Session-14 Statistics

03 August 2024 02:49 PM

Agenda

- Data
- Type of Data
- Quantitative vs Qualitative
- Frequency and Cumulative Frequency
- Measure of Frequency
- Measure of Central Tendency
- Measure of Dispersion
- Variance and Standard Deviation

Mean, median, Mode

Spread

facts

Piece of Information

Q. What is Data?

Ans: Data is a collection of facts, such as numbers, words, measurements, observations or just descriptions of things.

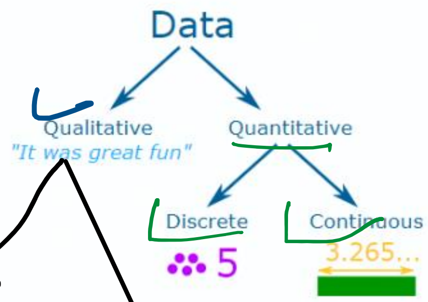
count

Qualitative vs Quantitative

Data can be qualitative or quantitative.

- **Qualitative data** is descriptive information (it *describes* something)
- **Quantitative data** is numerical information (numbers)

String, Category



eg Gender
Blood group
Pincode.

Nominal dataset

eg Best, Good, Bad → ordinal data set

Quantitative data can be Discrete or Continuous:

- **Discrete data** can only take certain values (like whole numbers)
- **Continuous data** can take any value (within a range)

Put simply: **Discrete data** is counted, **Continuous data** is measured

Data

Numerical data ← (a) Quantitative

categorical data ← (b) Qualitative

Quantitative

Discrete

Continuous

Qualitative

Nominal

Ordinals

(a) Discrete -> whole No. or exact No. } cont

eg (i) Bank A/c No

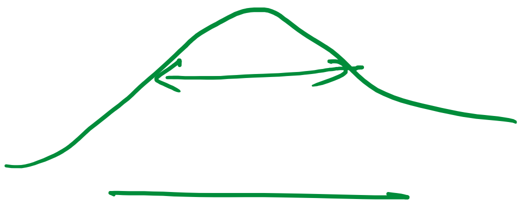
(ii) No. of children in a family

(b) Continuous -> Any value (measure)

eg -> weight, height, temperature, speed

Measures of Dispersion
(Spread Of Data)

1. Variance
2. Standard Deviation



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?)

• Then work out the average of those squared differences. (Why Square?)

Population variance

$$\sigma^2 = \sum_{i=1}^{N} \frac{(x_i - \mu)^2}{N}$$

$x_i \rightarrow$ Data Points

$\mu \rightarrow$ Population mean

$N \rightarrow$ Population size

Sample variance

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

$x_i \rightarrow$ Data Point

$\bar{x} \rightarrow$ Sample mean

$n \rightarrow$ Sample size

Q why we divide sample variance by $n-1$?

Ans The sample variance is devided by $(n-1)$ so that we can create an unbiased estimates of the Population data

Besel correction

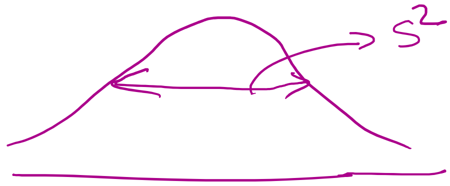
eg $\{1, 2, 3, 4, 5\}$

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

x	$\bar{x}$	$(x_i - \bar{x})^2$
1	3	4
2	3	1
3	3	0
4	3	1
5	3	4
$\bar{x} = 3$		10

$$s^2 = \frac{10}{5-1} = \frac{10}{4}$$

$$\boxed{s^2 = 2.5}$$



$s^2 \uparrow \propto$ spread graph

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?"

Population std

$$\sigma = \sqrt{\text{variance}}$$

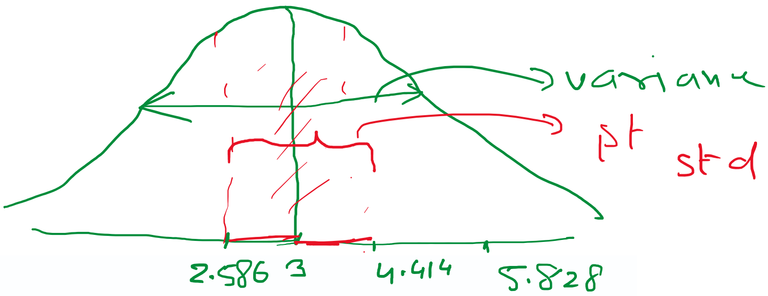
Sample std

$$\text{std} = \sqrt{s^2}$$

$\sigma = \sqrt{\text{variance}}$ $\qquad$ $std = \sqrt{s^2}$

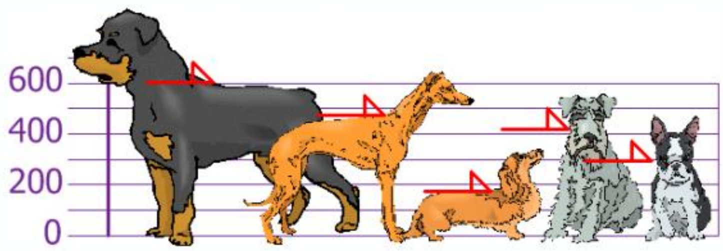
$\bar{x} = 3$

$\sigma = 1.414$



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:

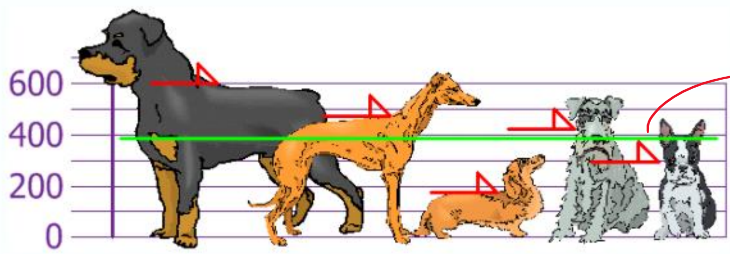
Answer:

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

$$= \frac{1970}{5}$$

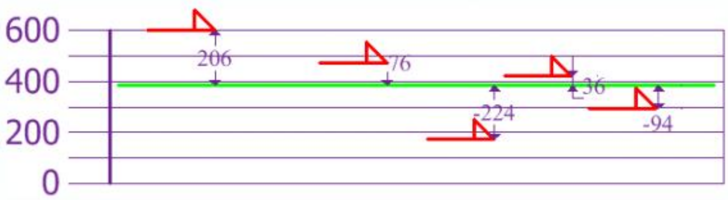
$$= \boxed{394}$$

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



394

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



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

Variance

$$\sigma^2 = \frac{206^2 + 76^2 + (-224)^2 + 36^2 + (-94)^2}{5}$$

$$= \frac{42436 + 5776 + 50176 + 1296 + 8836}{5}$$

$$= \frac{108520}{5}$$

$$= 21704$$

So the Variance is **21,704**

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

Standard Deviation

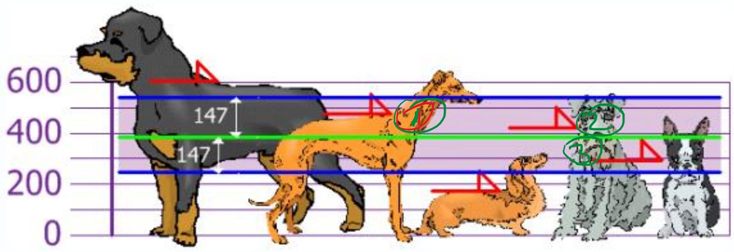
$$\sigma = \sqrt{21704}$$

$$= 147.32...$$

$$= \mathbf{147} \textit{ (to the nearest mm)}$$

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:

3/5



} 1st std

68%

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

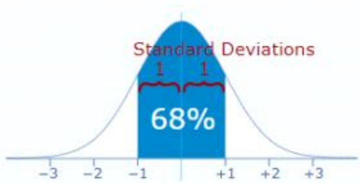
Rottweilers **are** tall dogs. And Dachshunds **are** a bit short, right?

