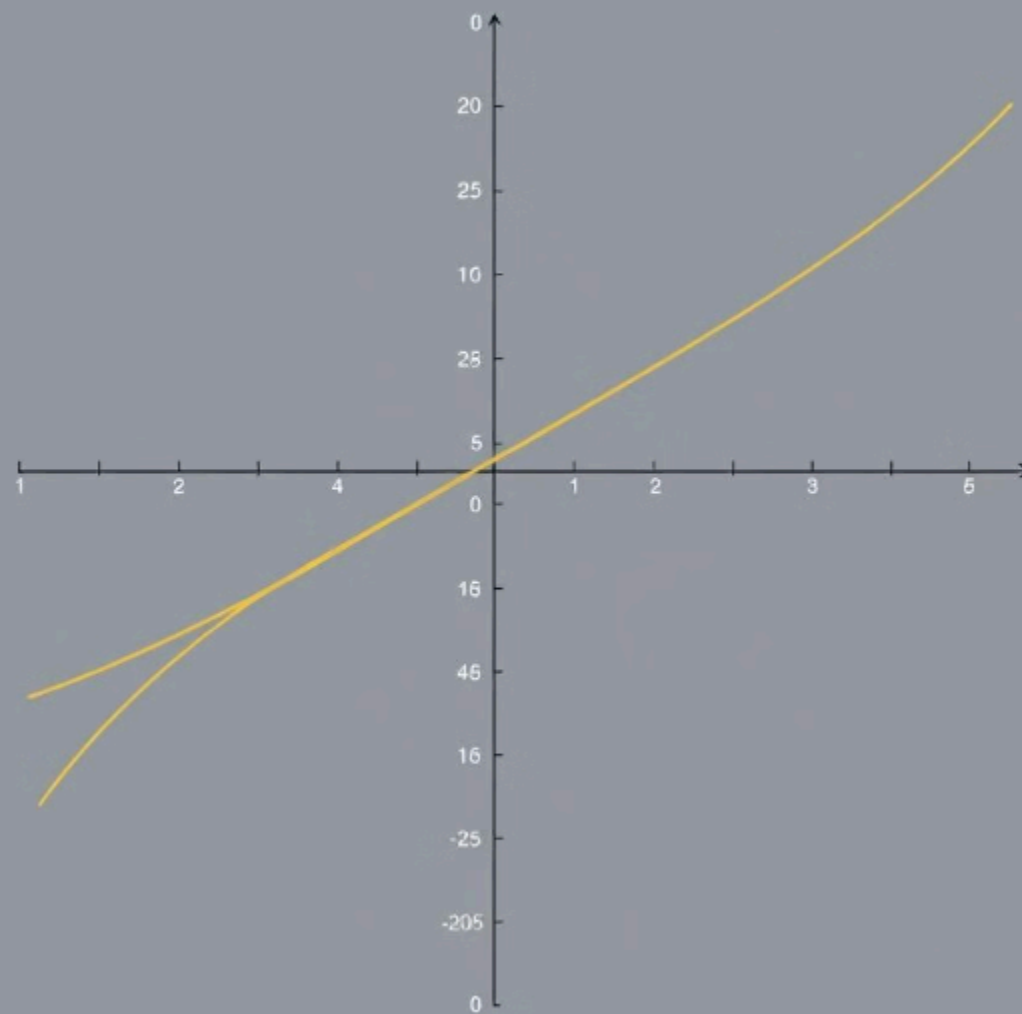