

POLYNOMIAL REGRESSION

Polynomial regression is a kind of linear regression in which the relationship shared between the dependent and independent variables Y and X is modeled as the nth degree of the polynomial. This is done to look for the best way of drawing a line using data points.

In statistics, polynomial regression is a form of regression analysis in which the relationship between the independent variable x and the dependent variable y is modelled as an nth degree polynomial in x.

The equation of the polynomial regression having an nth degree can be written as:

$$y = b_0 + b_1x_1 + b_2x_1^2 + b_3x_1^3 + \dots + b_nx_1^n$$

y: Dependent Variable

x_1 : Independent Variable

b1, b2, b3: Coefficients

n: Number of observations

Although this model allows for a nonlinear relationship between Y and X, polynomial regression is still considered linear regression since it is linear in the regression coefficients.

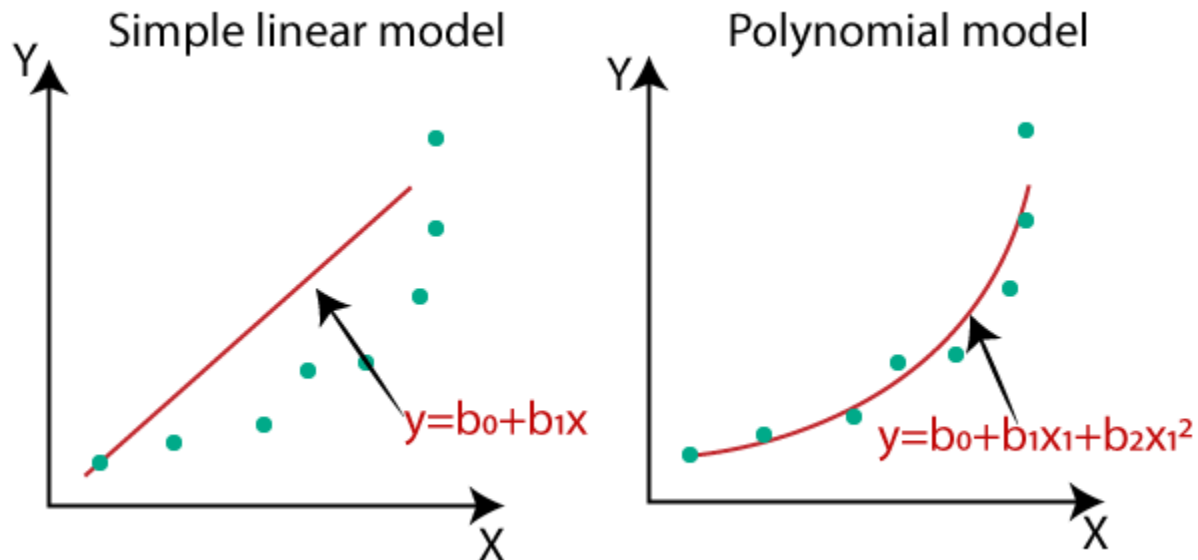
Need for Polynomial Regression:

The need of Polynomial Regression in ML can be understood in the below points:

- If we apply a linear model on a **linear dataset**, then it provides us a good result as we have seen in Simple Linear Regression, but if we apply the same model without any modification on a **non-linear dataset**, then it will produce a drastic output. Due to which loss

function will increase, the error rate will be high, and accuracy will be decreased.

- So for such cases, **where data points are arranged in a non-linear fashion, we need the Polynomial Regression model.** We can understand it in a better way using the below comparison diagram of the linear dataset and non-linear dataset.



- In the above image, we have taken a dataset which is arranged non-linearly. So if we try to cover it with a linear model, then we can clearly see that it hardly covers any data point. On the other hand, a curve is suitable to cover most of the data points, which is of the Polynomial model.
- Hence, if the datasets are arranged in a non-linear fashion, then we should use the Polynomial Regression model instead of Simple Linear Regression.

Advantages of using Polynomial Regression:

- Polynomial provides the best approximation of the relationship between the dependent and independent variable.
- A Broad range of function can be fit under it.

- Polynomial basically fits a wide range of curvature.

Disadvantages of Polynomial Regression:

One or two outliers in the data might have a significant impact on the nonlinear analysis' outcomes. These are overly reliant on outliers. Furthermore, there are fewer model validation methods for detecting outliers in nonlinear regression than there are for linear regression.

Applications of Polynomial Regression:

- It is used to study the isotopes of the sediments.
- It is widely applied to predict the spread rate of COVID-19 and other infectious diseases
- It is used to study the rise of different diseases within any population.
- It is used to study the generation of any synthesis.

Conclusion:

Polynomial Regression is used in many organizations when they identify a nonlinear relationship between the independent and dependent variables. It is one of the difficult regression techniques as compared to other regression methods, so having in-depth knowledge about the approach and algorithm will help you to achieve better results.

