

How to Easily Understand Monotonic Relationships

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RECOMMENDED CITATION

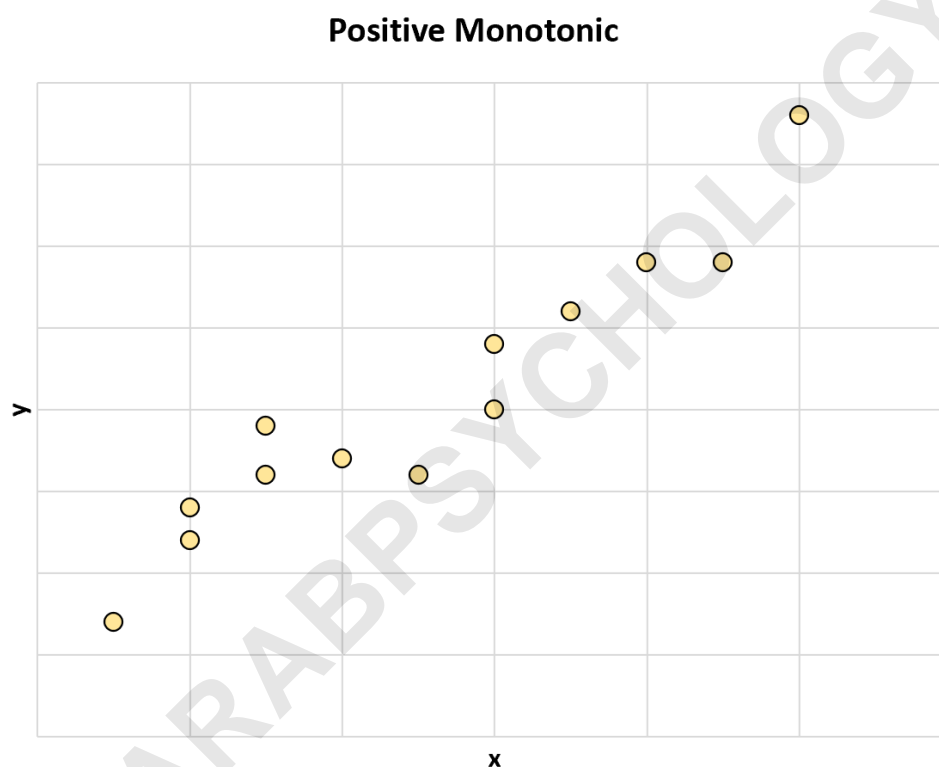
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A monotonic relationship is a type of relationship between two variables in which one variable increases or decreases as the other increases or decreases, without ever reversing direction. This means that the variables either have a positive or negative relationship, but never switch between the two. In a monotonic relationship, there is no change in the rate of the relationship.

In statistics, a **monotonic relationship** between two variables refers to a scenario where a change in one variable is generally associated with a change in a specific direction in another variable.

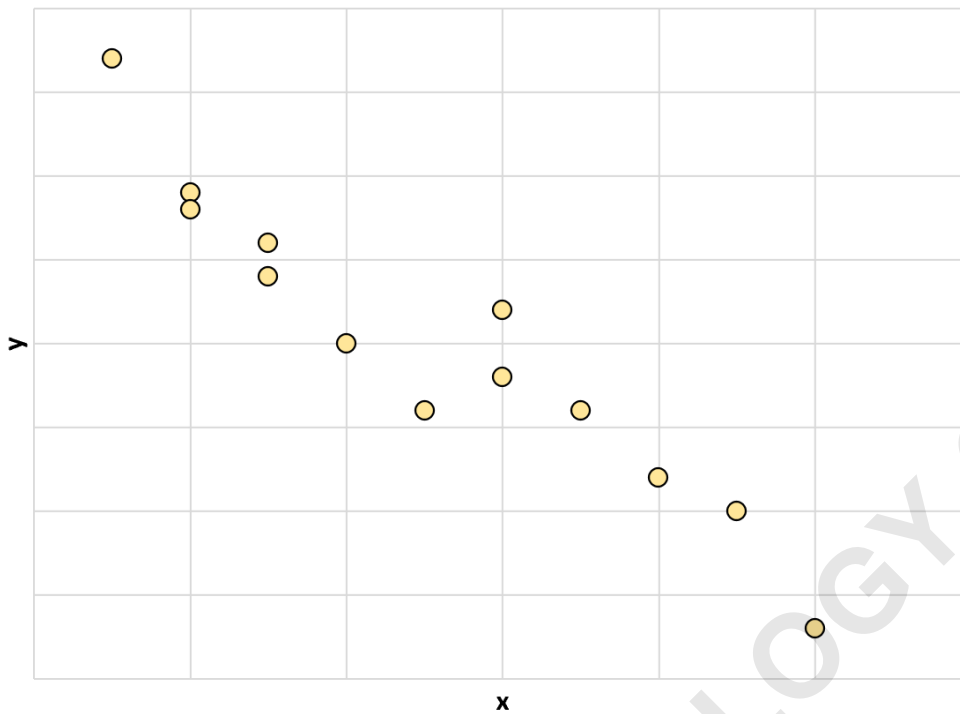
There are two types of monotonic relationships:

