

# What is Curvilinear Regression? (Definition & Examples)

Authored by  
**stats writer**

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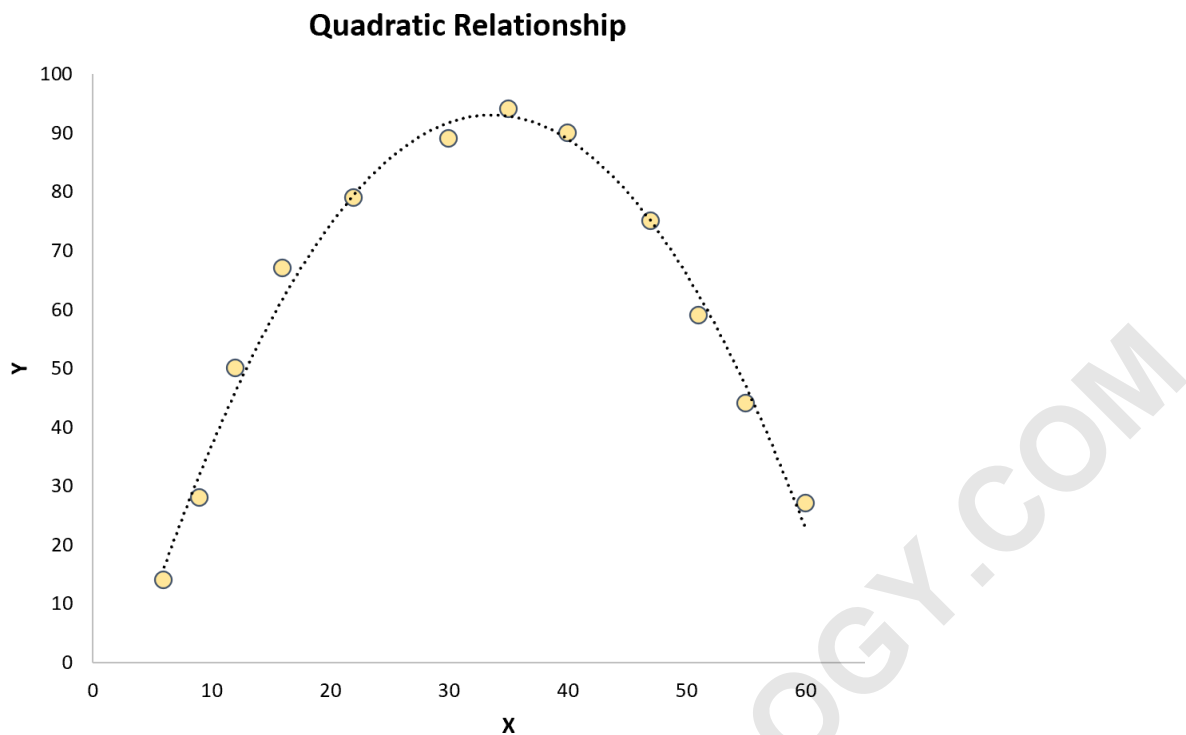
Curvilinear regression is a statistical method used to analyze relationships between variables that do not follow a linear pattern. It involves fitting a curved line to a scatter plot of data points, rather than a straight line. This allows for the detection and prediction of nonlinear relationships between variables. Examples of curvilinear relationships include parabolic, exponential, and logarithmic relationships. This type of regression is commonly used in fields such as economics, psychology, and biology to understand complex relationships between variables.

## What is Curvilinear Regression? (Definition & Examples)

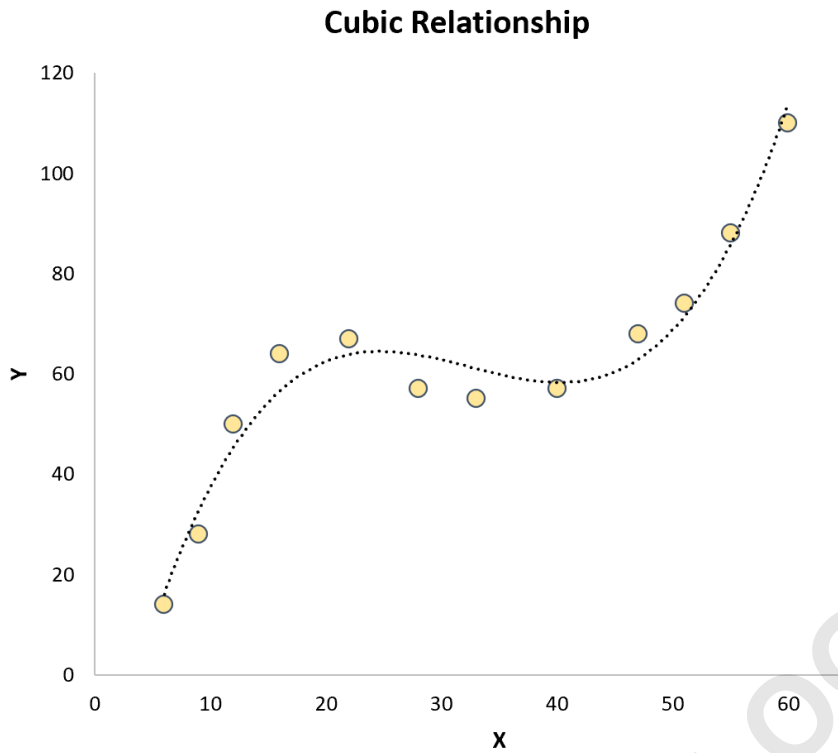
**Curvilinear regression is the name given to any regression model that attempts to fit a *curve* as opposed to a straight line.**

