

Standard Deviation and Variance

Deviation just means how far from the normal

Standard Deviation

The Standard Deviation is a measure of how spread out numbers are.

Its symbol is σ (the Greek letter sigma)

The formula is easy: it is the **square root** of the **Variance**. So now you ask, "What is the Variance?"

Variance

The Variance is defined as:

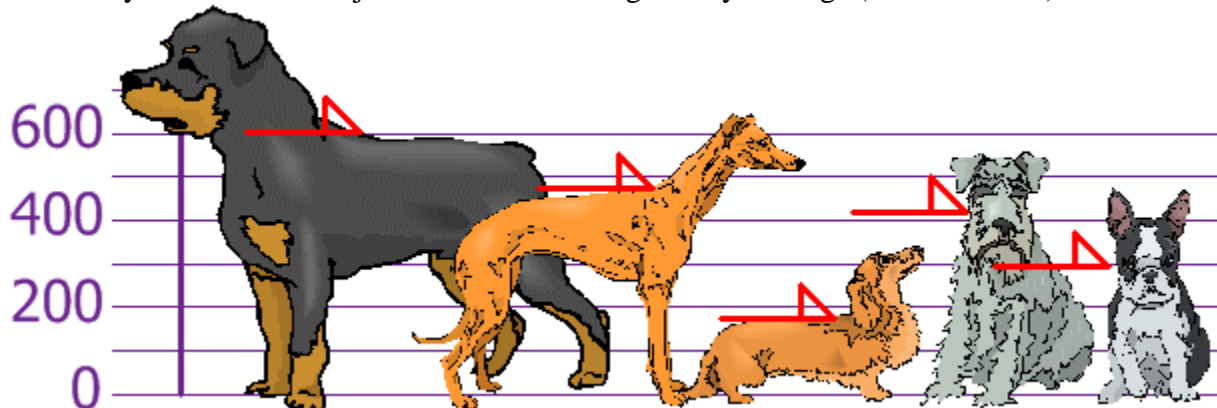
The average of the **squared** differences from the Mean.

To calculate the variance follow these steps:

- Work out the [Mean](#) (the simple 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. ([Why Square?](#))

Example

You and your friends have just measured the heights of your dogs (in millimeters):



The heights (at the shoulders) are: 600mm, 470mm, 170mm, 430mm and 300mm.

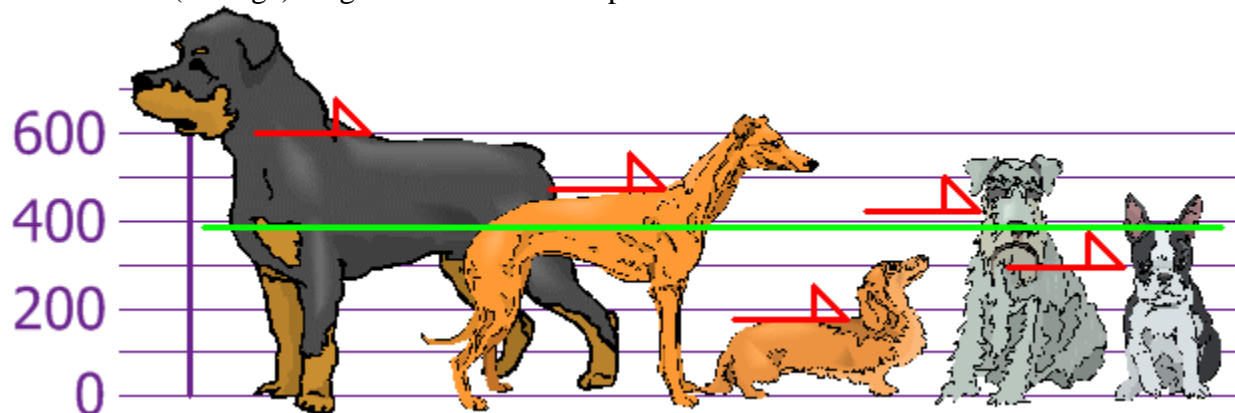
Find out the Mean, the Variance, and the Standard Deviation.

Your first step is to find the Mean:

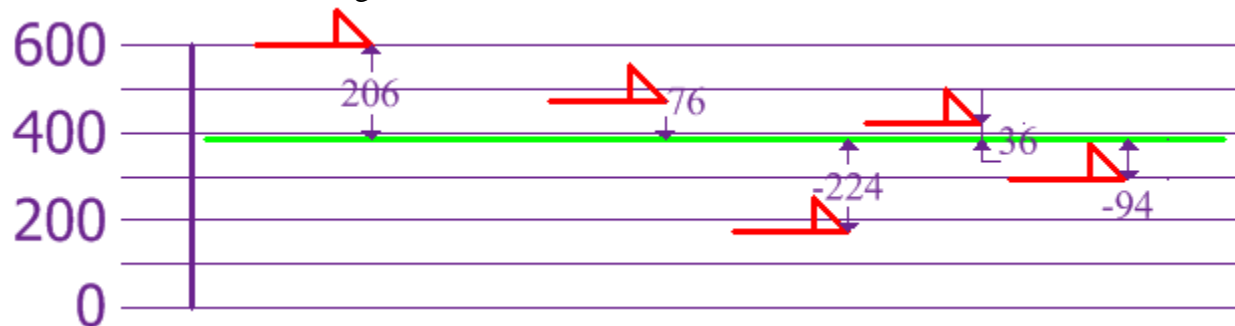
Answer:

$$\text{Mean} = \frac{600 + 470 + 170 + 430 + 300}{5} = \frac{1970}{5} = 394$$

so the mean (average) height is 394 mm. Let's plot this on the chart:



Now, we calculate each dog's difference from the Mean:



To calculate the Variance, take each difference, square it, and then average the result:

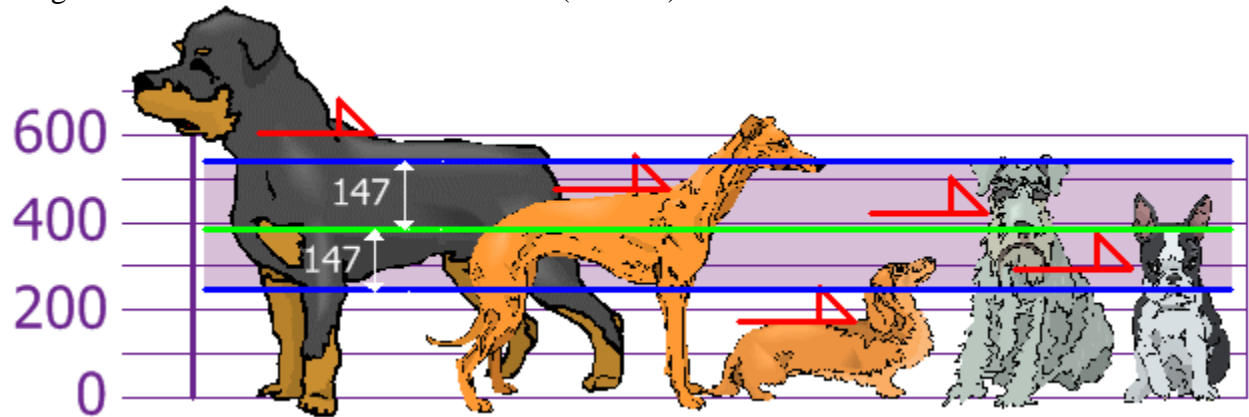
$$\begin{aligned}\text{Variance: } \sigma^2 &= \frac{206^2 + 76^2 + (-224)^2 + 36^2 + (-94)^2}{5} \\ &= \frac{42,436 + 5,776 + 50,176 + 1,296 + 8,836}{5} \\ &= \frac{108,520}{5} = 21,704\end{aligned}$$

So, the Variance is **21,704**.

And the Standard Deviation is just the square root of Variance, so:

Standard Deviation: $\sigma = \sqrt{21,704} = 147.32... = 147$ (to the nearest mm)

And the good thing about the Standard Deviation is that it is useful. Now we can show which heights are within one Standard Deviation (147mm) of the Mean:



So, using the Standard Deviation we have a "standard" way of knowing what is normal, and what is extra-large or extra small.

Rottweiler's **are** tall dogs. And Dachshunds **are** a bit short ... but don't tell them!