

# How can data be normalized between -1 and 1?

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## RECOMMENDED CITATION

stats writer (2024). *How can data be normalized between -1 and 1?*. PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=152358>

Data normalization is a mathematical process used to transform data into a standard range, typically between -1 and 1. This is done by scaling the data points to fit within this range, while maintaining their relative positions to each other. This allows for easier comparison and analysis of the data, as well as reducing the effects of outliers. The normalization process involves calculating the minimum and maximum values of the data, and then using a formula to transform the data points accordingly. By normalizing data between -1 and 1, it ensures that all data points are within a consistent and standardized range, making it easier to interpret and analyze.

## Normalize Data Between -1 and 1

To normalize the values in a dataset to be between -1 and 1, you can use the following formula:

$$z_i = 2 * ((x_i - x_{min}) / (x_{max} - x_{min})) - 1$$

where:

**$z_i$ :** The  $i$ th normalized value in the dataset  
 **$x_i$ :** The  $i$ th value in the dataset  
 **$x_{min}$ :** The minimum value in the dataset  
 **$x_{max}$ :** The maximum value in the dataset

For example, suppose we have the following dataset:

Data Values
13
16
19
22
23
38
47
56
58
63
65
70
71

The minimum value in the dataset is 13 and the maximum value is 71.

To normalize the first value of 13, we would apply the formula shared earlier:

$$z_i = 2 * ((x_i - x_{min}) / (x_{max} - x_{min})) - 1 = 2 * ((13 - 13) / (71 - 13)) - 1 = -1$$

To normalize the second value of 16, we would use the same formula:

$$z_i = 2 * ((x_i - x_{min}) / (x_{max} - x_{min})) - 1 = 2 * ((16 - 13) / (71 - 13)) - 1 = -0.897$$

To normalize the third value of 19, we would use the same formula:

$$z_i = 2 * ((x_i - x_{min}) / (x_{max} - x_{min})) - 1 = 2 * ((19 - 13) / (71 - 13)) - 1 = -0.793$$

We can use this exact same formula to normalize each value in the original dataset to be between -1 and 1:

Data Values	Normalized
13	-1
16	-0.897
19	-0.793
22	-0.690
23	-0.655
38	-0.138
47	0.172
56	0.483
58	0.552
63	0.724
65	0.793
70	0.966
71	1

Each value in the normalized dataset is now between -1 and 1.

Using this normalization method, the following statements will always be true:

The normalized value for the minimum value in the dataset will always be -1. The normalized value for the maximum value in the dataset will always be 1. The normalized values for all other values in the dataset will be between -1 and 1.

### When to Normalize Data

Often we normalize variables when performing some type of analysis in which we have multiple variables that are measured on different scales and we want each of the variables to have the same range.

This prevents one variable from being too influential, especially if it's measured in different units (i.e. if one variable is measured in inches and another is measured in yards).

Also note that the normalization method we used here is only one possible option.

In some cases, it makes sense to instead normalize variables between 0 and 1 or even between 0 and 100.

The following tutorials explain how to perform other

## types of normalization:

ARABPSYCHOLOGY.COM