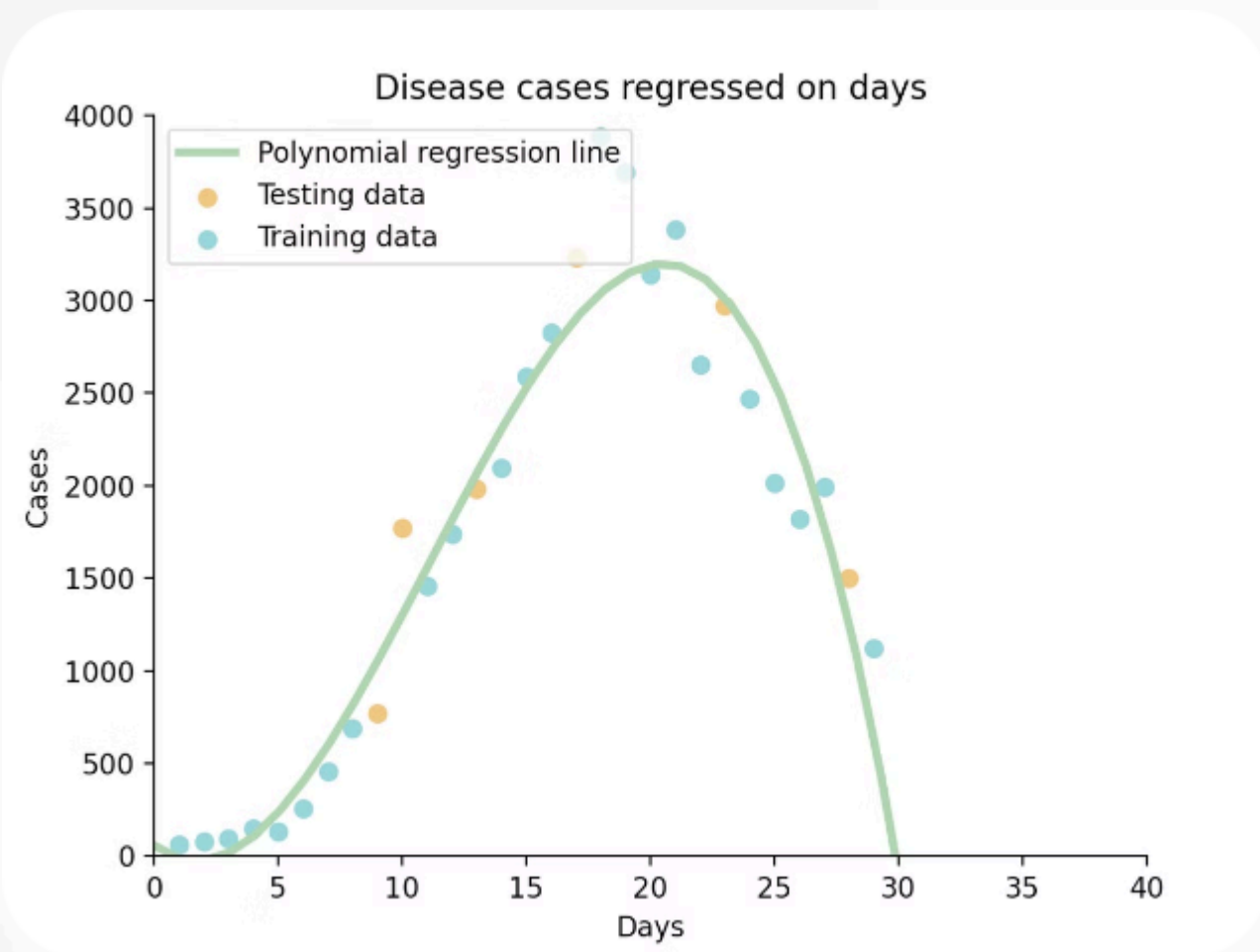# Polynomial Regression

