# Norm

## Definition and purpose

In mathematics, a **norm** is a function from a real or complex vector space to the nonnegative real numbers that behaves in certain ways like the distance from the origin:

* it commutes with scaling
* obeys a form of the triangle inequality
* and is zero only at the origin

For example, if we want to measure two vectors/points from the 2-D coordinate system, we may want to use the Euclidean Distance (also called norm), which is written as

A picture containing line chart

Description automatically generated

To generalize, we change 2 into a variable, so the equation becomes

/

If we set , we get the Manhattan distance

/ Manhattan distance

## Usage

It can be utilized as a constraint. For example, if we consider the 2-D space, with , it looks like

Chart, line chart

Description automatically generated

For , it looks like

Chart

Description automatically generated

For

Chart

Description automatically generated

This property has been widely used in multiple theorems. Recall the definition of the Mean Squared Error

For Ridge Regression Constraint

Chart, schematic, box and whisker chart

Description automatically generated

For Lasso Regression Constraint

Diagram, shape

Description automatically generated with medium confidence