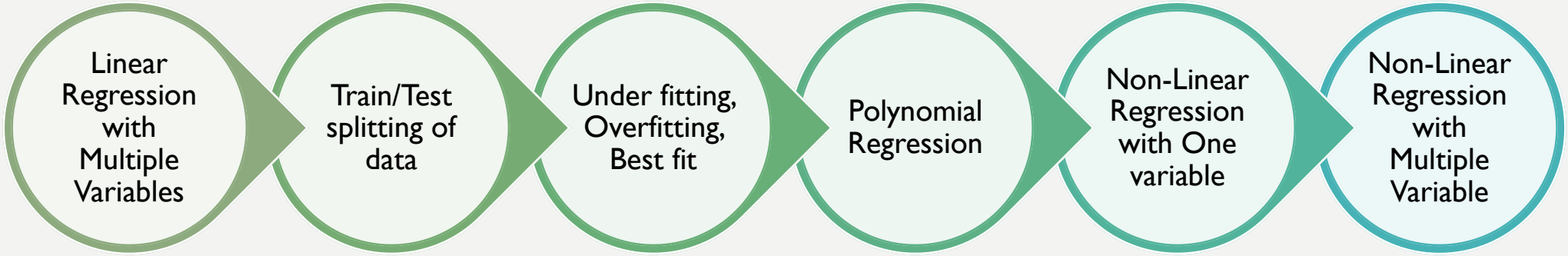
# POLYNOMIAL REGRESSION

# DAY3 AGENDA

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# NON LINEAR REGRESSION

It is a special type of multiple regression whose independent variables are powers of a single variable X. It is used to approximate a curve with unknown functional form.

$$Y_i = \alpha + \beta_1 X + \beta_2 X^2 + \ldots + \beta_k X^k + \varepsilon_i$$

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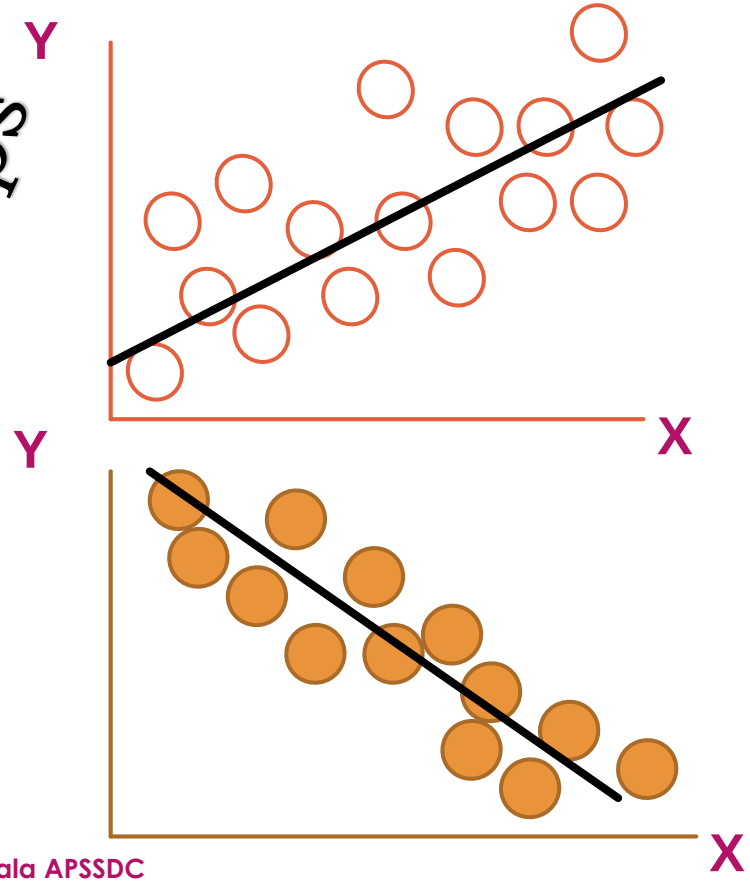
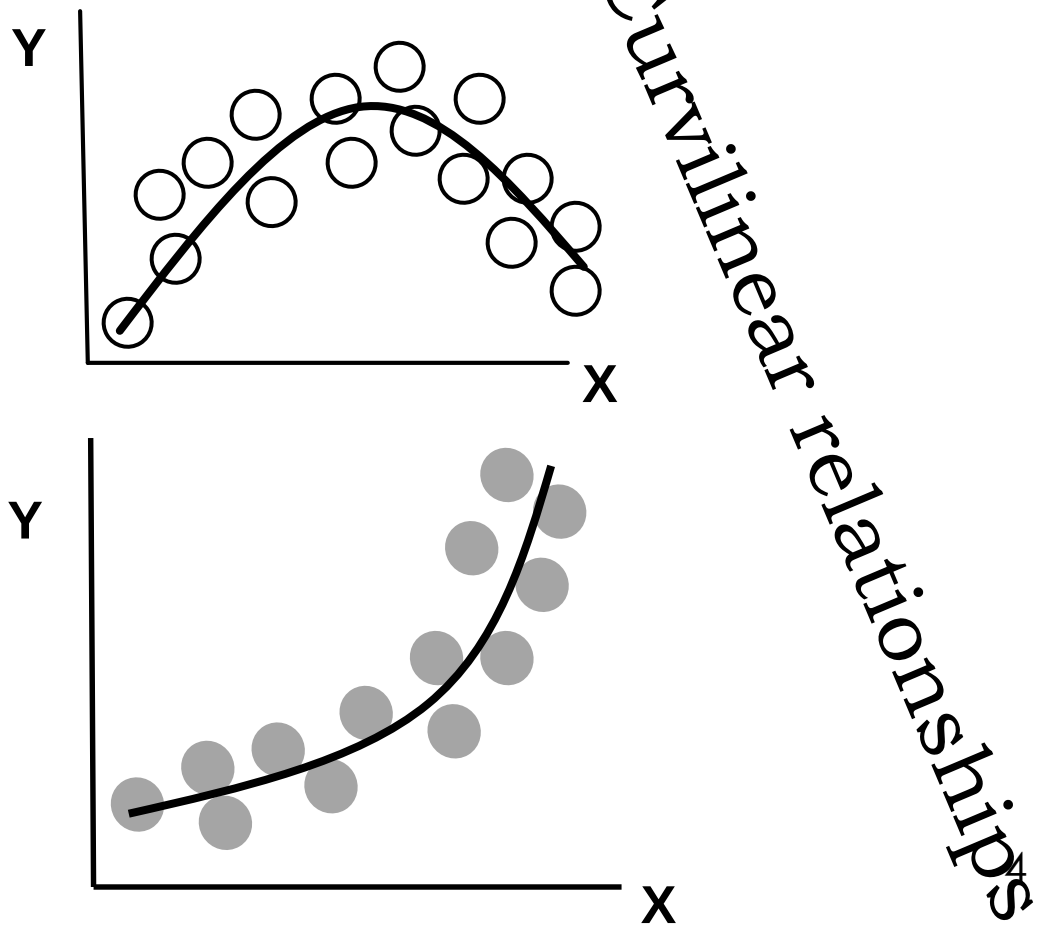
# Linear Correlation