Polynomial Regression is a form of regression analysis that models the relationship between a dependent variable and one or more independent variables as an nth-degree polynomial, allowing it to capture non-linear patterns in the data.

Manoj Kumar Sahoo

Equation of Polynomial Regression

Disease cases regressed on days

The equation for polynomial regression is a linear combination of polynomial terms. For example, a second-degree polynomial regression equation takes the form: y = b0 + b1*x + b2*x^2.

Linear Term

b1*x represents a linear relationship between the dependent and independent variables.

Quadratic Term

b2*x^2 represents a quadratic relationship between the dependent and independent variables.

Disease cases regressed on days

Degree of the Polynomial

The degree of the polynomial determines the complexity of the model. A higher degree polynomial can capture more complex relationships between variables but may also lead to overfitting.
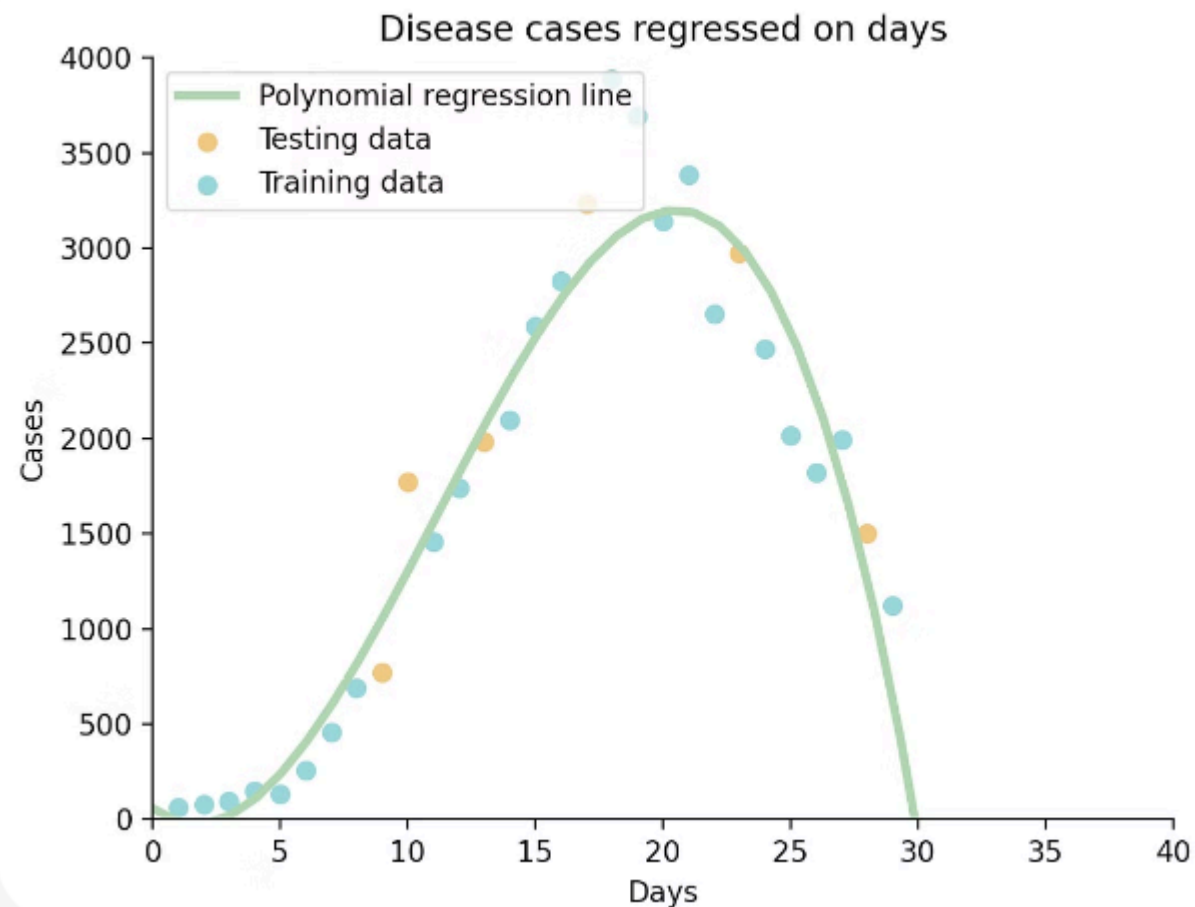
1

First Degree

Represents a linear relationship, similar to linear regression.

2

Second Degree

Represents a quadratic relationship, often used to capture curved relationships.

3

Third Degree

Represents a cubic relationship, used for even more complex curves.

Overfitting in Polynomial Regression

Overfitting occurs when a model fits the training data too well, but fails to generalize to new data. This can happen when using a high-degree polynomial for a small dataset.

Training Data

The model fits the training data very well, capturing all the noise and fluctuations.

New Data

The model performs poorly on new data because it has learned the specific patterns of the training data rather than general trends.