Using

We can expect about 68% of values to be within plus-or-minus 1 standard deviation.

Read Standard Normal Distribution to learn more.

Also try the Standard Deviation Calculator.



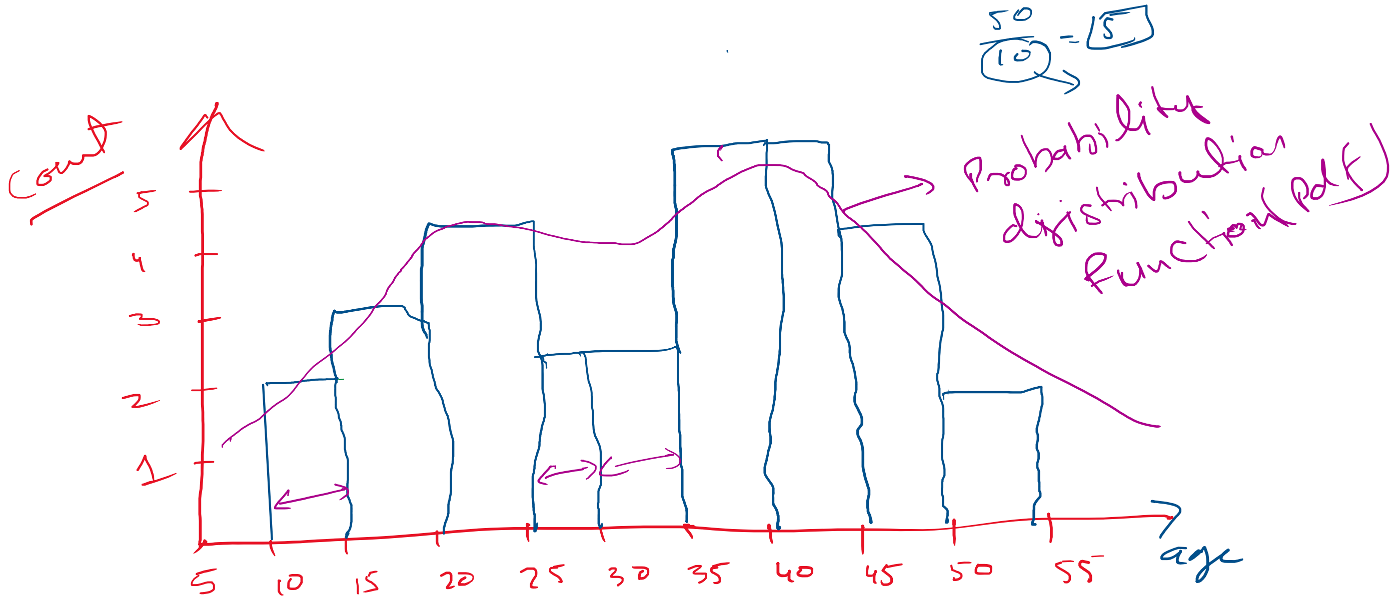
394

394 − 147 394 + 147

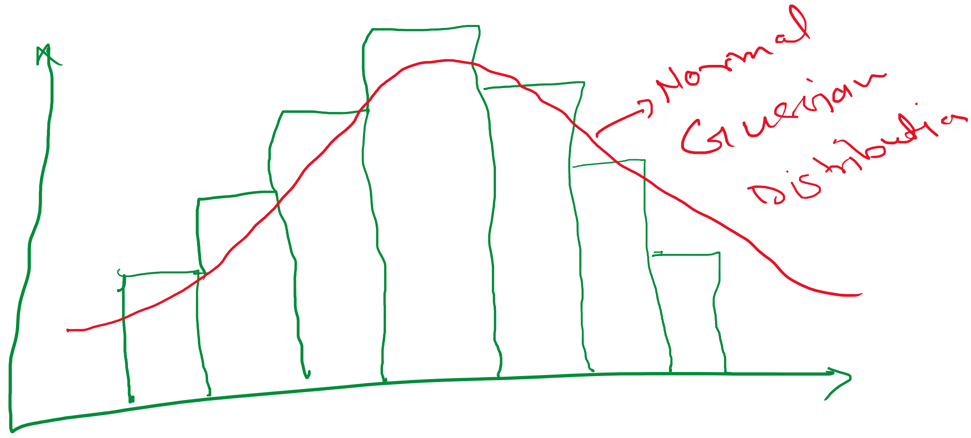
Histogram and Skewness

[Frequency]

$\frac{50}{10} = \boxed{5}$



(1)

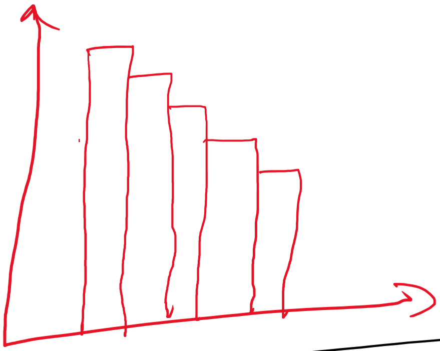


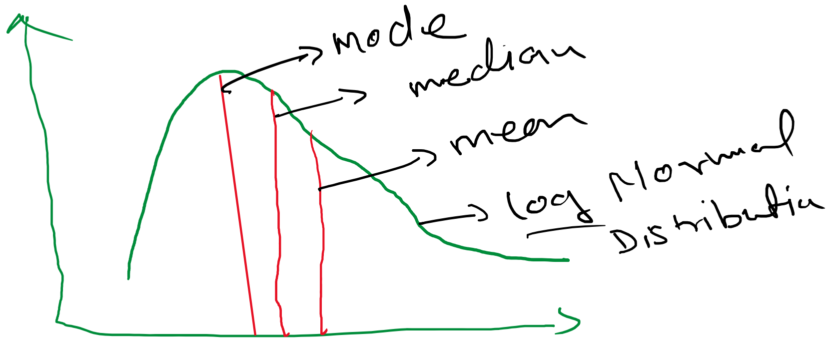
(1) Mean, median & mode all are perfectly at the Center.

$$\boxed{\text{Mean} = \text{Median} = \text{mode}}$$

(5) Right Skewed

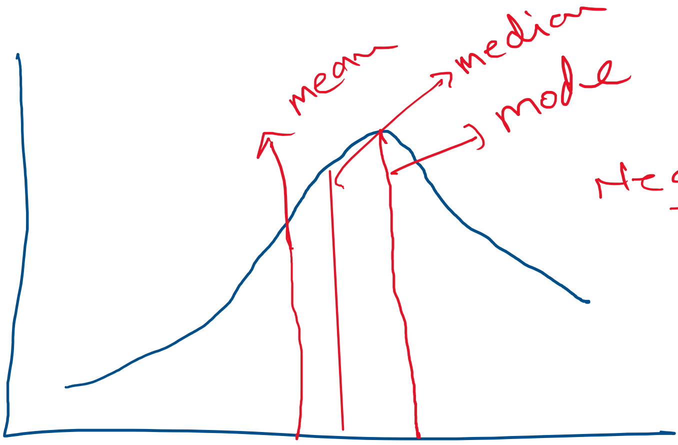
Positive skewed





Mean $\geq$ median $\geq$ mode

(6) Left skewed Distribution



Negative skewed

Mean $\leq$ median $\leq$ mode