**Common examples of curvilinear regression models include:**

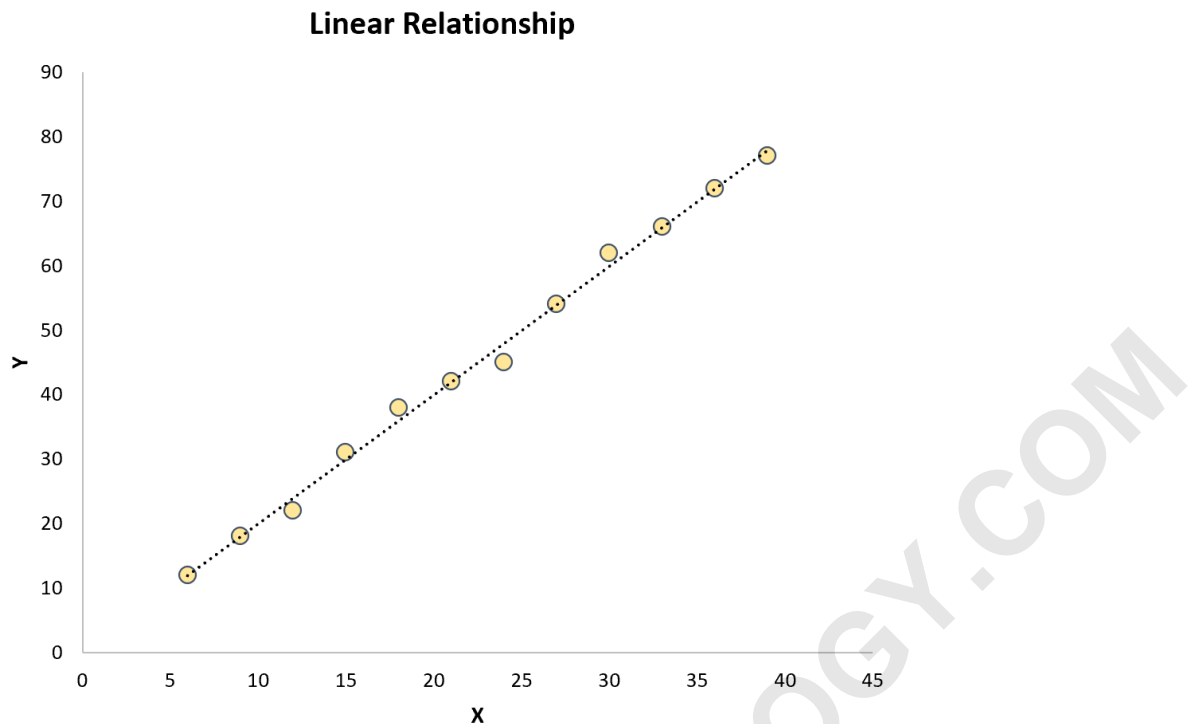
**Quadratic Regression: Used when a quadratic relationship exists between a predictor variable and a . When graphed, this type of relationship looks like a "U" or an upside-down "U" on a scatterplot:**



**Cubic Regression:** Used when a cubic relationship exists between a predictor variable and a response variable. When graphed, this type of relationship has two distinct curves on a scatterplot:



**These are both in contrast to in which the relationship between the predictor variable and the response variable is linear:**



### The Formula of Curvilinear Regression Models

**A simple linear regression model attempts to fit a dataset using the following formula:**

$$Y = \beta_0 + \beta_1 X$$

**where:**

**Y:** The response variable  
 **$\beta_0$ ,  $\beta_1$ :** The regression coefficients  
**X:** The predictor variable

**In contrast, a quadratic regression model uses the following formula:**

$$y = \beta_0 + \beta_1x + \beta_2x^2$$

And a cubic regression model uses the following formula:

$$y = \beta_0 + \beta_1x + \beta_2x^2 + \beta_3x^3$$

$$y = \beta_0 + \beta_1x + \beta_2x^2 + \dots + \beta_kx^k$$

The value for  $k$  indicates the degree of the polynomial. Although the degree can be any positive number, in practice we rarely fit polynomial regression models with a degree higher than 3 or 4.

By using exponents in the regression model formula, polynomial regression models are able to fit *curves* to datasets instead of straight lines.

#### When to Use Curvilinear Regression

The easiest way to know whether or not you should use curvilinear regression is to create a scatterplot of the predictor variable and response variable.

If the scatterplot displays a linear relationship between the two variables, then simple linear regression is likely appropriate to use.

However, if the scatterplot shows a quadratic, cubic, or some other curvilinear pattern between the predictor and response variable, then curvilinear regression is likely more appropriate to use.

You can also fit a simple linear regression model and a curvilinear regression model and compare the adjusted R-squared values of each model to determine which model offers a better fit to the data.

The adjusted R-squared is useful because it tells you the proportion of the variance in the response variable that can be explained by the predictor variable(s), adjusted for the number of predictor variables in the model.

In general, the model with the higher adjusted R-squared value offers a better fit to the dataset.

The following tutorials explain how to perform polynomial regression in different statistical software: