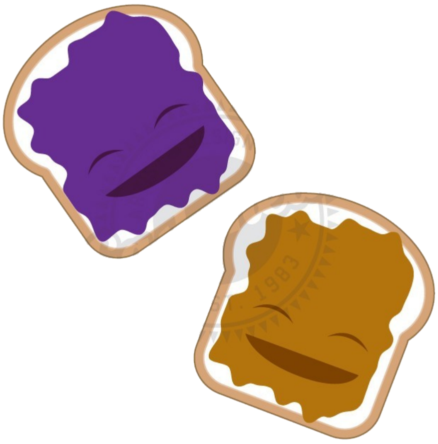
2.4

Describing Spread of Data



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RANGE

Measure of spread

The range is the difference between the largest and smallest values in the data set;

Range = max – min

Do you think the range would be affected by outliers?

Absolutely - *strongly* affected

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MIDRANGE

The average of the largest value and the smallest value.

(MAX + MIN)/2

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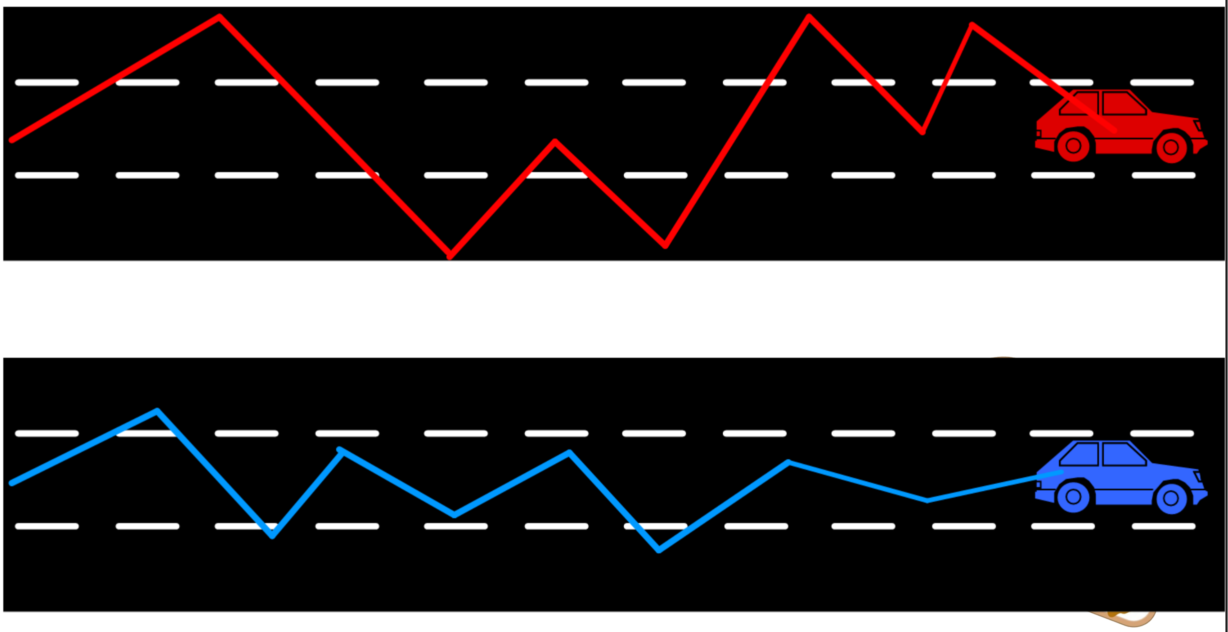
Who's Better?



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Standard Deviation

The better driver is the one who stays closer to the center lane THROUGHOUT the whole trip.

This is the Standard Deviation:

The smaller the Standard Deviation, the closer the data stays to the mean throughout the entire graph.

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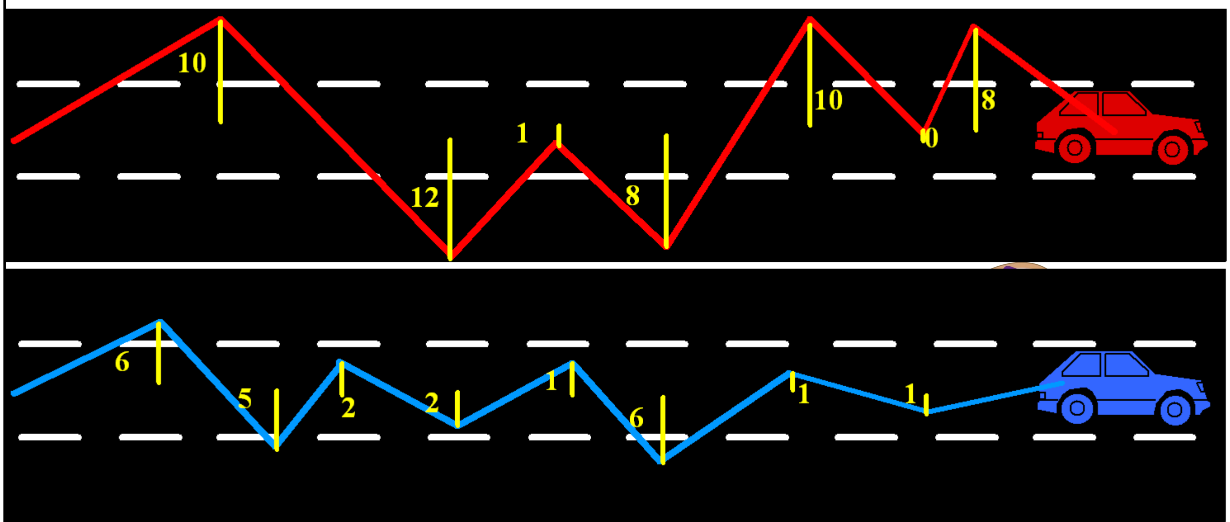
Standard Deviation

It is the **average** of **all** of the **differences** between the mean and the data.



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Standard Deviation

Each data value has an associated **deviation** from the mean, $x - \bar{x}$

A deviation is positive if it falls above the mean and negative if it falls below the mean

The sum of the deviations is always zero

Feb 1-12:50 PM

"We Do" Example

The following data set shows the salaries of 6 players on the NY Yankees from 2003. Find the **deviation** of each salary.

900,000
300,000
10,100,000
5,500,000
750,000
11,428,571

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Practice Example

The following data set shows the prices of 5 SUVs. Find the **deviation** of each car's price.

$\bar{x} = 26{,}447$

$29,290	− 26,447 = $2,843
$23,150	− 26,447 = $−3,297
$28,870	− 26,447 = $2,423
$27,700	− 26,447 = $1,253
$23,225	− 26,447 = −$3,222

Feb 1-12:50 PM

Standard Deviation STEPS

1. First, calculate the differences between every data point and the mean.

$$x - \bar{x}$$

2. Square each difference to eliminate any negatives.

$$\left(x - \bar{x}\right)^2$$

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Standard Deviation STEPS

3. Add all the squared differences together.

$$\sum(x-\bar{x})^2$$

4. Find the average of those differences. This is also know as the Variance (s^2)

$$s^2=\frac{\sum(x-\bar{x})^2}{n-1}$$

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Standard Deviation STEPS

5. Take the square root to eliminate the squaring done earlier.

$$s=\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$$

Feb 1-12:50 PM

RECAP

Standard Deviation - is the average of all the differences between the mean and the data.

The smaller the Standard Deviation, the closer the data stays to the mean throughout the entire graph.

Feb 1-12:50 PM

Find the variance and standard deviation of:

"We Do" Example

74, 86, 92, 97, 100

$\bar{x} = 89.8$

① $x - \bar{x}$ ② $(\ )^2$

$74 - 89.8 = (-15.8)^2 = 249.64$

$86 - 89.8 = (-3.8)^2 = 14.44$

$92 - 89.8 = (2.2)^2 = 4.84$

$97 - 89.8 = (7.2)^2 = 51.84$

$100 - 89.8 = (10.2)^2 = 104.04$

③ Σ 424.8

④ $n-1$ $\frac{424.8}{4} = 106.2 = s^2$

⑤ $\sqrt{\ }$ $= s = 10.31$

Feb 1-12:50 PM

Practice Example

Find the **standard deviation** and **variance** of the metabolic rates of 5 men (cal./24hr.):

1792

1666

1362

1614

1460

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BELLWORK!

1. Why do we divide by n-1 when finding the standard deviation?

to find avg.

2. Find the standard deviation of the following test scores:
   75, 89, 64, 92, 72, 98, 100, 67, 77

s=13.46

3. What does standard deviation mean?

avg. distance from mean

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First of all...

What was that formula for midrange?

(Min + Max)/2

Find the midrange of the following data:
4, 8, 2, 3, 5, 9

(9+2)/2 = 11/2 = 5.5

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Resistant

Do you remember what resistant means?