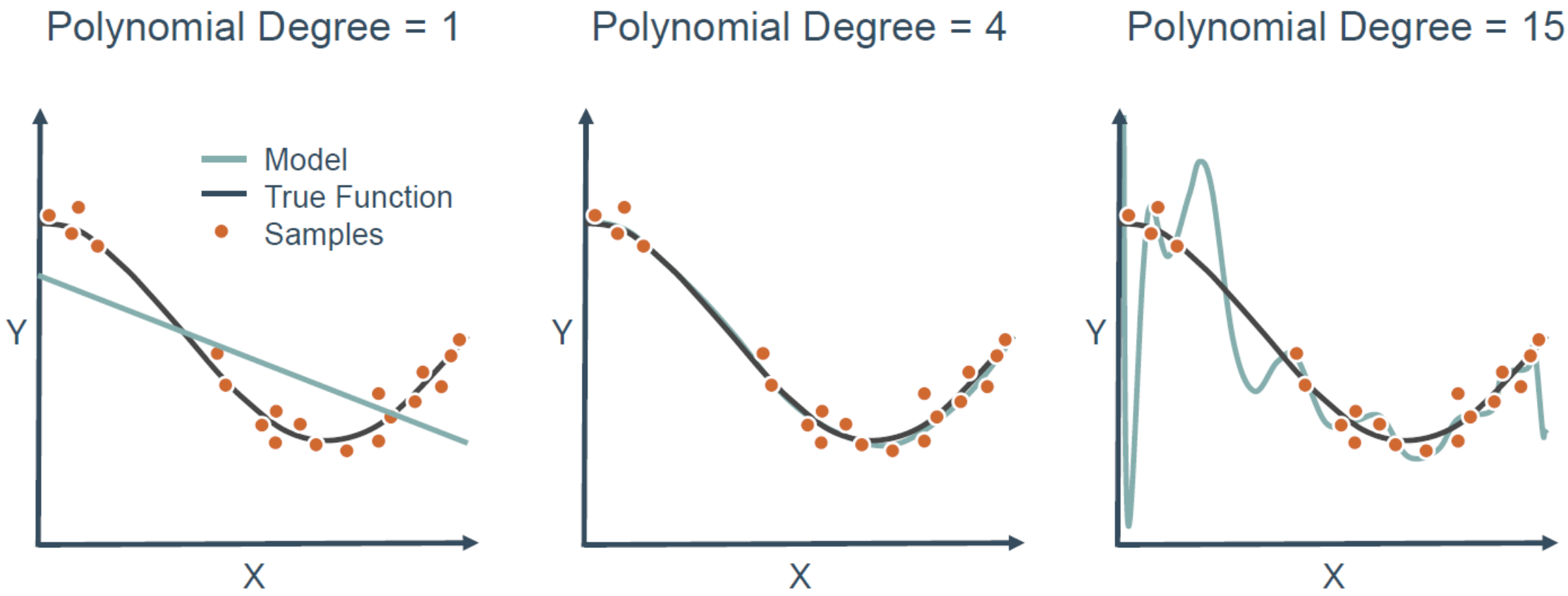
Linear relationships




Curvilinear relationships



# CHOOSING BETWEEN DIFFERENT COMPLEXITIES

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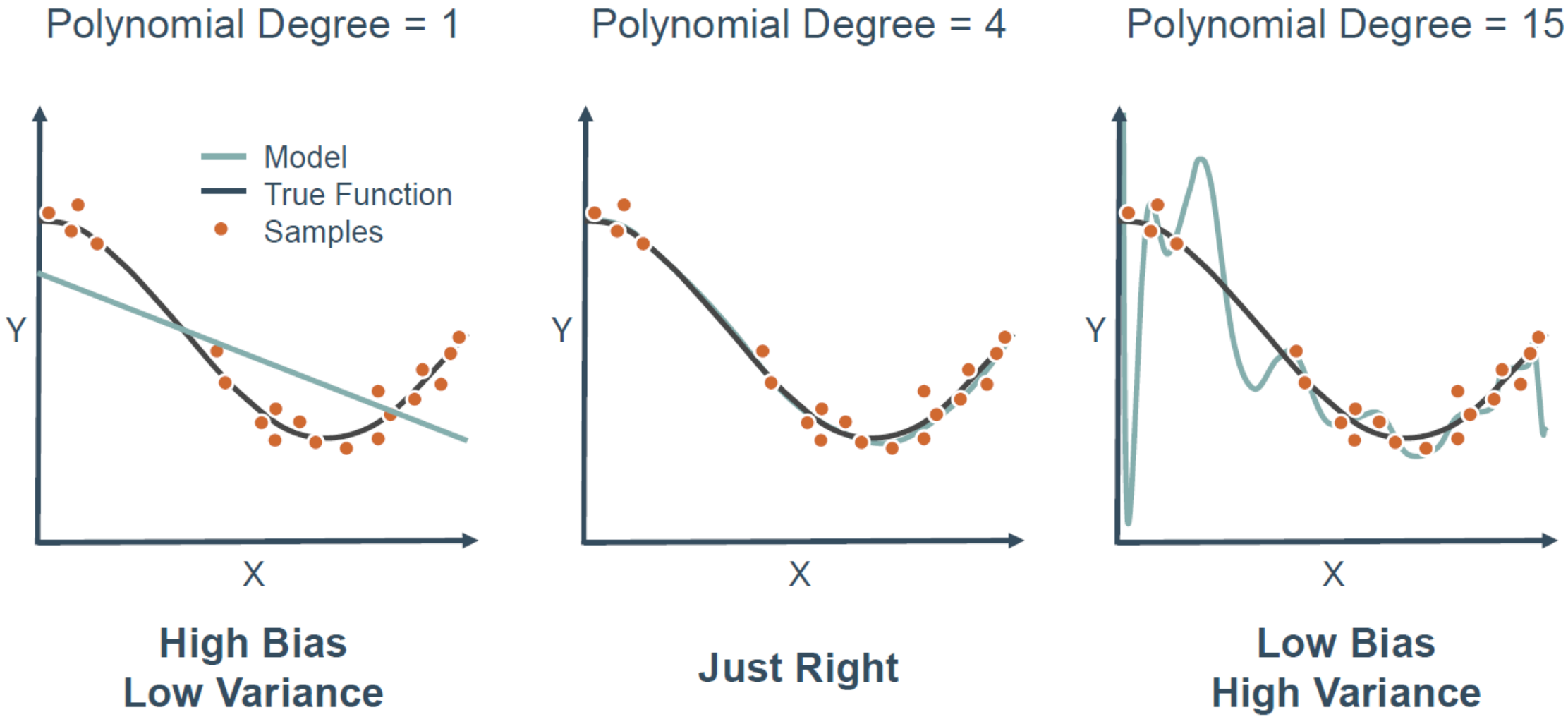
# BIAS–VARIANCE TRADEOFF