Feature Transformation

Feature transformation involves creating new features from existing ones. This can be helpful in polynomial regression to create non-linear features and improve model performance.
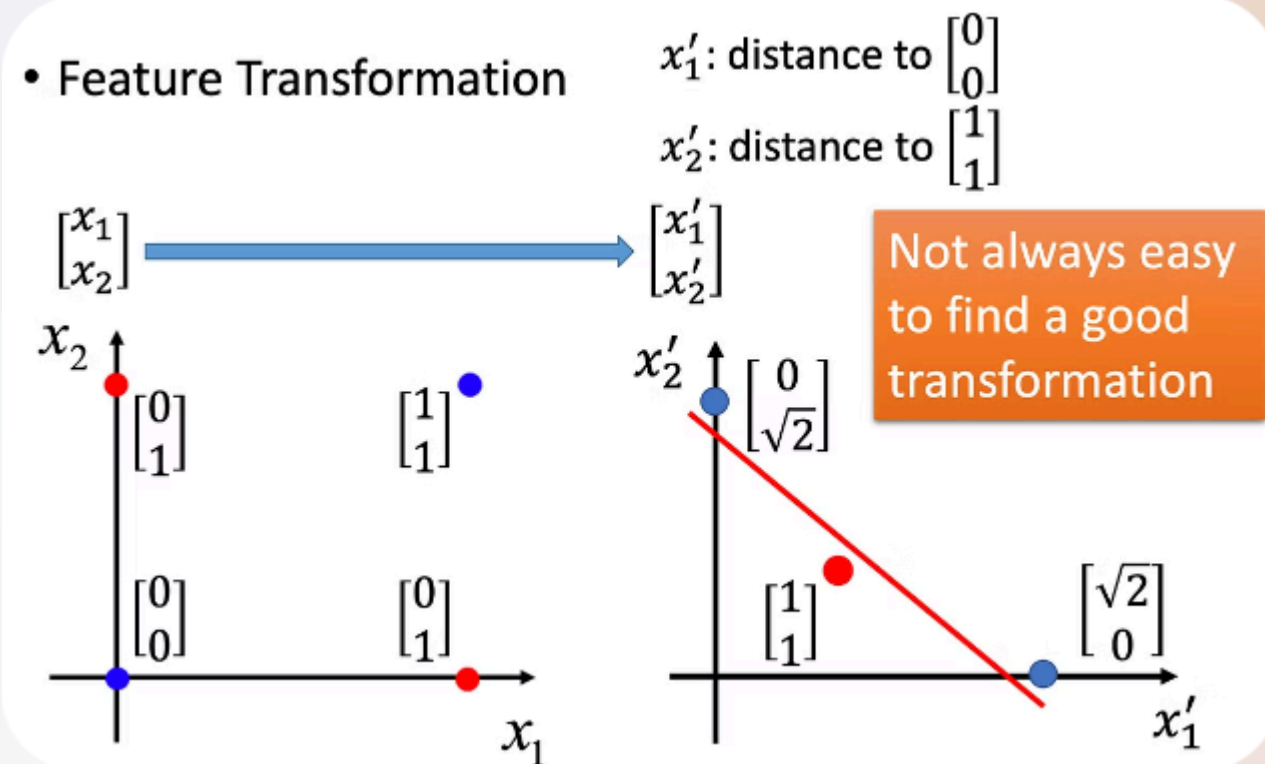
1 **Polynomial Features**

Adding polynomial terms to the features creates non-linear relationships, allowing the model to capture more complex patterns.

2 **Interaction Terms**

Multiplying two existing features creates a new feature that captures the interaction between them.

Applications of Polynomial Regression

Polynomial regression has numerous applications across various fields. It is commonly used for predicting, forecasting, and modeling complex relationships between variables.