Positive Monotonic: When the value of one variable increases, the value of the other variable tends to increase as well.



Negative Monotonic: When the value of one variable increases, the value of the other variable tends to decrease.

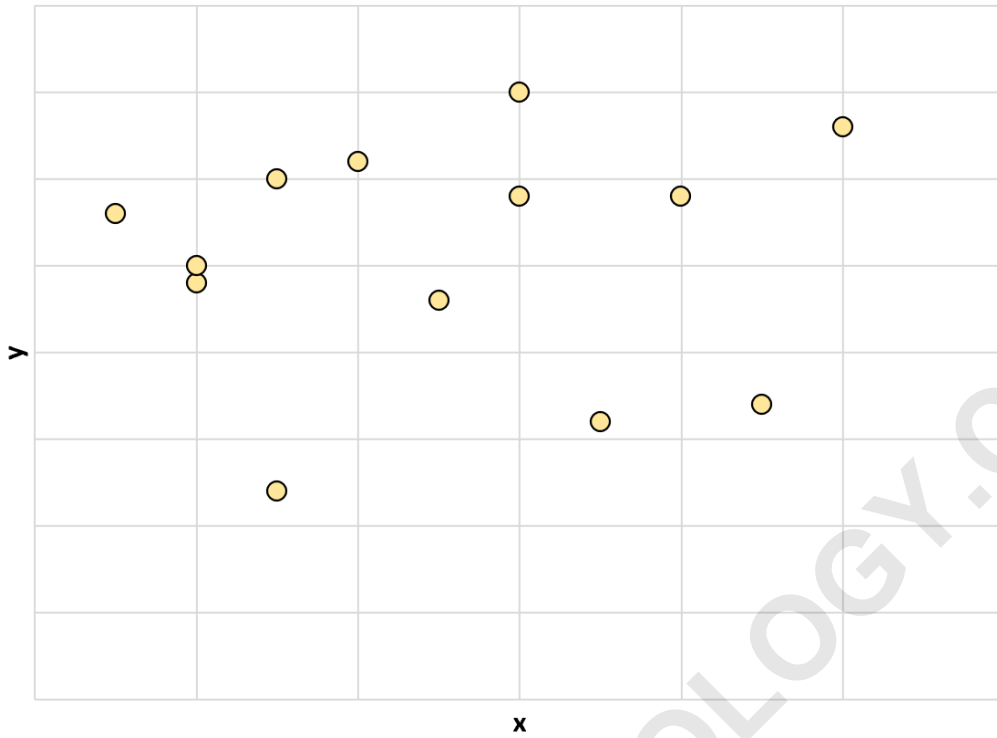
Negative Monotonic



If two variables don't generally change in the same direction, then they are said to have a **non-monotonic relationship**.

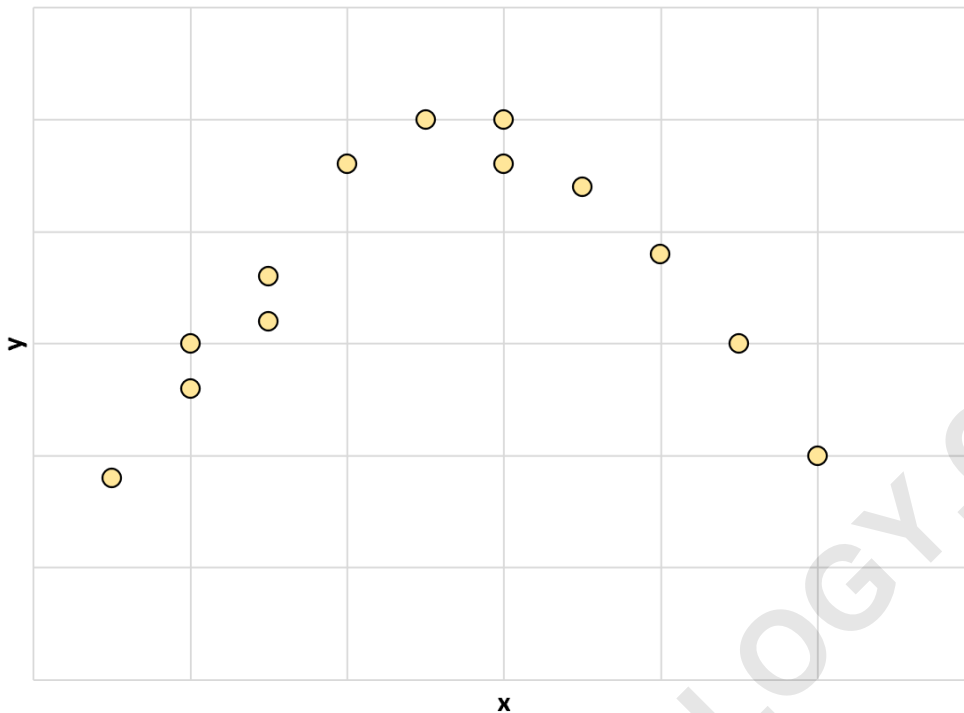
Here's one example of a non-monotonic relationship between two variables:

Non-Monotonic



And here's another example of a non-monotonic relationship between two variables:

Non-Monotonic



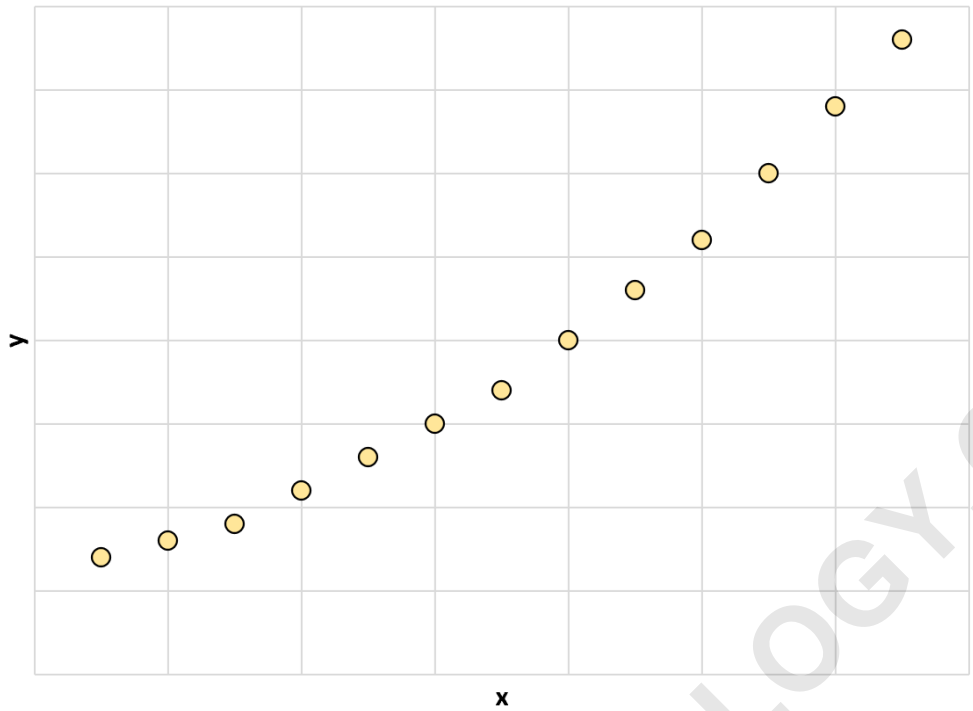
As the value of x increases, the value of y *sometimes* increases, but sometimes the value of y *decreases*.

Strictly Monotonic vs. Non-Strictly Monotonic

Two variables are said to have a **strictly monotonic** relationship if changes in one variable are *always* associated with a change in the same direction in another variable.

For example, the following chart illustrates a strictly positive monotonic relationship between two variables:

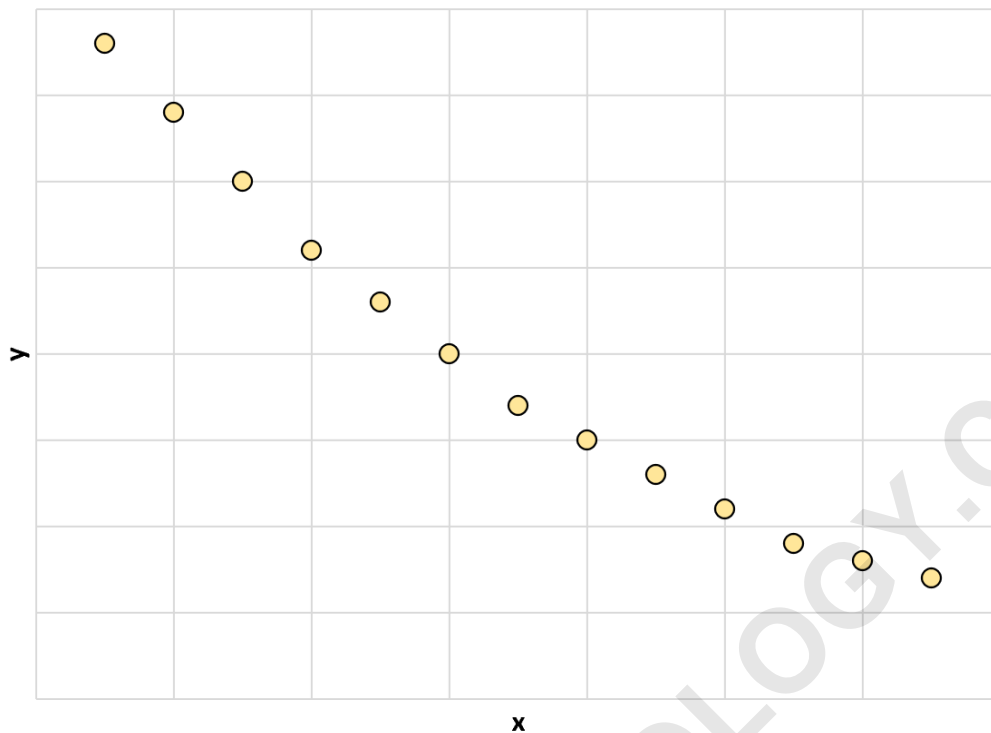
Strictly Positive Monotonic



When the value of x increases, the value of y *always* increases.

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Strictly Negative Monotonic



When the value of x increases, the value of y *always* decreases.

How to Quantify Monotonic Relationships

The most common way to quantify the relationship between two variables is to use the r , which measures the linear association between two variables.

This coefficient always takes on a value between -1 and 1 where:

-1 indicates a perfectly negative linear correlation between two variables

0 indicates no linear correlation between two variables

1 indicates a perfectly positive linear correlation between two variables

The closer the coefficient is to 1 , the stronger the positive relationship between two variables. Conversely, the closer the coefficient is to -1 , the stronger the negative relationship between two variables.

However, if the relationship between two variables is monotonic but non-linear (like an exponential relationship) then it's a good idea to use the s , which was designed to handle monotonic relationships well.

No matter which type of correlation coefficient you calculate, it's always a good idea to create a scatterplot to visualize the relationship between the variables as well.

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