Do you think standard deviation (or variance) is resistant to outliers?

Psh, nah! An outlier can greatly affect both your variance and standard deviation.

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Properties of st. dev.

↙ sample

- s measures the spread of the data   σ = pop st. dev

- s = 0 only when all observations have the same value, otherwise s > 0. As the spread of the data increases, s gets larger.

- s has the same units of measurement as the original observations. The variance=s^2 has units that are squared

- s is **not** resistant to outliers

Feb 1-12:50 PM

Empirical Rule

If a distribution is bell-shaped, then approximately:

- 68% of observations fall within one standard deviation of the mean

- 95% of observations fall within two standard deviations of the mean

- 99.7% of observations fall within three standard deviations of the mean

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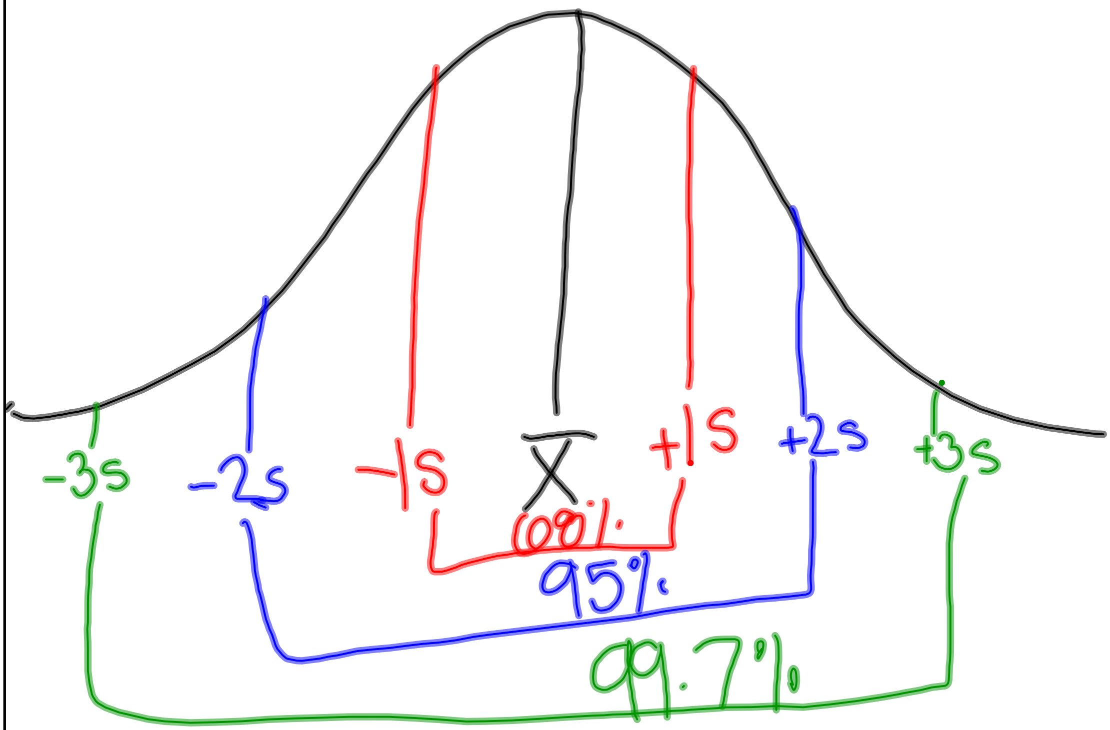

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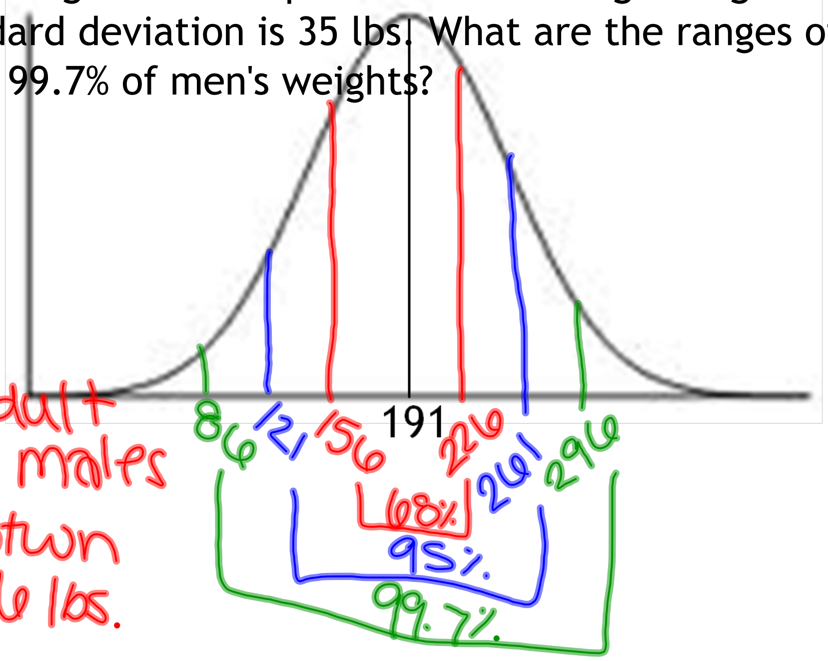
"We Do" Example

