

What are 5 examples of nonlinear relationships between variables?

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Nonlinear relationships between variables refer to the type of relationship where the change in one variable is not directly proportional to the change in another variable. In other words, the relationship between the two variables is not a straight line. Here are 5 examples of nonlinear relationships between variables:

1. Quadratic relationship: This type of relationship can be observed when the change in one variable is proportional to the square of the change in another variable. For example, the relationship between the distance traveled and the time taken by a moving object is quadratic, as the distance increases faster with time.
2. Inverse relationship: In this type of relationship, the change in one variable results in an opposite change in the other variable. For instance, as the price of a product increases, the demand for it decreases.
3. Exponential relationship: This type of relationship can be seen when the change in one variable is proportional to the change in another variable raised to a power. For example, the growth of a bacteria population follows an exponential relationship with time.
4. Logarithmic relationship: In this type of relationship, the change in one variable results in a decreasing change in the other variable. For instance, the amount of time spent studying and the increase in knowledge has a logarithmic relationship, as the initial increase in knowledge is larger than subsequent increases.
5. S-shaped relationship: This type of relationship is characterized by a gradual increase, followed by a rapid increase, and then a gradual decrease. An example of this is the relationship between the number of employees hired and the productivity of a company. Initially, as the number of employees increases, productivity also increases, but after a certain point, adding more employees may result in a decrease in productivity.

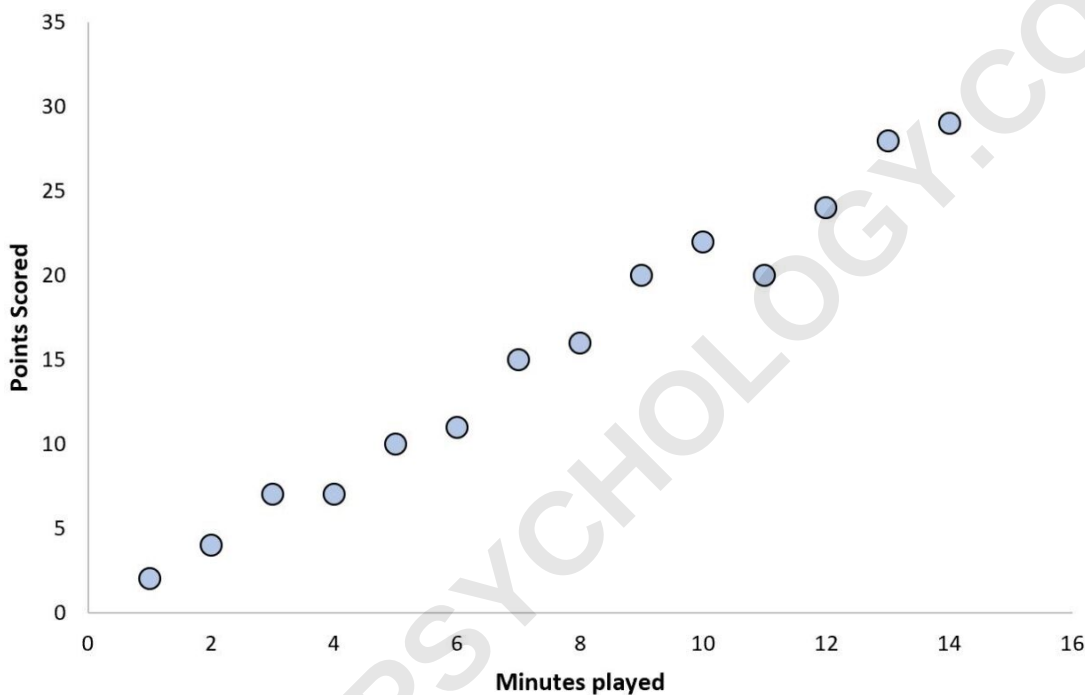
5 Examples of Nonlinear Relationships Between Variables

In most statistics courses, students learn about linear relationships between variables.

These are relationships where an increase in one

variable is associated with a predictable increase in another variable.

One example of this might be minutes played in a basketball game vs. total points scored:



Players who play more minutes tend to score more points.

However, there can also exist nonlinear relationships between variables and these appear all the time in the real world.

This tutorial provides five examples of nonlinear

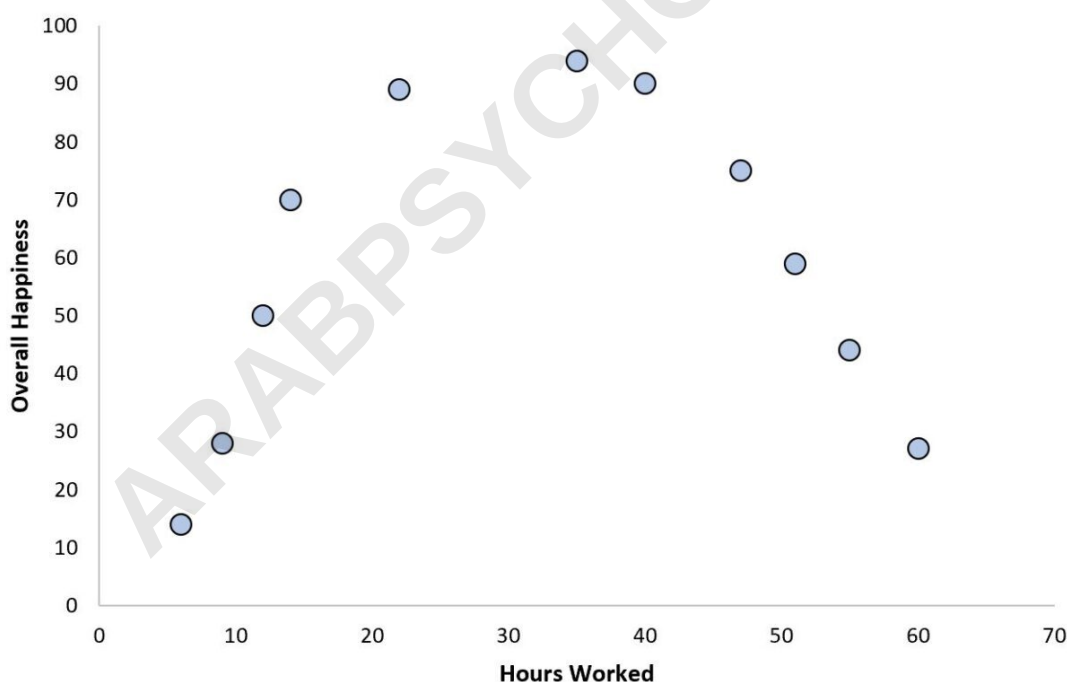
relationships between variables in the real world.

Example 1: Quadratic Relationships

One of the most common nonlinear relationships in the real world is a quadratic relationship between variables.

When plotted on a scatterplot, this relationship typically exhibits a "U" shape.

One example might be total working hours per week vs. overall happiness:



As working hours increase from zero, overall happiness tends to increase, but beyond a certain threshold more

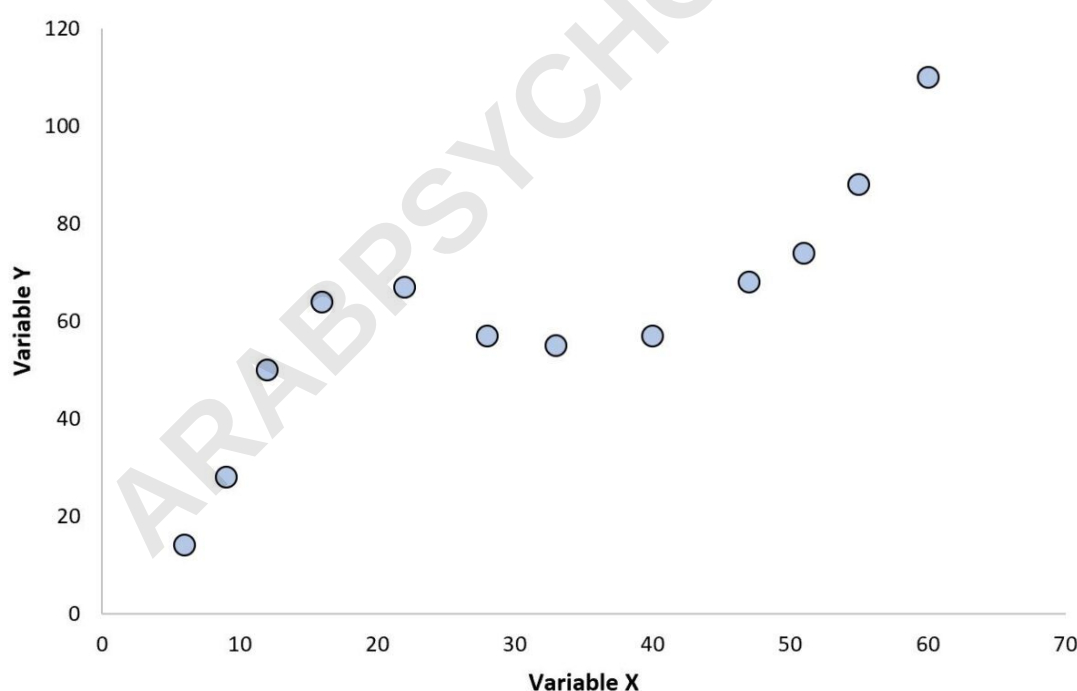
working hours actually leads to decreased happiness.

This upside down "U" shape is the signature shape of a quadratic relationship between two variables.

Example 2: Cubic Relationships

Another common nonlinear relationship in the real world is a cubic relationship between variables.

When plotted on a scatterplot, this relationship typically has two distinct curves.



Notice that there are two distinct curves on the plot and the relationship between variable X and variable Y is

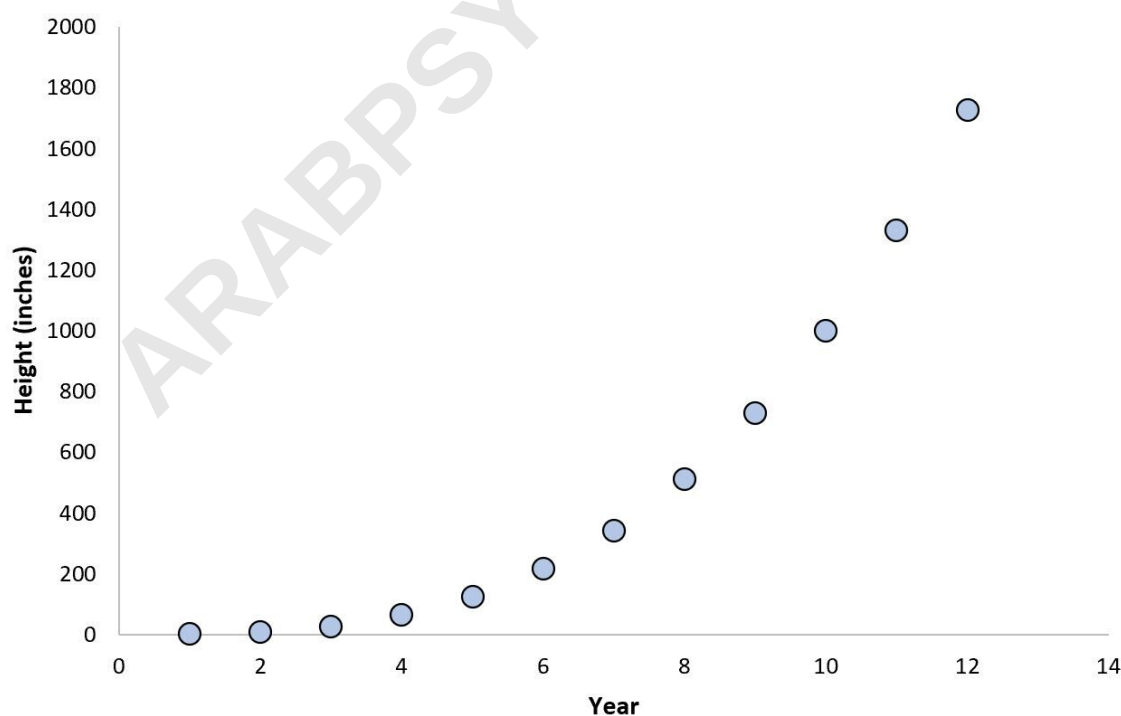
clearly not linear.

Example 3: Exponential Relationships

Another common nonlinear relationship in the real world is an exponential relationship between variables.

When plotted on a scatterplot, this relationship exhibits a single curve that becomes more pronounced as the variable on the x-axis increases.

One well-known example of an exponential relationship is the lifespan of bamboo plants and their yearly growth:



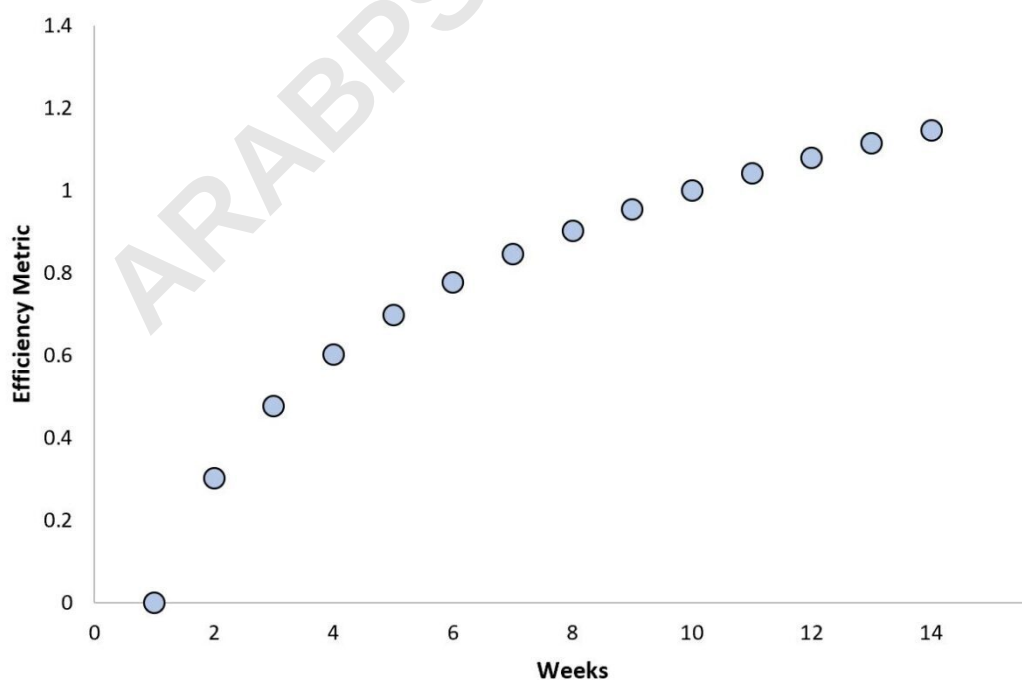
During the first few years of growth, a bamboo plant grows very slowly but once it reaches a certain age it explodes in height and grows at a rapid pace.

Example 4: Logarithmic Relationships

Another common nonlinear relationship in the real world is a logarithmic relationship between variables.

When plotted on a scatterplot, this relationship exhibits a single curve that becomes less pronounced as the variable on the x-axis increases.

One example of a logarithmic relationship is between the efficiency of smart-home technologies and time:



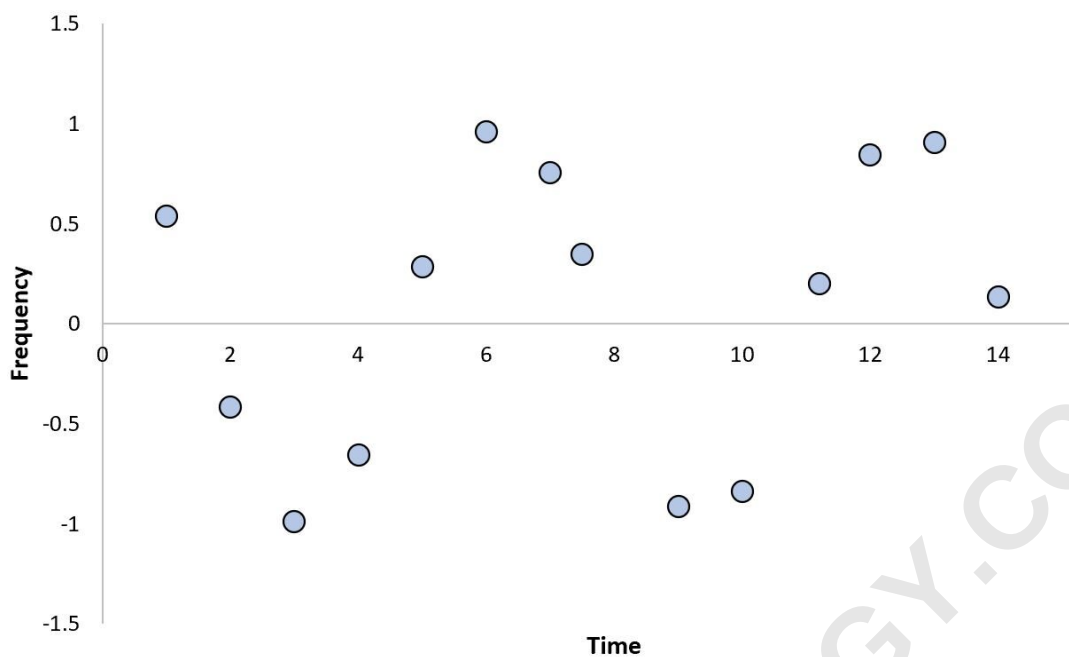
When a new smart-home technology (like a self-operating vacuum or self-operating AC unit) is installed in a home, it learns rapidly how to become more efficient, but then once it reaches a certain point it hits a maximum threshold in efficiency.

Example 5: Cosine Relationships

Another common nonlinear relationship in the real world is a cosine relationship between variables.

When plotted on a scatterplot, this relationship exhibits a "wave" shape.

One example of a cosine relationship is between the frequency of sound waves and time:



Notice how the relationship exhibits a "wave" shape, which is highly nonlinear.

Additional Resources

The following tutorials explain how to perform different types of nonlinear regression in Excel: