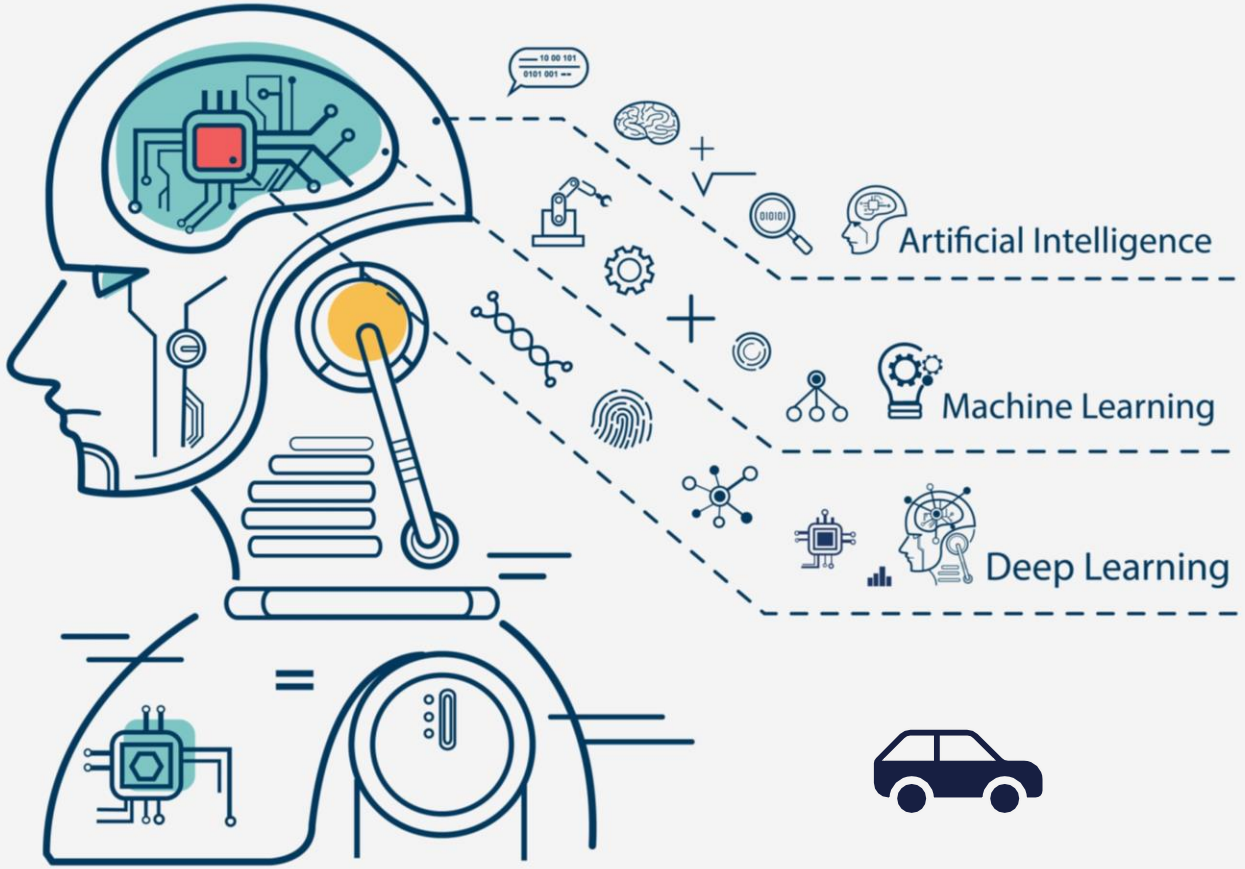
APSSDC

Andhra Pradesh State Skill Development Corporation

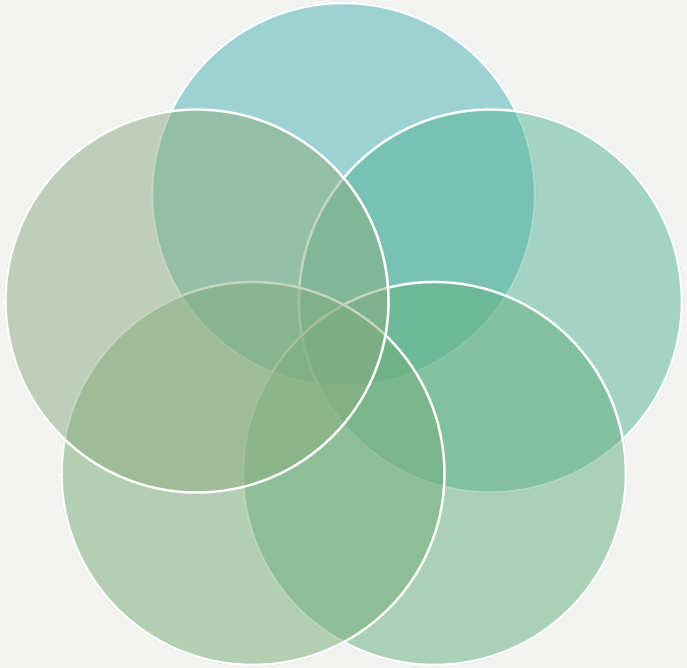


MACHINE LEARNING USING PYTHON

DAY2 AGENDA

Linear Regression with One variable

Linear Regression with Multiple Variables



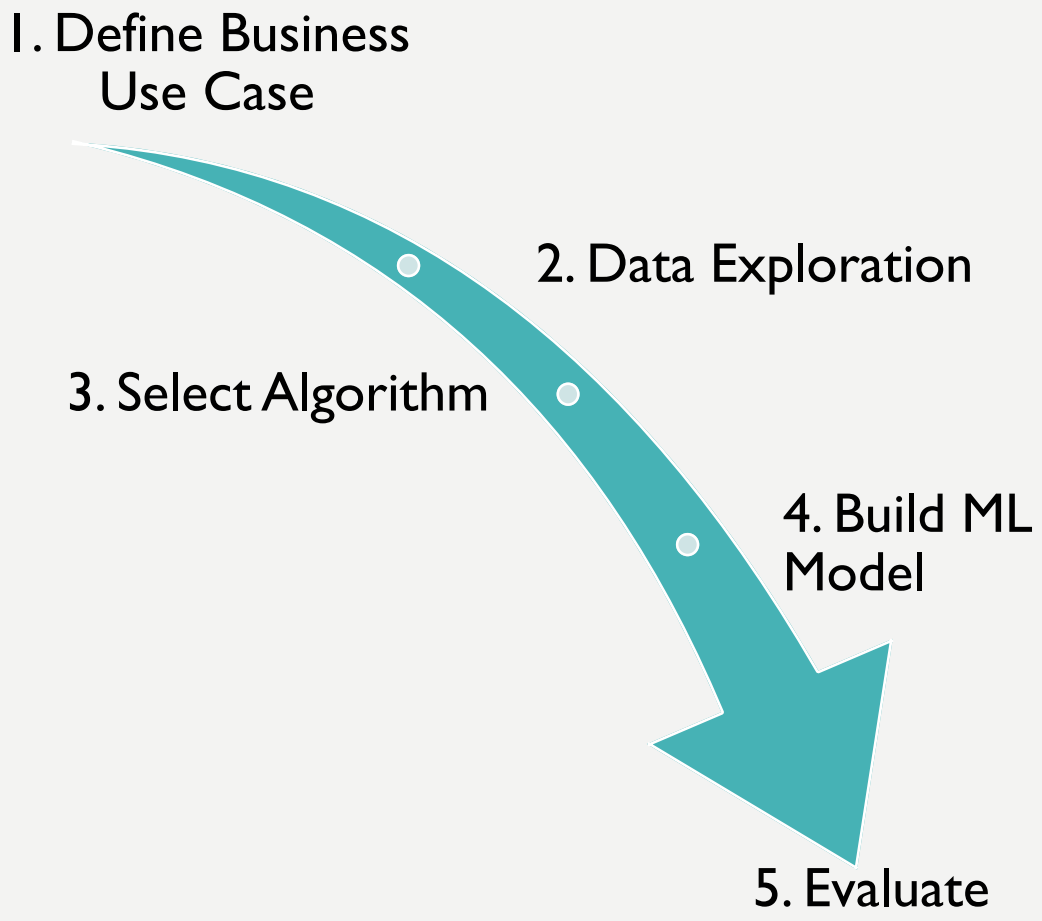
Evaluation Metrics in Regression Models

Cross Validation

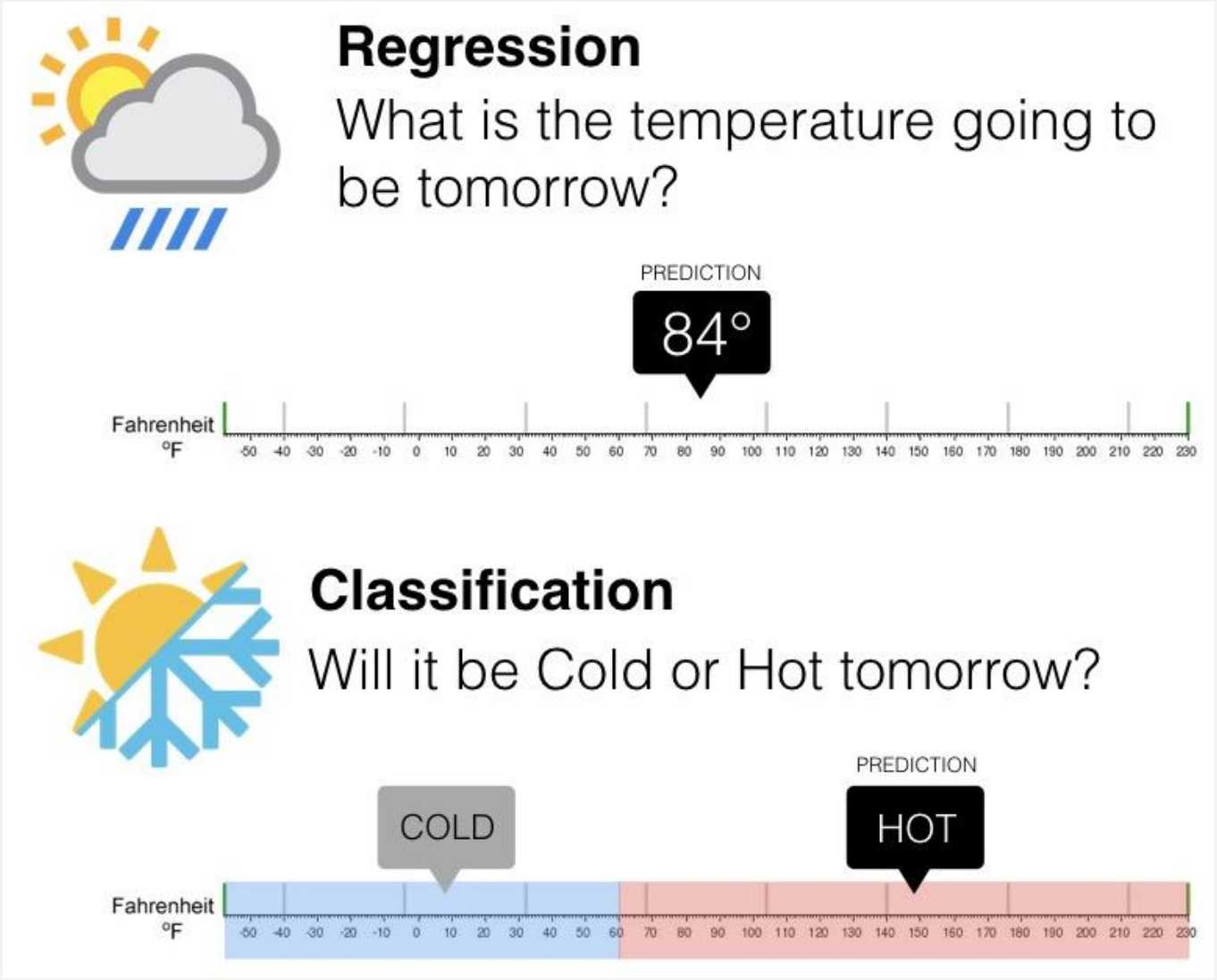
Train/Test splitting of data

- Regression
- Classification

ML MODEL DEVELOPMENT LIFE CYCLE



REGRESSION VS CLASSIFICATION



Linear Regression in Machine Learning

What is Regression?

- Function: a mathematical relationship enabling us to predict what values of one variable (Y) correspond to given values of another variable (X).
- Y: is referred to as the ***dependent variable***, **the *response variable* or the *predicted variable*.**
- X: is referred to as **the *independent variable***, the *explanatory variable* or the ***predictor variable***.

Thus Regression analysis is a form of predictive modelling technique which investigates the relationship between a dependent and independent variable.

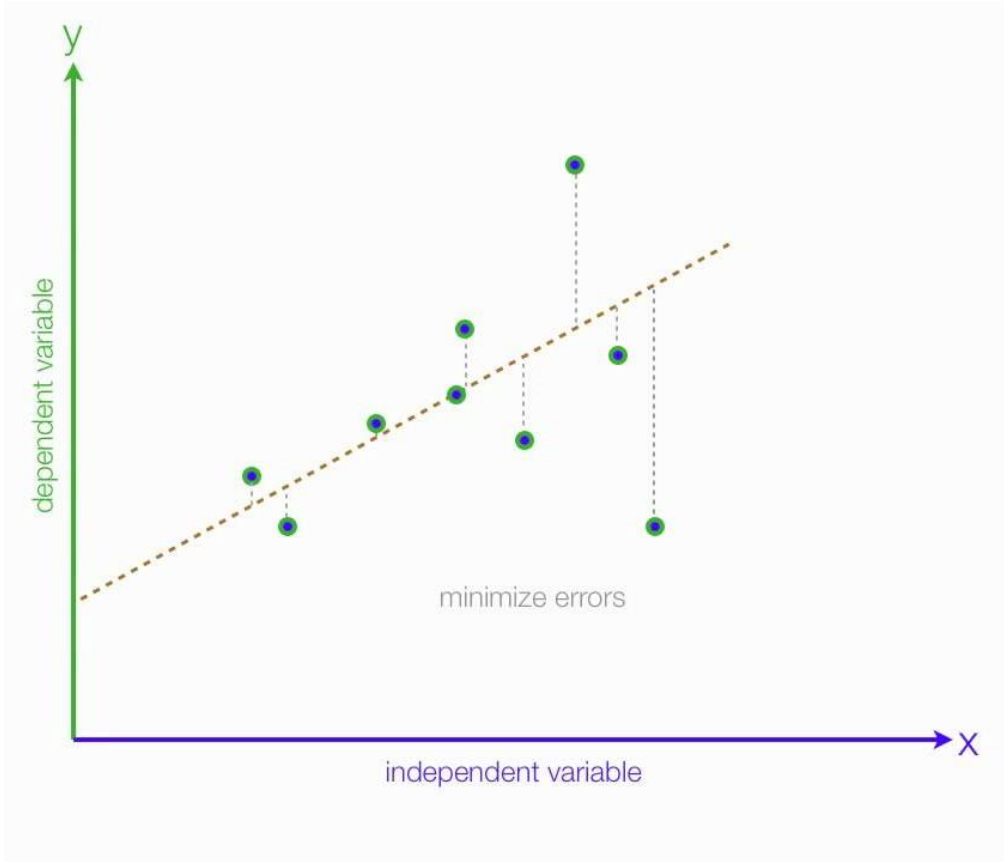
REGRESSION

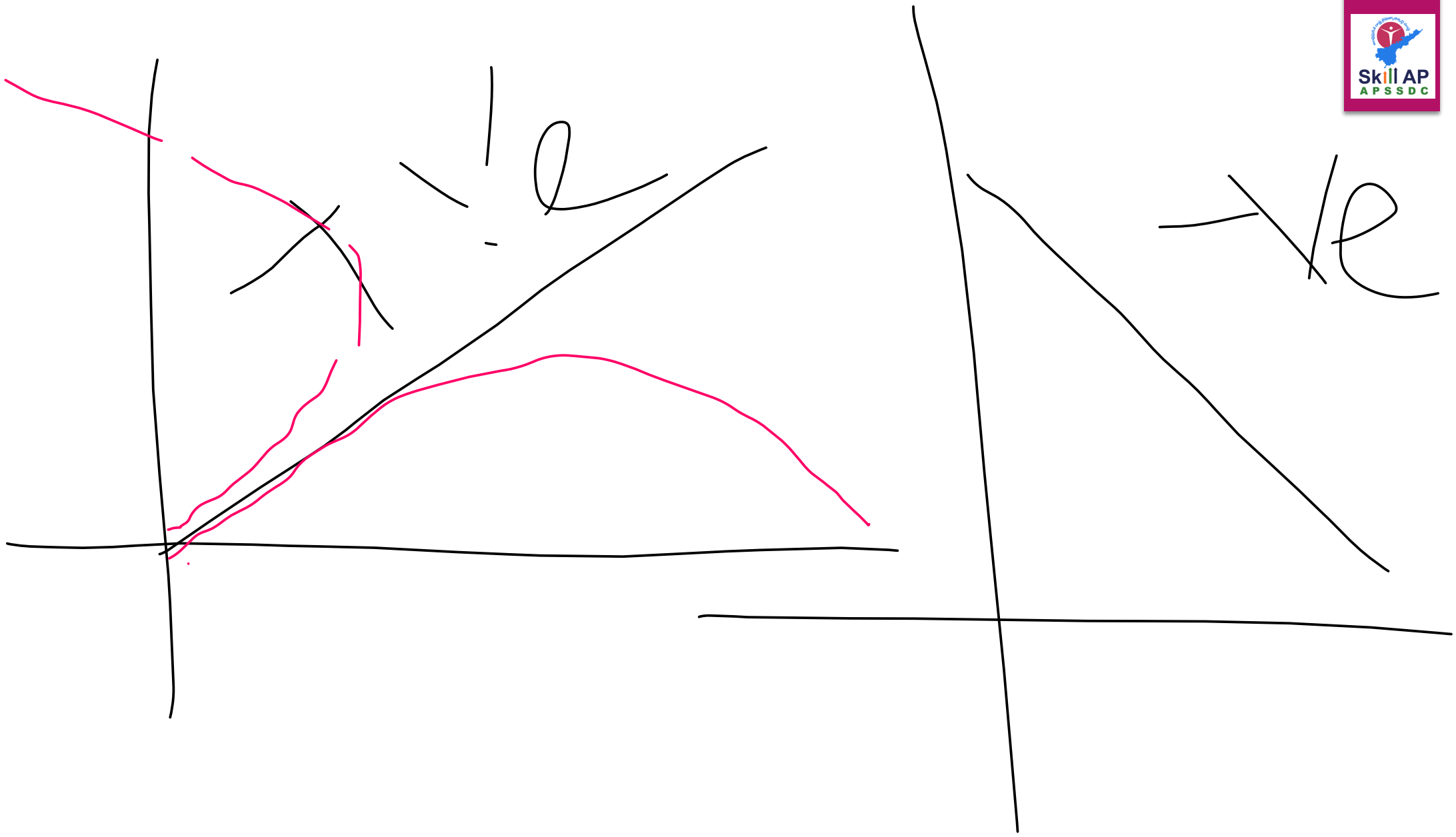
- **Linear Regression**
  - **Linear Regression with one variable**
  - **Linear Regression with multiple variable**
- Non-Linear Regression/Polynomial Regression
  - Non-Linear Regression with one variable
  - Non-Linear Regression with multiple variables
- SGD
- Ridge
- Lasso
- Elastic Net

Contd.

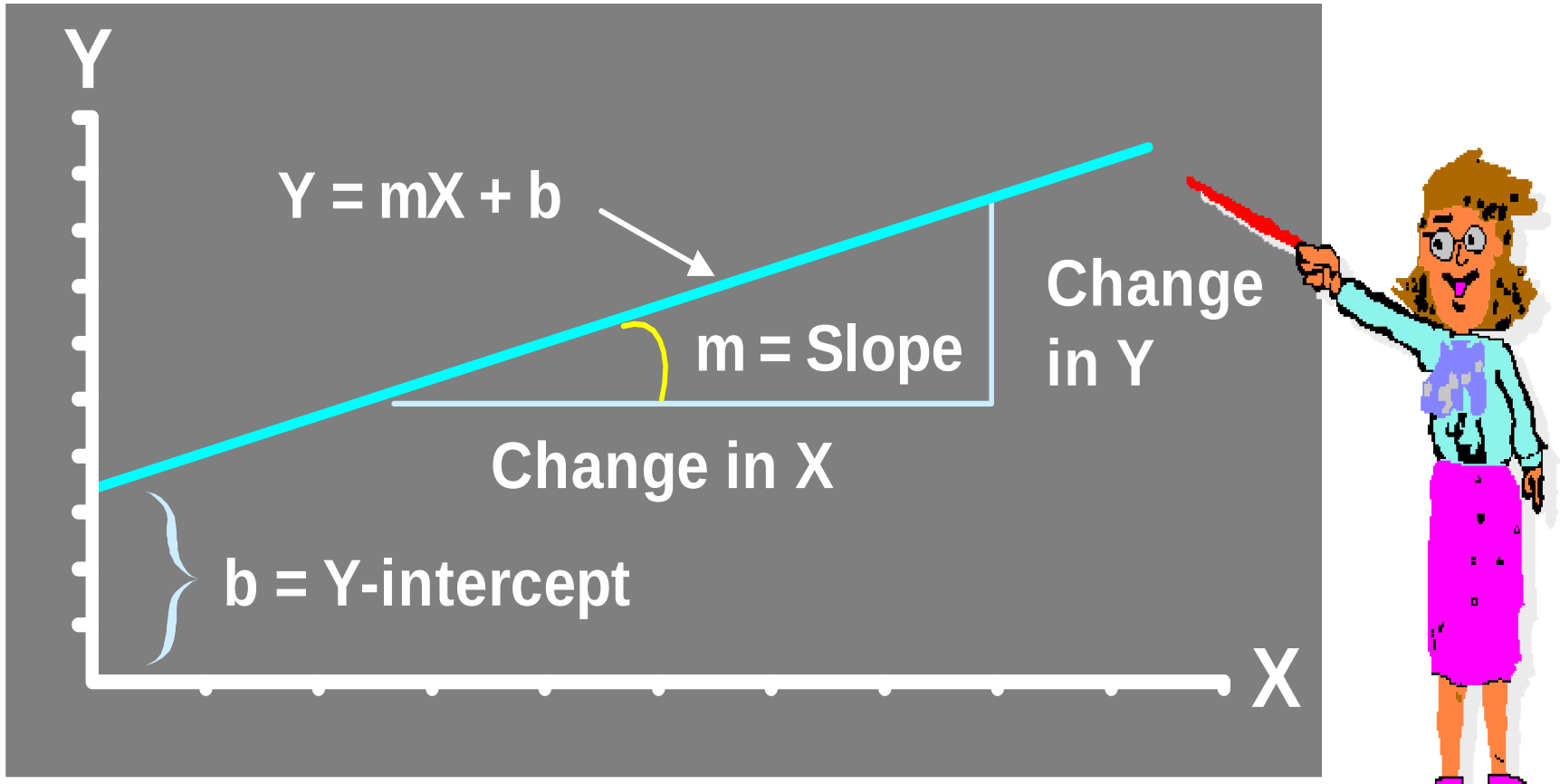
A typical Linear Regression model can be represented in the form :

y = b1x + b0 where b1 is slope and b0 is the intercept.




+ve
-ve

Linear Equations



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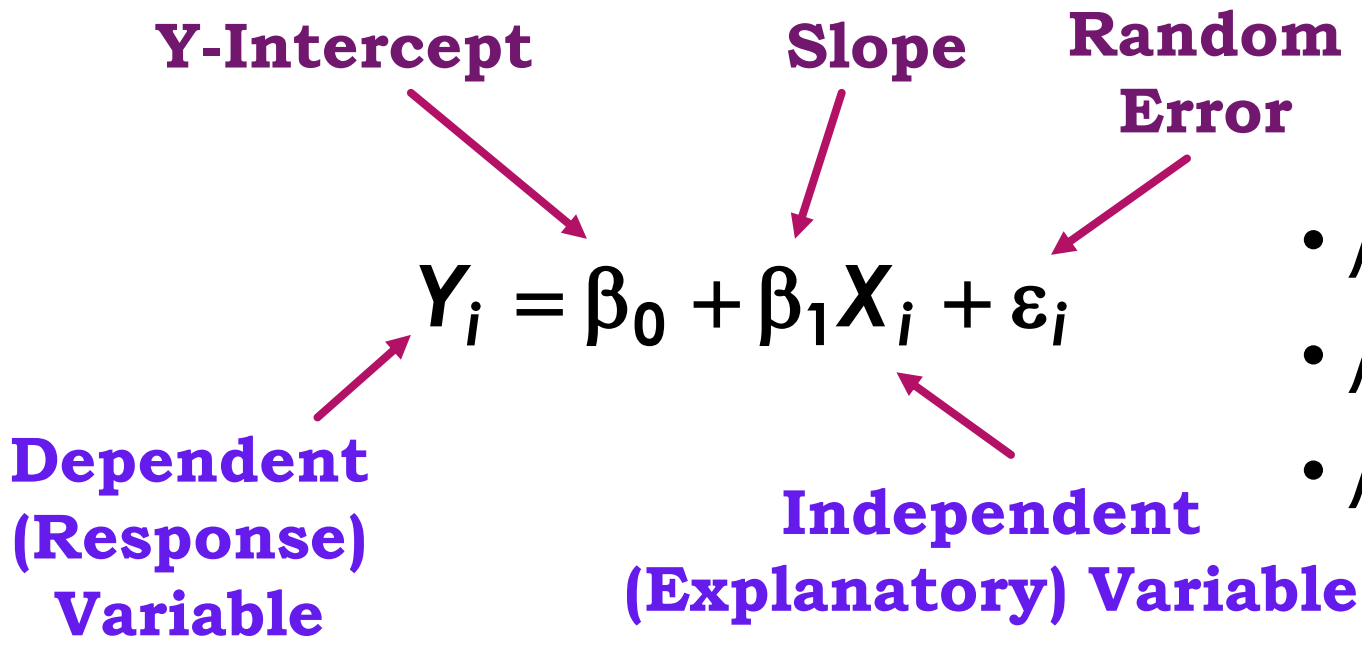
Linear Regression Model

Relationship Between Variables Is a Linear Function

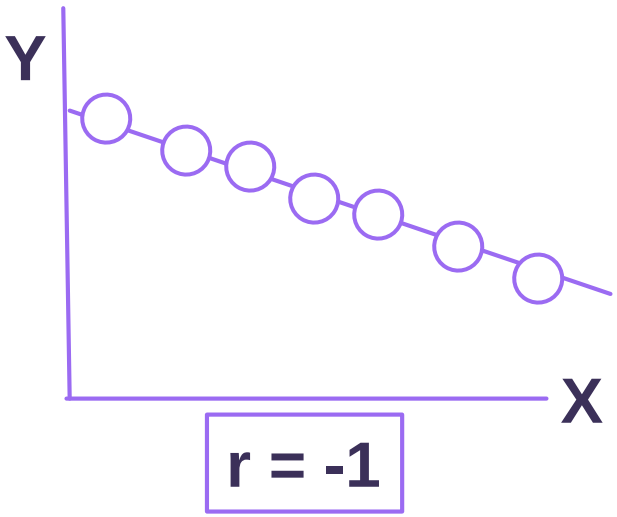


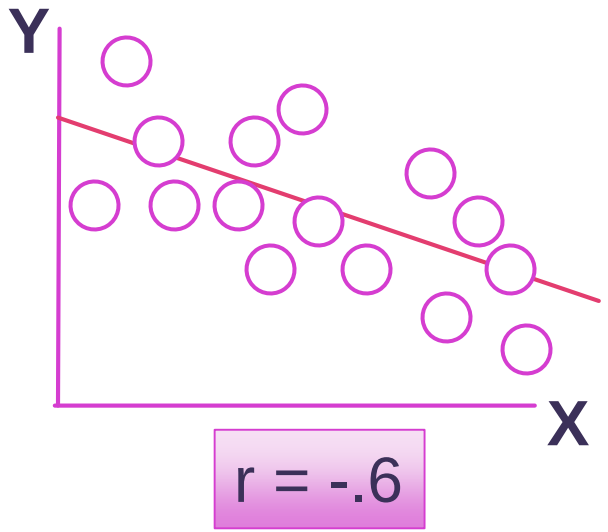
- $\beta_1 > 0 \Rightarrow$ Positive Association
- $\beta_1 < 0 \Rightarrow$ Negative Association
- $\beta_1 = 0 \Rightarrow$ No Association

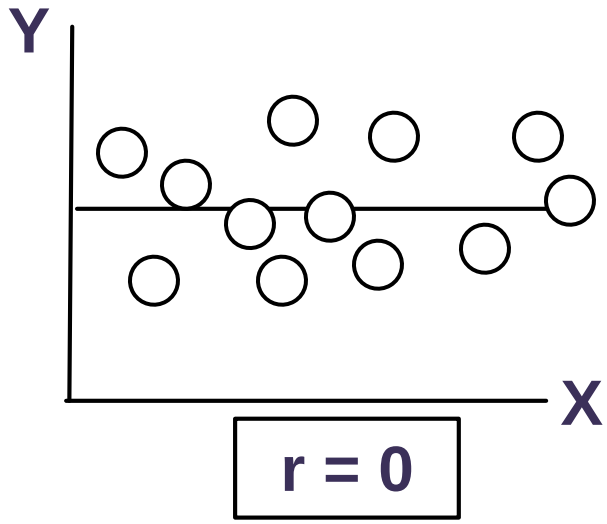
Correlation

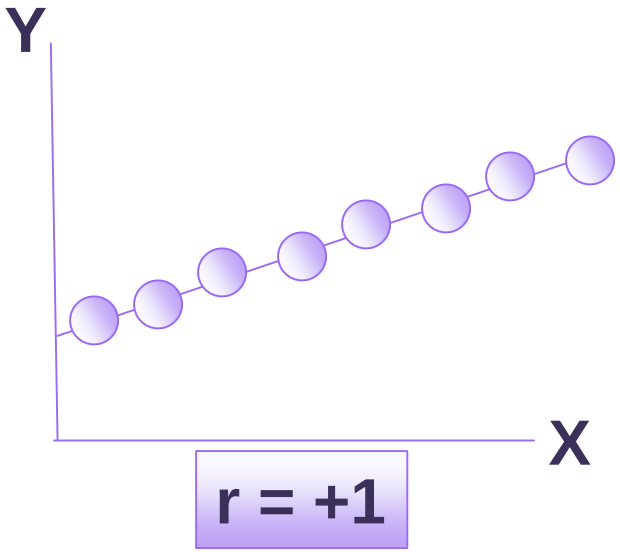
- Measures the relative strength of the *linear* relationship between two variables Unit-less
- Ranges between –1 and 1
- The closer to –1, the stronger the negative linear relationship
- The closer to 1, the stronger the positive linear relationship
- The closer to 0, the weaker any positive linear relationship

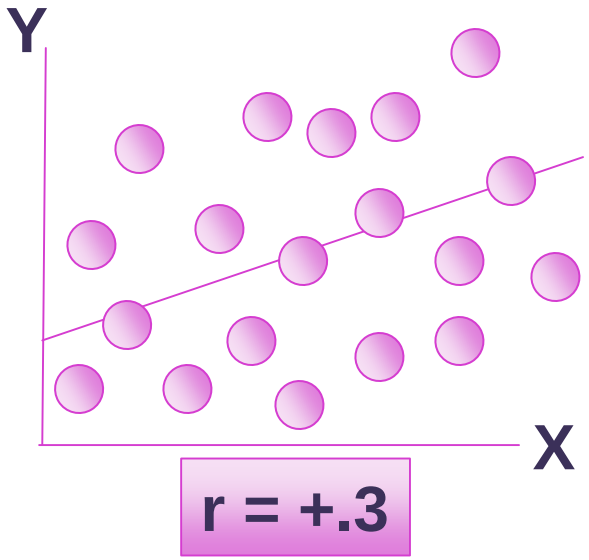
Scatter Plots of Data with Various Correlation Coefficients

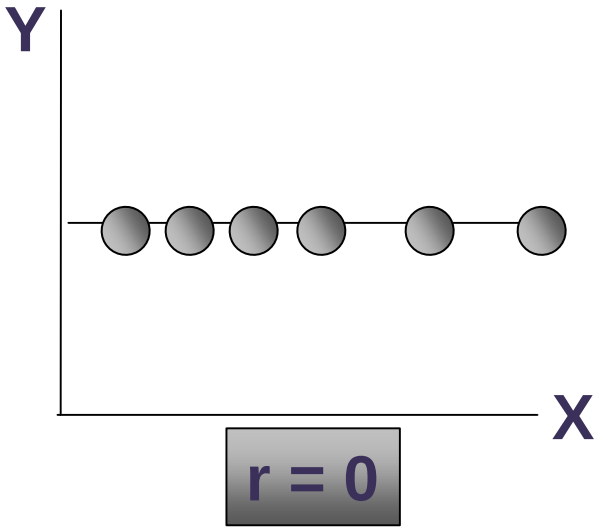






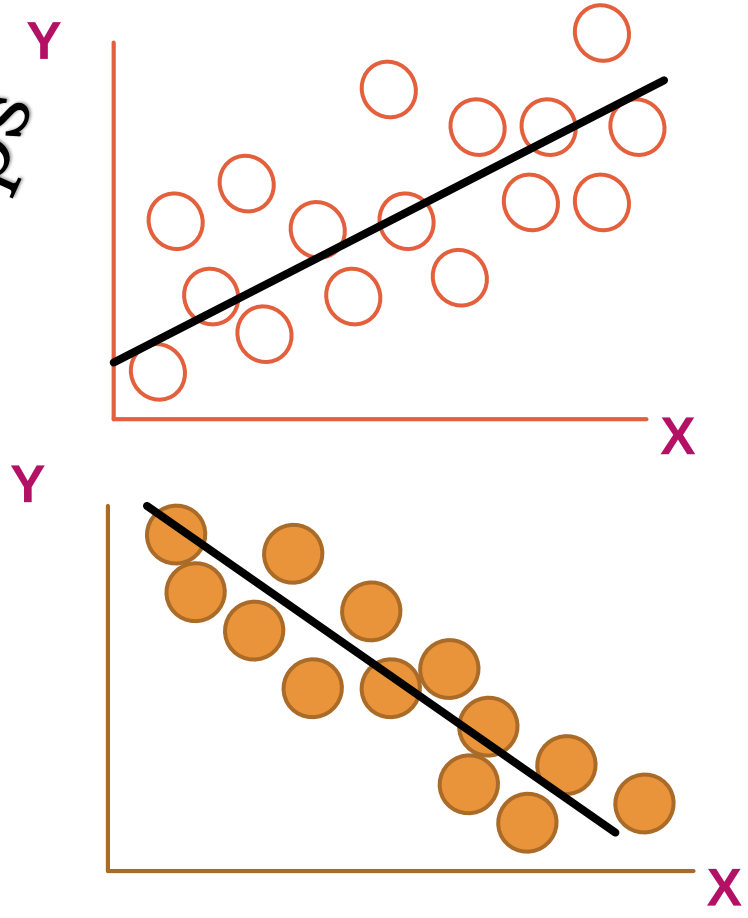




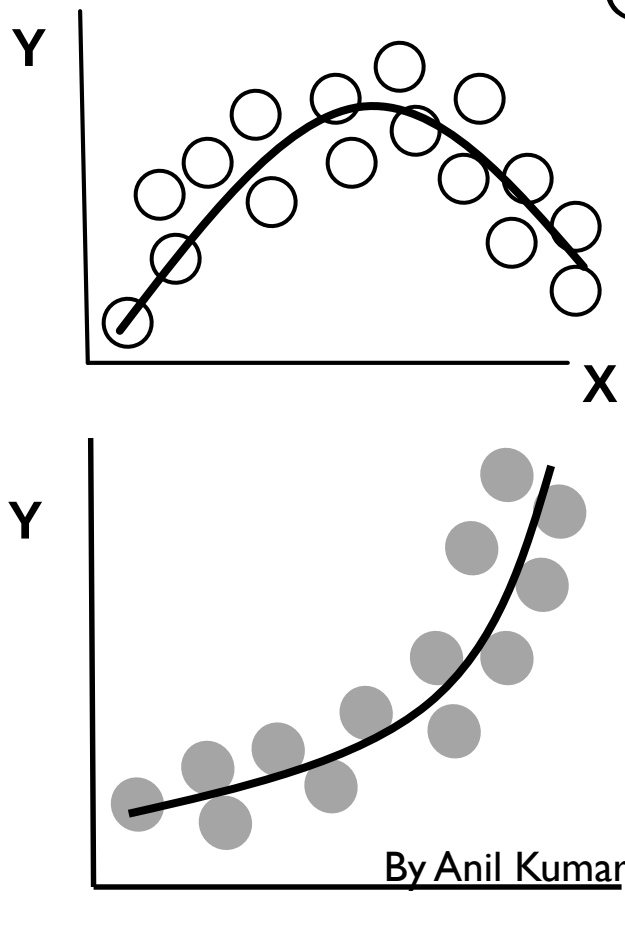


Linear Correlation

Linear relationships



Curvilinear relationships



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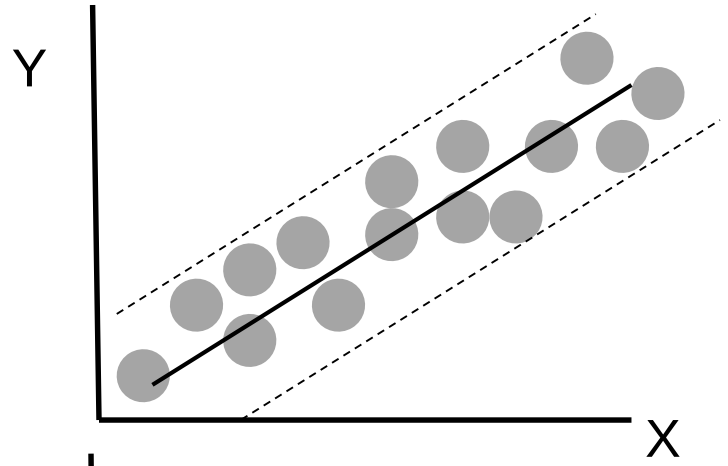
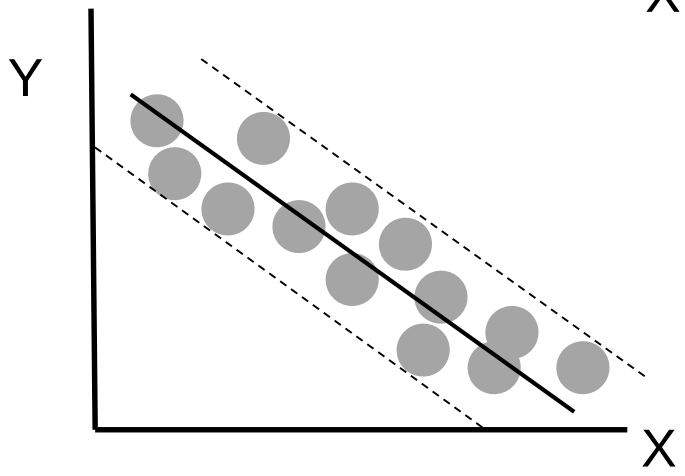
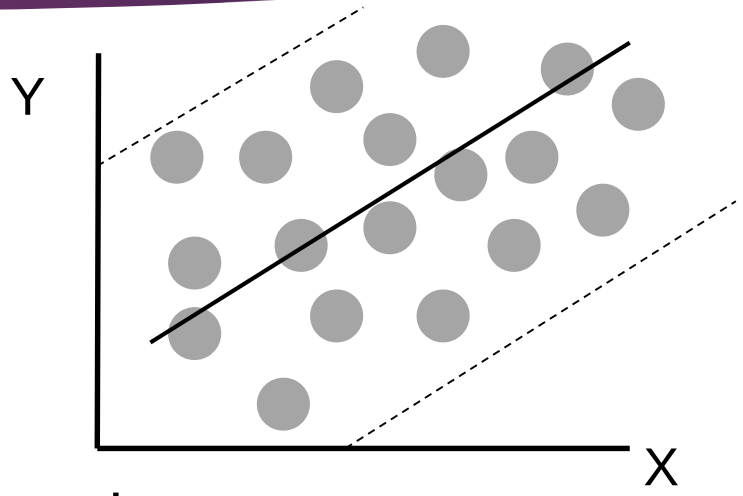
Linear Correlation