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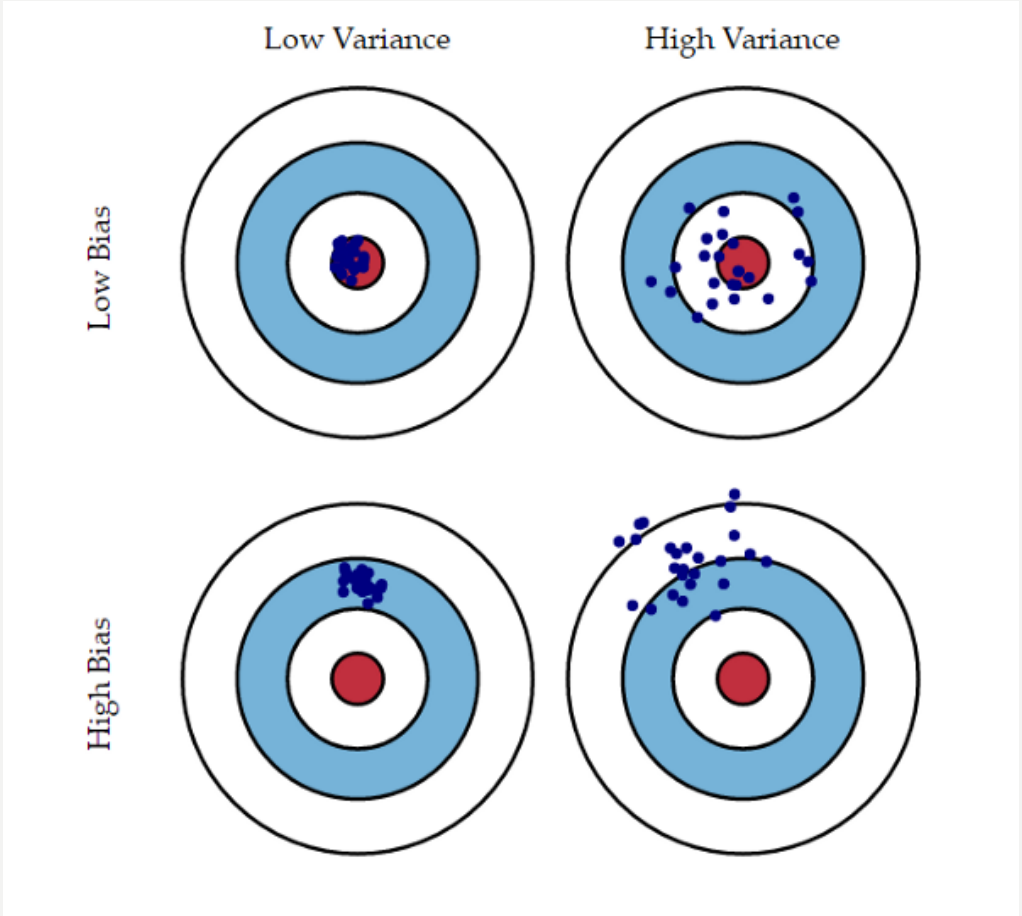
# What is bias and variance?

Bias is the difference between the average prediction of our model and the correct value which we are trying to predict. Model with high bias pays very little attention to the training data and oversimplifies the model. It always leads to high error on training and test data.

