-5 = **3611**.
- > The single value of 3616 makes the range large, but most values are around 10.

Example: In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9.Example: In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9.Example: In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9.Example: In {4, 6, 9, 3, 7} the lowest value is 3, and the highest is 9.

So the range is 9-3 = 6.

Try the following:

Find the Range for the following:

1) {2, 3, 5, 6, 13, 5, 1} 12

2) {201, 199, 201, 200, 199} 2

3) {8, 7, 5, 19} 14

4) {3, 7, 21, 23, 63, 27, 29, 95, 23} 92

Variance

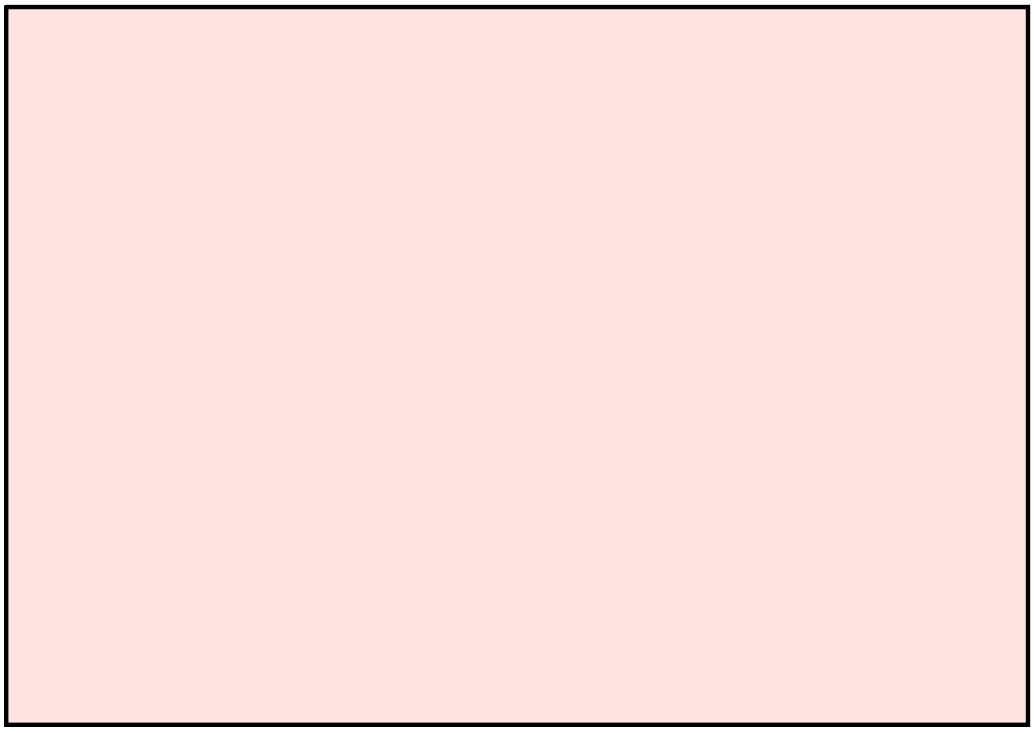
σ^2

- The average of the **squared** differences from the Mean (symbol is σ^2)

- To calculate the variance follow these steps:
  - > find the Mean (average of the numbers)
  - > then for each number: subtract the Mean and square the result (the squared difference)
  - > then work out the average of those squared differences

- Example: find the variance {600, 470, 170, 430, 300}
  - > Step 1: Find the Mean
    - $\frac{600 + 470 + 170 + 430 + 300}{5} = \frac{1970}{5} = 394$
  - > Step 2: Subtract the Mean from each number in the set and square it
    - 600 - 394 = 206 206^2 = 42,436
    - 470 - 394 = 76 76^2 = 5,776
    - 170 - 394 = -224 $(-224)^2$ = 50,176
    - 430 - 394 = 36 36^2 = 1,296
    - 300 - 394 = -94 $(-94)^2$ = 8,836
  - > Step 3: Average those numbers (find the Mean) of the squared #'s
    - $\frac{42{,}436 + 5{,}776 + 50{,}176 + 1{,}296 + 8{,}836}{5} = \frac{108{,}520}{5} = 21{,}704$
  - > The variance, $\sigma^2 = 21{,}704$

σ^2 : Sigma squared



Standard Deviation

- The Standard Deviation is a measure of how spread out numbers are (what is the standard difference between values in the set?)

- Its symbol is σ (the greek letter sigma)

- The formula
  - > the **square root** of the **Variance**

$\sqrt{\sigma^2} = \sigma$

Variance σ^2 St. Dev σ

- From our last example:
  - > The variance, $\sigma^2 = 21{,}704$
  - > The standard deviation, $\sigma = \sqrt{21{,}704} = 147.3227749 \approx 147.3228$

Variance/Standard Deviation:

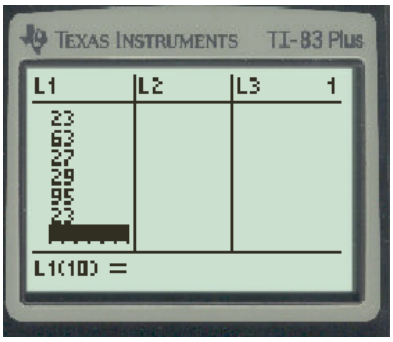
small - data tends to be close to the mean

big - data is more spread out

Variance seems like ALOT of work!

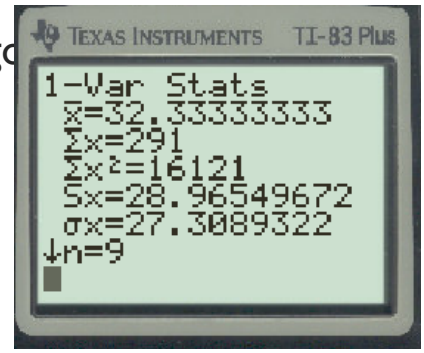
GOOD NEWS...

It can ALL be done in your calculator!

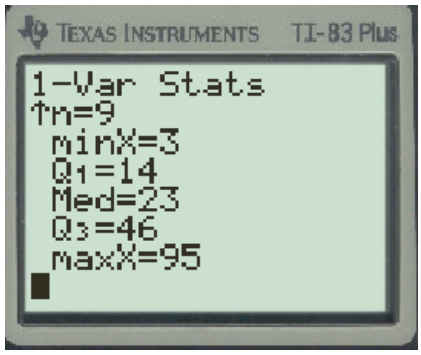


Here's how: (I'm using example 4 from **Try This**)

- > Go to STAT (enter to pull up lists)
  - – enter the values in L1
    - « order doesn't matter



- > Once values are entered, 2nd Mode to go
- > Go to STAT
- > Arrow over to CALC
- > Choose 1: 1-Var-Stats
  - – hit enter 3 or 4 times to get the screen on the right



- > Scroll down and there's more!
- > All of your stats are here!

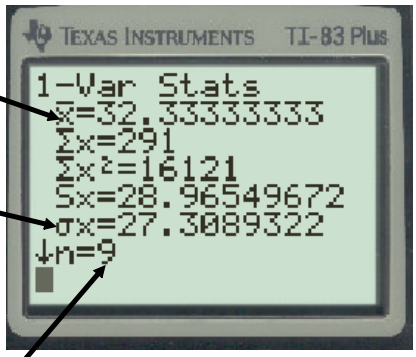
$\bar{X}$: mean

What do they mean??

$\bar{x}$ Mean

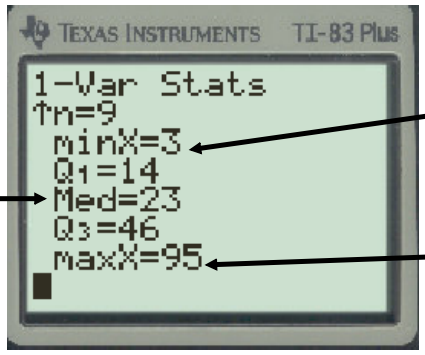
σ Standard Deviation

this is the number of values in your set/list



Median

Range (subtract minX from maxX)



What's missing??

σ : 27.3089322 $\rightarrow$ 745.7778

Variance: Take standard deviation (σx) and square it!

Mode: You still have to find that one on your own! 23

TRY IT AIL TOGETHER NOW...

- Find the following for the set X={2, 5, 8, 21, 45, 26, 5, 10}
  - > Mean: $\bar{X}$ 15.25
  - > Median: 9
  - > Mode: 5
  - > Range: 45 - 2 = 43
  - > Variance: $\sigma^2 = 187.4375$
  - > Standard Deviation: $\sigma = 13.690781577$