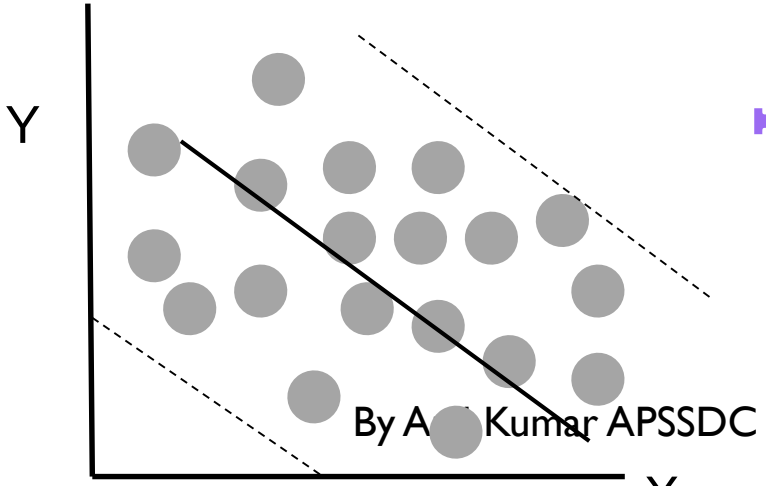
Strong relationships





Weak relationships





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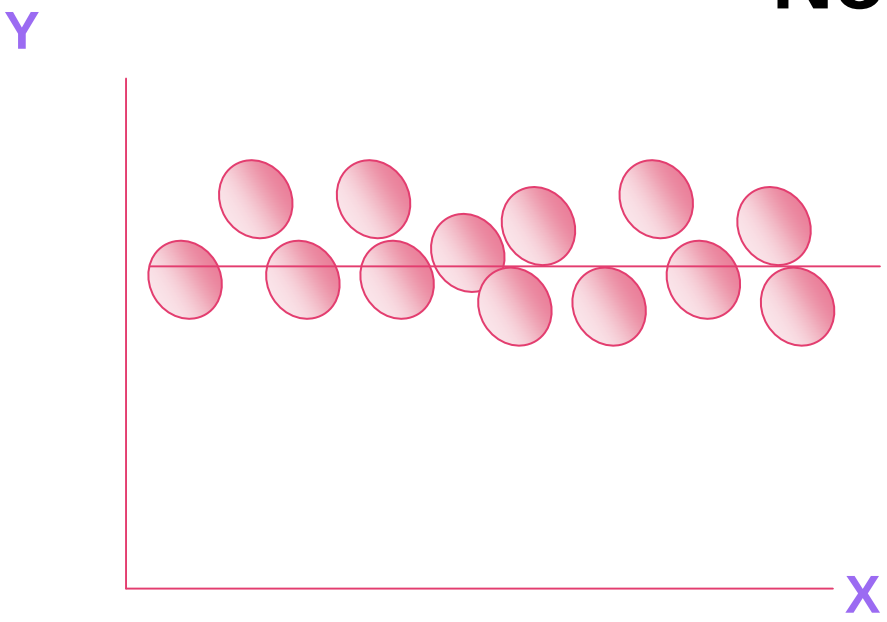
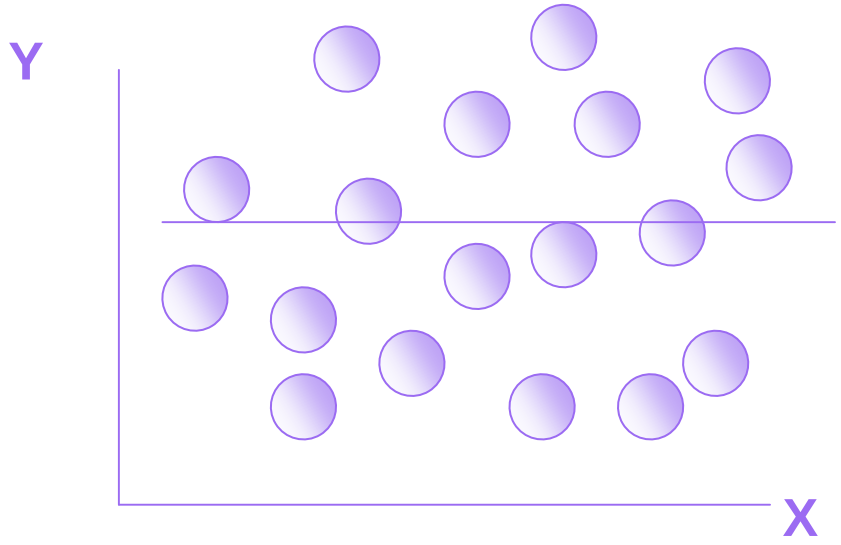
Linear Correlation

No relationship





Steps in Regression Analysis

- Examine the scatterplot of the data.
  I. Does the relationship look linear?
  II. Are there points in locations they shouldn't be?
  III. Do we need a transformation?
- Assuming a linear function looks appropriate, estimate the regression parameters.
  I. How do we do this? (Method of Least Squares)
- If there is a significant linear relationship, estimate the response, Y, for the given values of X, and compute the residuals

Regression Analysis

- Thus we have the regression formula as :

  Y = MX + C + error(e).

Initially we calculate the value for slope and predict the values of Y for any given X values we have.

$$\text{Slope(M)} = \sum_{i=0}^{len(X)} \frac{(X_i - X_{mean}) * (Y_i - Y_{mean})}{(X_i - X_{mean})^2}$$

Thus we calculate the C value and find out the "Line of Regression".

Regression Analysis

- Next our job is to reduce the distance between the actual value and the predicted value or in other words reduce the error between the actual and predicted value. Thus the line with least error will be the **"Best Fit Line"**.
- In order to check it out we calculate the "Coefficient of Determination".

$$Mean\ Squared\ value\ (R^2) = \sum_{i=0}^{len(X)} \frac{(Y_{pred} - Y_{mean})^2}{(Y - Y_{mean})^2}$$

- Thus our ultimate aim is to reduce the error i.e. distance between the actual and predicted values.