The following is an example of men's average weight. Suppose the standard deviation is 35 lbs. What are the ranges of 68%, 95%, and 99.7% of men's weights?



68% of Adult Amer. males weigh btwn 156-226 lbs.

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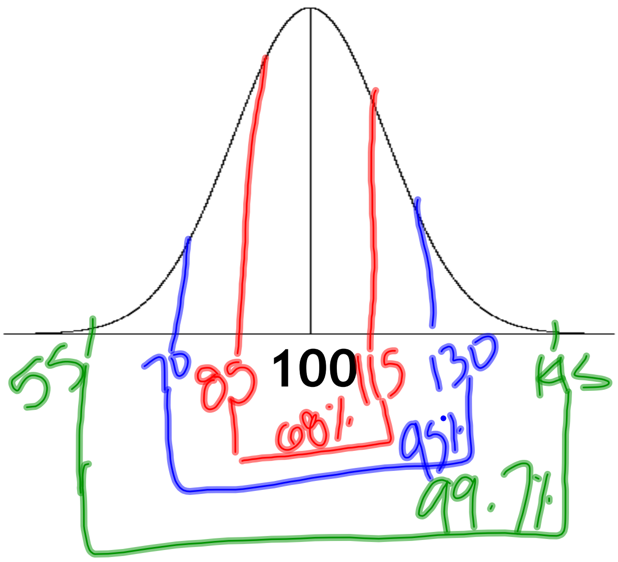
Practice Example

The following is an example of average IQ. Suppose the standard deviation is 15. What are the ranges of 68%, 95%, and 99.7% of IQ's?



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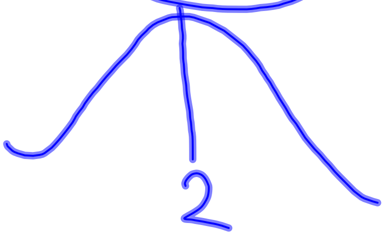
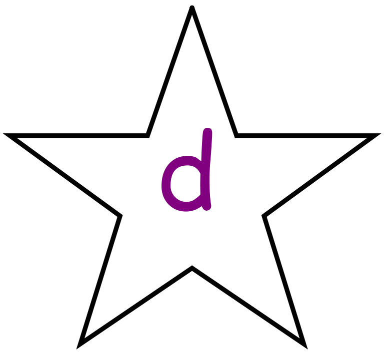
Standard Deviation

If I ask how many siblings a person has, what do you think I would see as my standard deviation?

~~a) 20~~
~~b) -10~~
~~c) 0~~
d) 0.75





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Standard Deviation

If I ask how many minutes it takes you to get to school, what do you think I would see as my standard deviation?

- ~~a) 20~~
- ~~b) -5~~
- c) 5
- d) 1

C

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Think about it...

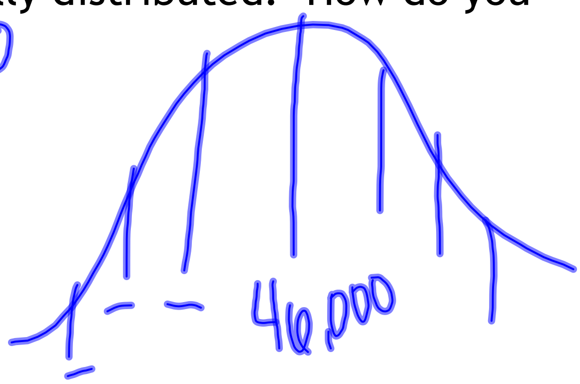
The average household income is $46,000 with a standard deviation of $70,000.

OK, this is just my best guess - google let me down here

Do you think this is normally distributed? How do you know?

No

b/c can't have - income



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