

# Standardabweichung berechnen

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Standard deviation ( $\sigma$ ) equals the squareroot ( $\sqrt{\phantom{x}}$ ) of the squared ( $^2$ ) sum ( $\sum$ ) of the difference between each value and the mean ( $x_{1...n} - \mu$ ), divided by the number of values minus 1 ( $N-1$ ):

$$\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{N - 1}} \quad (1)$$

Let's try doing this step-by-step:

1. Save values as object
2. Determine  $N$
3. compute mean ( $\mu$ )
4. compute difference between each value and the mean (subtract mean from each value;  
 $x_{1...n} - \mu$ )

5. square these values ( $^2$ )
6. sum the squared values ( $\sum$ )
7. divide this value by N-1
8. compute the squareroot ( $\sqrt{\phantom{x}}$ )

## Save values as object

```
werte <- c(13, 0, 2000, 5, 19)
```

Print values

```
werte
```

```
[1] 13 0 2000 5 19
```

## Determine $N$

\* By hand: print values and count how many there are

```
werte
```

```
[1] 13 0 2000 5 19
```

\* Or, use the `length()` function

```
length(werte)
```

```
[1] 5
```

## Compute mean

The mean ( $\mu$ ) is the sum ( $\sum$ ) of the values ( $x$ ) divided by the number of values ( $N$ ):

$$\mu = \frac{\sum x}{N}$$

\* By hand

Typing out all the values:

```
(13 + 0 + 2000 + 5 + 19)/5
```

```
[1] 407.4
```

\* Or by using the functions `sum()` and `length()`

```
sum(werte)/length(werte)
```

```
[1] 407.4
```

\* Or by simply using the function `mean()`

```
mean(werte)
```

```
[1] 407.4
```

## Subtract mean from each value

This can also be done several different ways

\* By hand (tedious and prone to human error)

```
(13 - 407.4)
```

```
[1] -394.4
```

```
(0 - 407.4)
```

```
[1] -407.4
```

```
(2000 - 407.4)
```

```
[1] 1592.6
```

```
(5 - 407.4)
```

```
[1] -402.4
```

```
(19 - 407.4)
```

```
[1] -388.4
```

\* Or using the object name

```
werte - mean(werte)
```

```
[1] -394.4 -407.4 1592.6 -402.4 -388.4
```

## Square these values

\* By hand

```
(13 - 407.4)^2
```

```
[1] 155551.4
```

```
(0 - 407.4)^2
```

```
[1] 165974.8
```

```
(2000 - 407.4)^2
```

```
[1] 2536375
```

```
(5 - 407.4)^2
```

```
[1] 161925.8
```

```
(19 - 407.4)^2
```

```
[1] 150854.6
```

\* Or by using ^2 with the variable name

```
(werte - mean(werte))^2
```

```
[1] 155551.4 165974.8 2536374.8 161925.8 150854.6
```

## Sum the squared values

\* By hand

```
(13 - 407.4)^2 +  
(0 - 407.4)^2 +  
(2000 - 407.4)^2 +  
(5 - 407.4)^2 +  
(19 - 407.4)^2
```

```
[1] 3170681
```

\* Or with the object name and some functions

```
sum((werte - mean(werte)) ^ 2)
```

```
[1] 3170681
```

## Divide by N-1

\* By hand

```
((13 - 407.4) ^ 2 +  
  (0 - 407.4) ^ 2 +  
  (2000 - 407.4) ^ 2 +  
  (5 - 407.4) ^ 2 +  
  (19 - 407.4) ^ 2)/(5-1)
```

```
[1] 792670.3
```

\* Or with the object name and some functions

```
sum((werte - mean(werte)) ^ 2) / (length(werte) - 1)
```

```
[1] 792670.3
```

## Compute the squareroot

\* By hand

```
sqrt(((13 - 407.4)^2 +  
(0 - 407.4)^2 +  
(2000 - 407.4)^2 +  
(5 - 407.4)^2 +  
(19 - 407.4)^2)/(5-1))
```

```
[1] 890.3203
```

\* Or with the object name and some functions

```
sqrt(sum((werte - mean(werte)) ^ 2) / (length(werte) - 1))
```

```
[1] 890.3203
```

## Check with sd() function

```
sd(werte)
```

```
[1] 890.3203
```