Economics

1

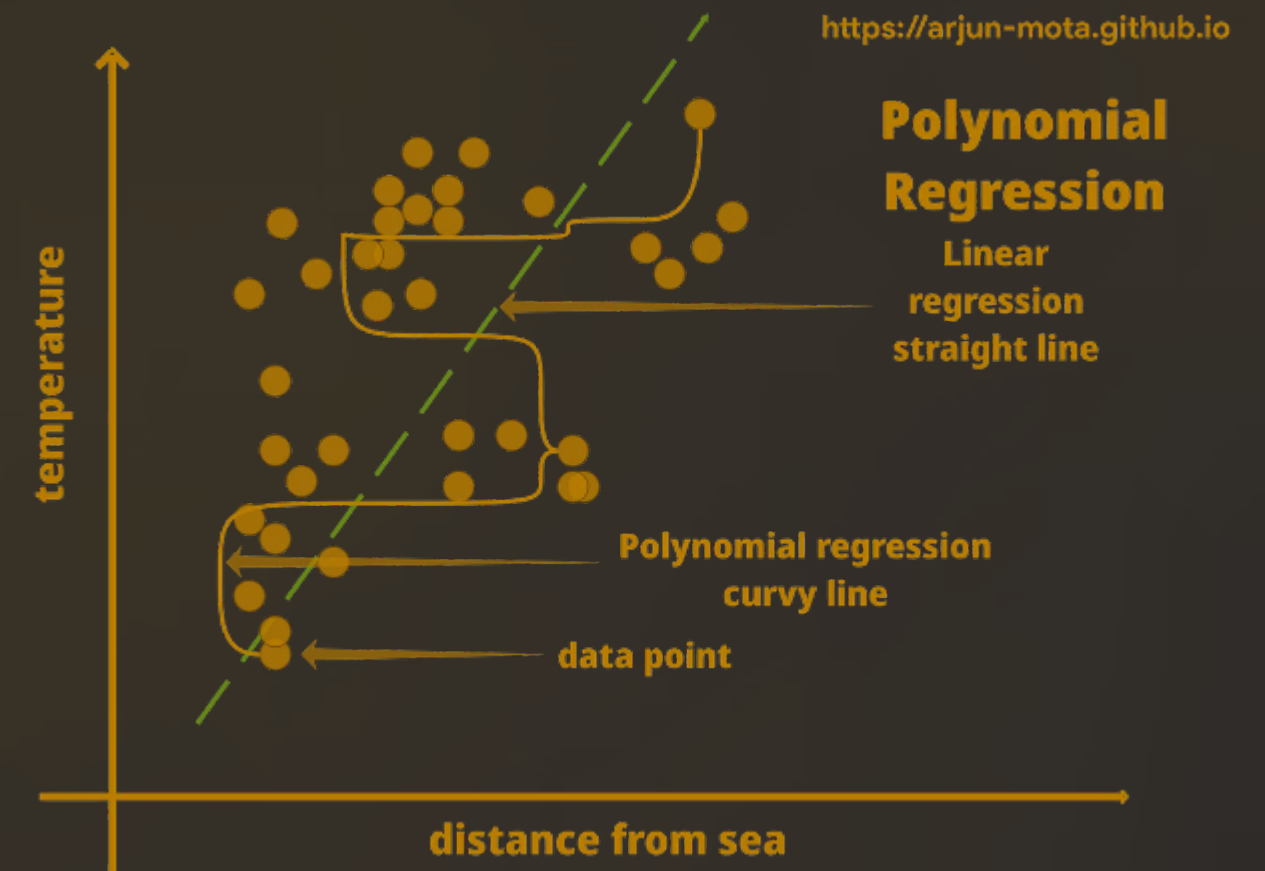Predicting the relationship between variables like inflation and unemployment.

Finance

2

Modeling stock market trends and pricing derivatives.

Engineering

3

Optimizing the design and performance of systems and structures.

Conclusion

Polynomial Regression is a powerful and versatile technique for modeling non-linear relationships between variables. By understanding the concepts of overfitting and feature transformation, practitioners can effectively use polynomial regression to solve a wide range of real-world problems.

Data Analysis

Polynomial regression is a valuable tool for analyzing and understanding data relationships.

Prediction

It can be used to make accurate predictions based on past data.

Model Building

It helps build robust and reliable models for various applications.