Variance is the variability of model prediction for a given data point or a value which tells us spread of our data. Model with high variance pays a lot of attention to training data and does not generalize on the data which it hasn't seen before. As a result, such models perform very well on training data but has high error rates on test data.

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# UNDERFITTING

In supervised learning, **underfitting** happens when a model unable to capture the underlying pattern of the data. These models usually have high bias and low variance. It happens when we have very less amount of data to build an accurate model or when we try to build a linear model with a nonlinear data.

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# OVER FITTING VS UNDER FITTING

- Under Fitting

- Over Fitting

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# Evaluation Metrics

## 1. Mean Absolute Error

$$MAE = \frac{1}{n}\sum \left| y - \hat{y} \right|$$

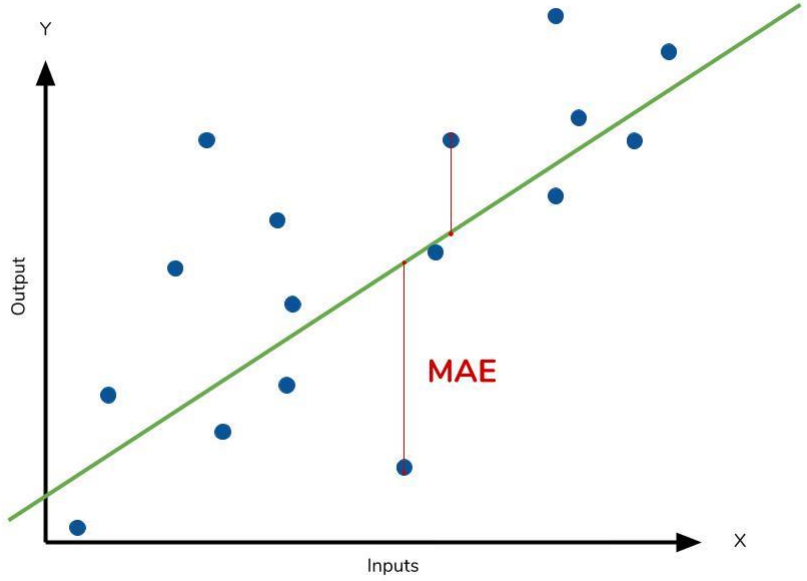
Divide by the total number of data points

Predicted output value

Actual output value

Sum of

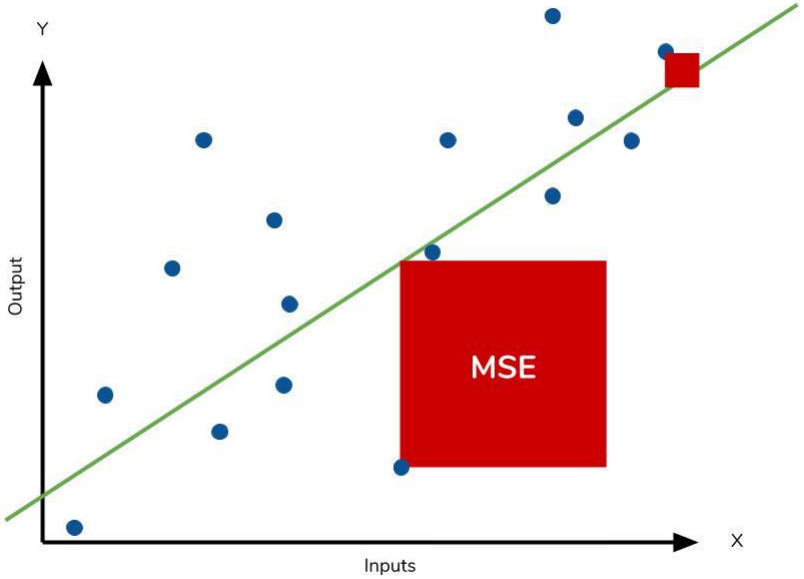
The absolute value of the residual



# Contd..

## 2. Mean Square Error

$$MSE = \frac{1}{n}\sum\underbrace{\left(y - \hat{y}\right)^2}_{\text{The square of the difference between actual and predicted}}$$



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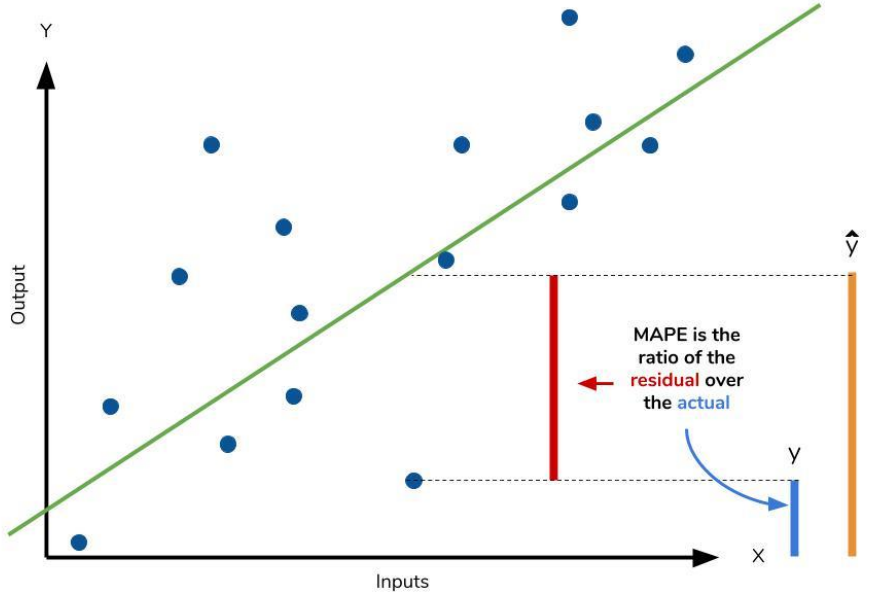
## 3. Mean Absolute Percentage Error

$$MAPE = \frac{100\%}{n} \sum \left| \frac{y - \hat{y}}{y} \right|$$

Multiplying by 100% converts to percentage

The residual

Each residual is scaled against the actual value



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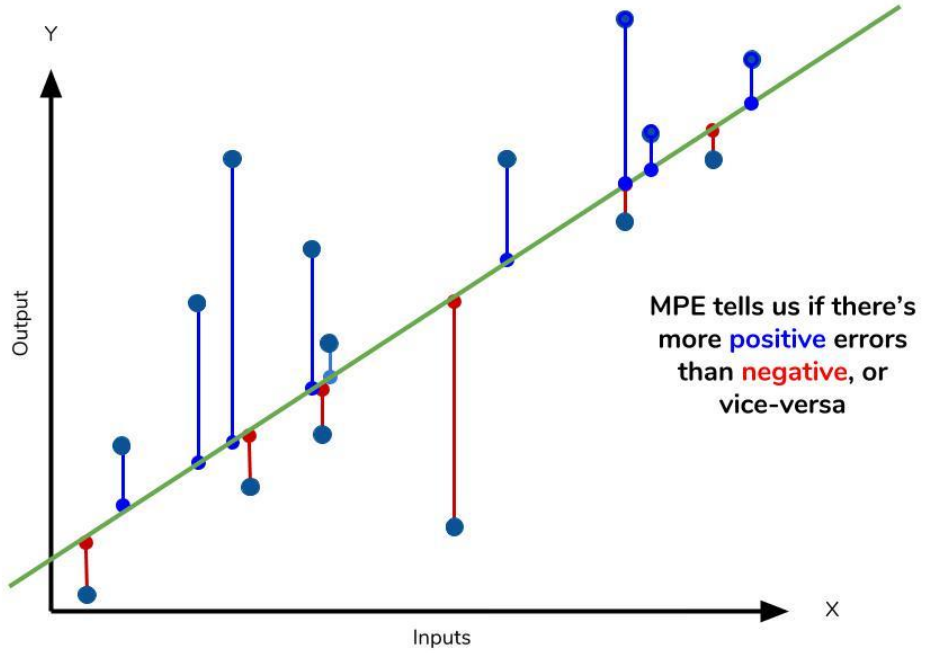
### 3. Mean Percentage Error

$$MPE = \frac{100\%}{n} \Sigma \left( \frac{y - \hat{y}}{y} \right)$$



# Conclusion

| Acroynm | Full Name | Residual Operation? | Robust To Outliers? |
|---|---|---|---|
| MAE | Mean Absolute Error | Absolute Value | Yes |
| MSE | Mean Squared Error | Square | No |
| RMSE | Root Mean Squared Error | Square | No |
| MAPE | Mean Absolute Percentage Error | Absolute Value | Yes |
| MPE | Mean Percentage Error | N/A | Yes |


https://www.dataquest.io/blog/understanding-regression-error-metrics/