بِسمِ اللهِ الرَّحمٰنِ الرَّحِيمِ

Variance And Standard Deviation

Objectives

- To find the **variance** of a data set.
- To find the **standard deviation** of a data set.

VARIANCE

- **Variance** is the average squared deviation from the mean of a set of data.
- It is used to find the **standard deviation**.

Variance

{Processes To Find Variance}

- Find the Mean of the data.
    - Mean is the average so add up the values and divide by the number of items.
- Subtract the mean from each value – the result is called the deviation from the mean.
- Square each deviation of the mean.
- Find the sum of the squares.
- Divide the total by the number of items.

VARIANCE FORMULA

The variance formula includes the Summation Notation, $\sum$ which represents the sum of all the items to the right of Sigma.

$$\sigma^2 = \frac{\sum\left(x - \bar{X}\right)^2}{N}$$

For population variance

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

For sample variance

Mean is represented by μ & $\bar{x}$ and ***n & N*** is the number of items.

STANDARD DEVIATION

- **Standard Deviation** shows the variation in data.
- If the data is close together, the standard deviation will be small.
- If the data is spread out, the standard deviation will be large.

- **Standard Deviation** is often denoted by the lowercase Greek letter sigma, σ.

Standard Deviation

{Processes To Find Variance & Standard Deviation}

- Find the **variance**.
  a) Find the **Mean** of the data.
  b) Subtract the mean from each value.
  c) Square each deviation of the mean.
  d) Find the sum of the squares.
  e) Divide the total by the number of items.
- Take the square root of the variance.

Standard Deviation Formula

The standard deviation formula can be represented using Sigma Notation:

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

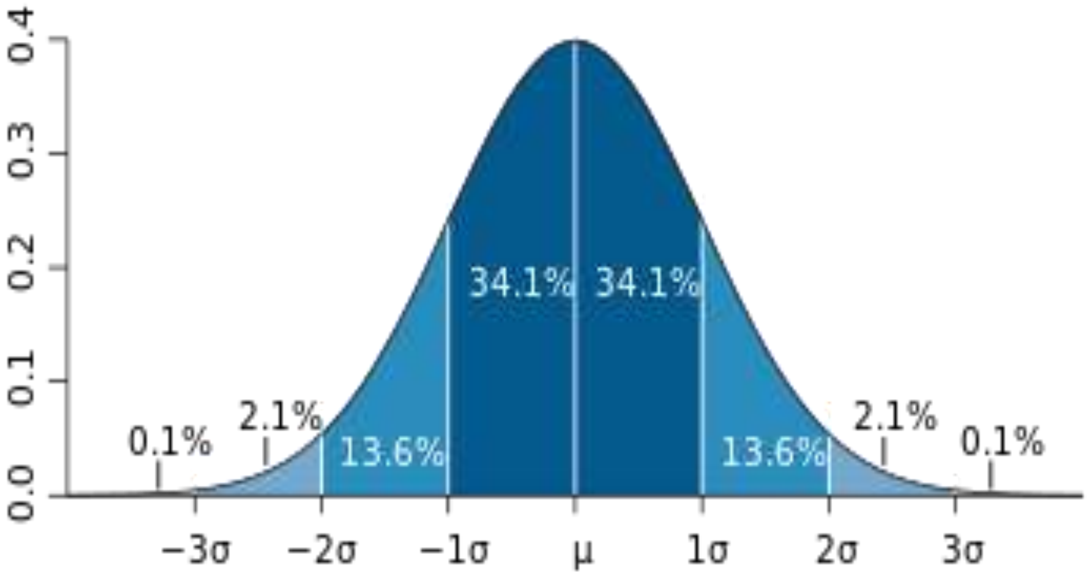
$$\sigma = \sqrt{\frac{\sum\left(x - \mu\right)^2}{N}}$$

sample standard deviation **population standard deviation**

The standard deviation formula is the square root of the variance.

Graph

- The bell curve is commonly seen in statistics as a tool to understand **standard deviation**.



- The following **graph** of a normal distribution represents a great deal of data in real life. The mean, or average, is represented by the Greek letter μ, in the center.

Find The Variance And Standard Deviation

Example : 1

The math test scores of five students are: 92,88,80,68 and 52.

"Consider test scores values are (x)"

1) Find the **Mean** ($\bar{x}$):

(92+88+80+68+52)/5 = 76.

2) Find the **deviation from the mean**:

$(x - \bar{x})$

92-76=16

88-76=12

80-76=4

68-76= -8

52-76= -24

3) Square the deviation from the mean:

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

$(16)^2 = 256$

$(12)^2 = 144$

$(4)^2 = 16$

$(-8)^2 = 64$

$(-24)^2 = 576$

4) Find the sum of the squares of the deviation from the mean $(x - \bar{x})^2$:

256+144+16+64+576= 1056

5) Divide by the number of data items to find the **variance**:

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

1056/5 = 211.2

6) Find the square root of the variance:

$$\sqrt{211.2} = 14.53$$

Thus the standard deviation of the test scores is 14.53.

Standard Deviation Example

Example : 2

Measure the height of all the person's in your room.

- If your room contains four members and their height's are :

165

145

153

150

1) Now you have to find the mean of the height's measured :

$$\textbf{Mean}\ (\bar{x}) = \frac{165+145+153+150}{4} = 153.25$$

2) Next step is to find the variance.

- It is the average of the squares of the differences from mean.
- Subtract individual height's from the mean and square each value.

3) Find the **deviation from the mean:**

$(x - \bar{x})$

165-153.25= 11.75

145-153.25= -8.25

153-153.25= -0.25

150-153.25= -3.25

4) Square the **deviation from the mean:**

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

$(11.75)^2=138.0625$

$(-8.25)^2=68.0625$

$(-0.25)^2=0.0625$

$(-3.25)^2=10.5625$

5) Find the sum of the squares of the deviation from the mean $(x - \bar{x})^2$

138.0625+68.0625+0.0625+10.5625=216.75

- Sum of the square of deviation is: 216.75

- For population standard deviation, we would calculate variance without subtracting “1” from the denominator.
- But here we subtracting “1” from the denominator.
- This Process is called degree of freedom.

6) Divide by the number of data items and subtracting 1 from the denominator to find the **variance**:

$$s^2 = \frac{\sum\left(x-\bar{X}\right)^2}{n-1} \qquad \frac{216.75}{4-1} = 72.25$$

7) Find the square root of the variance:

$$s = \sqrt{\frac{\sum\left(x-\bar{X}\right)^2}{n-1}} = \sqrt{72.25} = 8.5$$

Thus the standard deviation of the heights of the members is 8.5.

Conclusion

- As we have seen, standard deviation measures the dispersion of data.
- The greater the value of the standard deviation, the further the data tend to be dispersed from the mean.

Thank you