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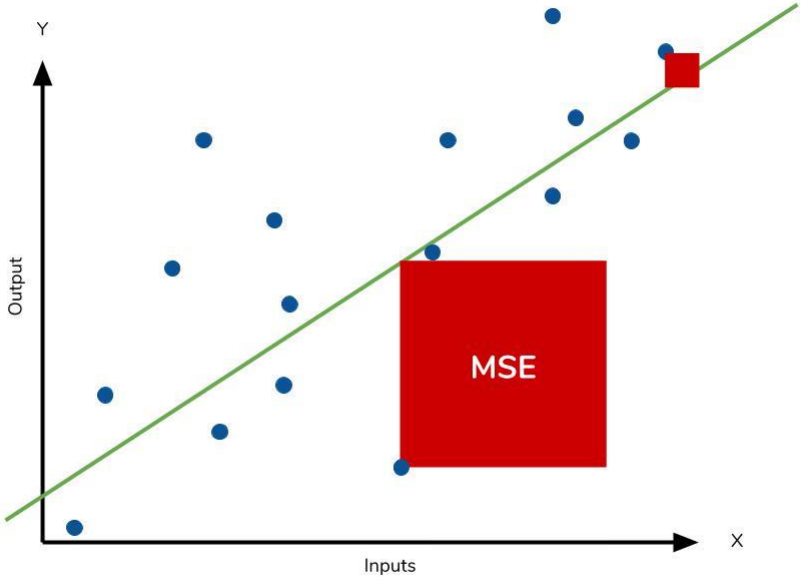
2. Mean Square Error

$$MSE = \frac{1}{n}\sum\underbrace{\left(y - \hat{y}\right)}^{2}$$

The square of the difference between actual and predicted



Evaluation Metrics

1. Mean Absolute Error

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

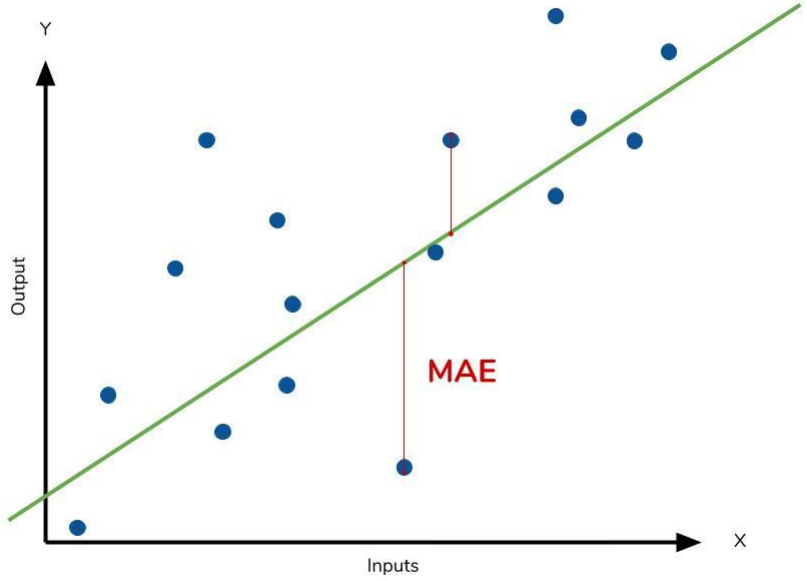
Divide by the total number of data points

Predicted output value

Actual output value

Sum of

The absolute value of the residual



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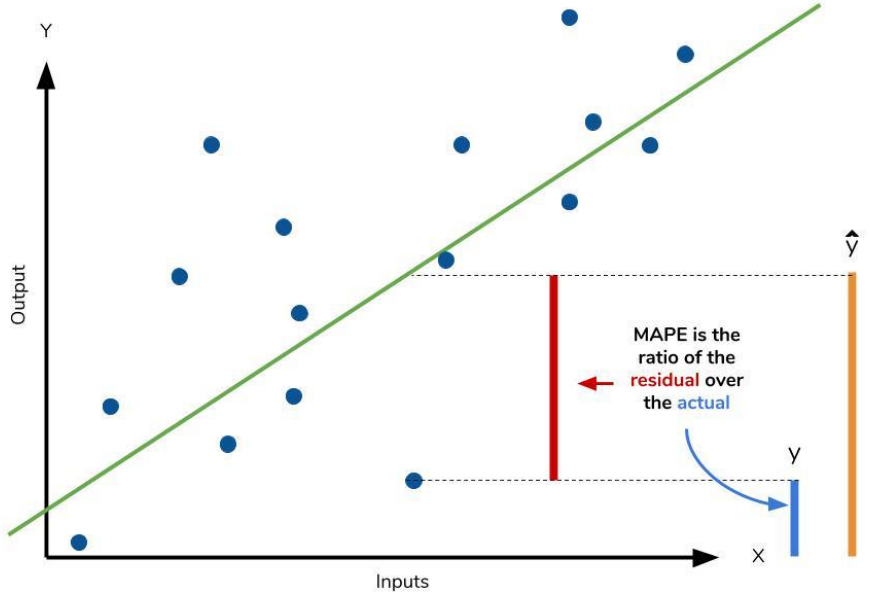
3. Mean Absolute Percentage Error

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

Multiplying by 100% converts to percentage

The residual

Each residual is scaled against the actual value



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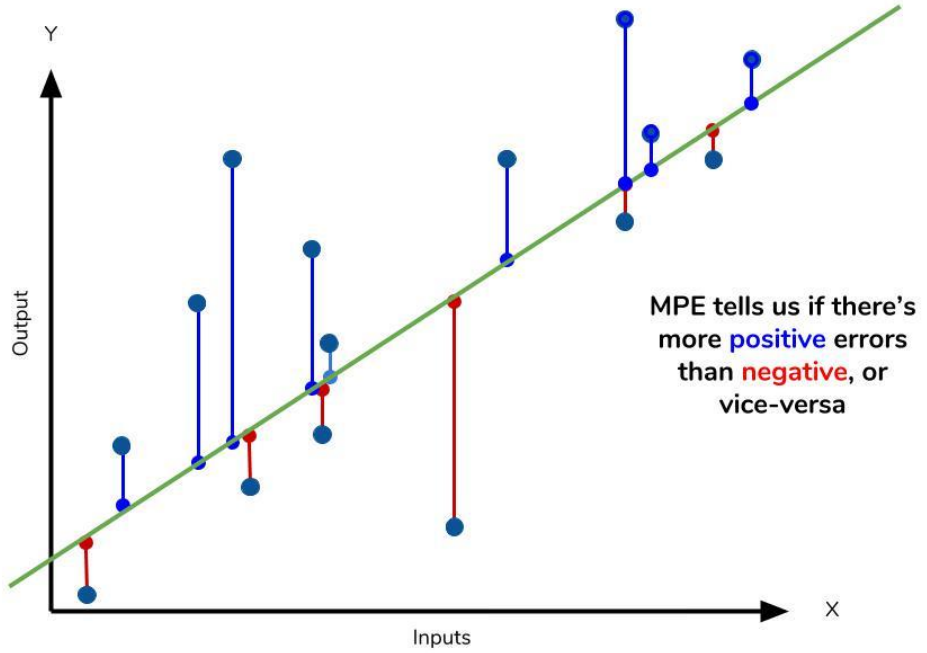
3. Mean Percentage Error

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



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/

By Anil Kumar APSSDC