LOGISTIC REGRESSION

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- Regression refers to a statistical method used to model the relationship between a **dependent variable** and **one or more independent variables**.

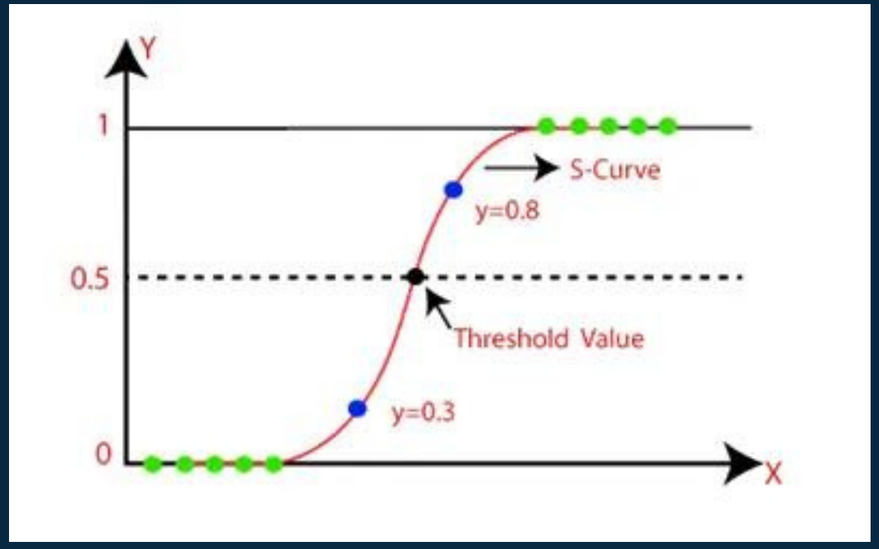
- It involves finding the line or curve that **best fits the data points** to predict the value of the dependent variable based on the values of the independent variable(s).

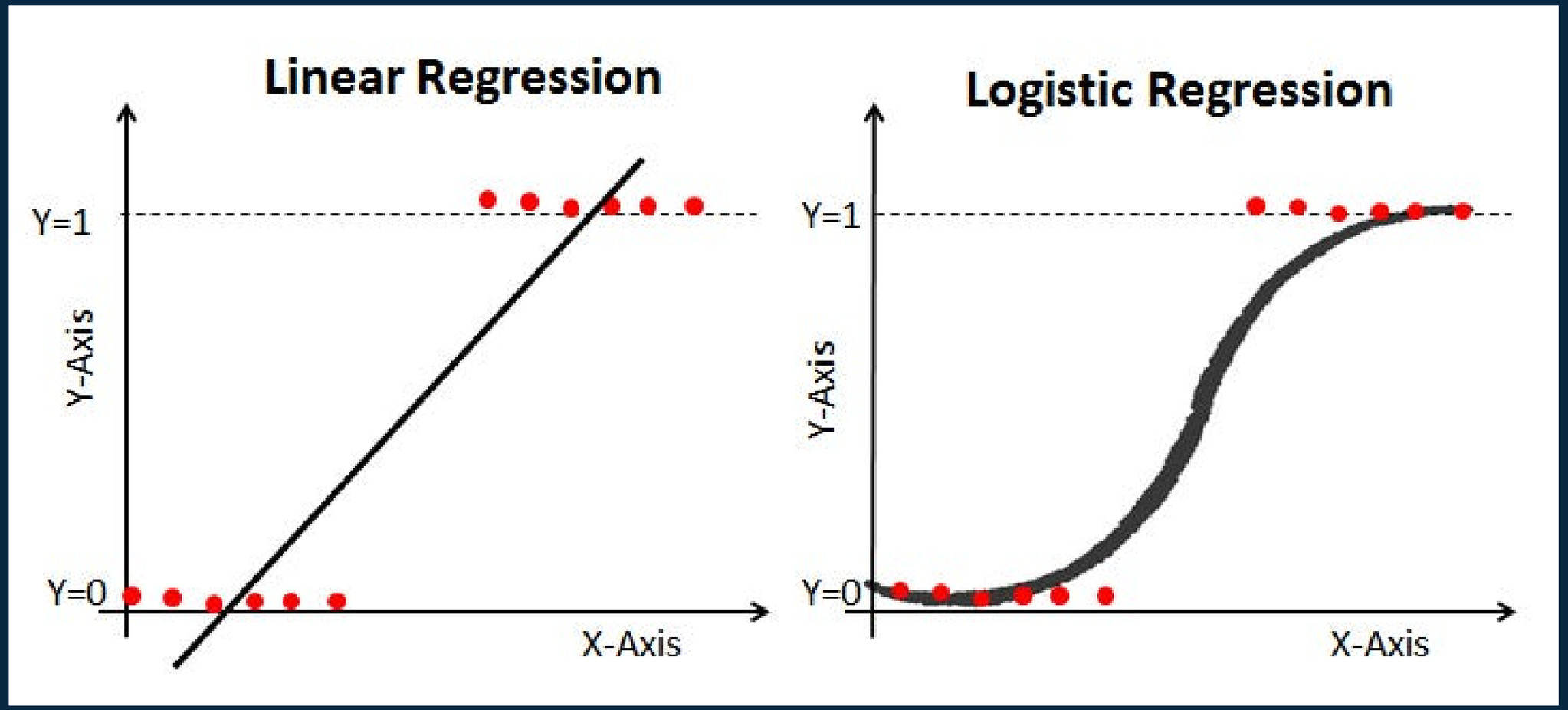
- What if our task is not just finding the best fit? What if we needed to see the possibility of the occurence of a particular thing?

- Identifying if a person is prone to a disease based on age,gender, and other health variables
- Predicting if a loan is going to be approved or not based on previous records
- Classifying if an emain is spam or not.
- Predicting if s student will fail or not.

- Logistic regression uses a logistic function to map the input variables onto the probability of the binary outcome, which is bounded between 0 and 1.

- Logistic regression predicts the output of a categorical dependent variable. Therefore the outcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or False, etc. but instead of giving the exact value as 0 and 1, it gives the probabilistic values which lie between 0 and 1.




Linear Regression
Y=1
Y-Axis
Y=0
X-Axis
Logistic Regression
Y=1
Y-Axis
Y=0
X-Axis

Why is it logistic regression if all it does is classification?

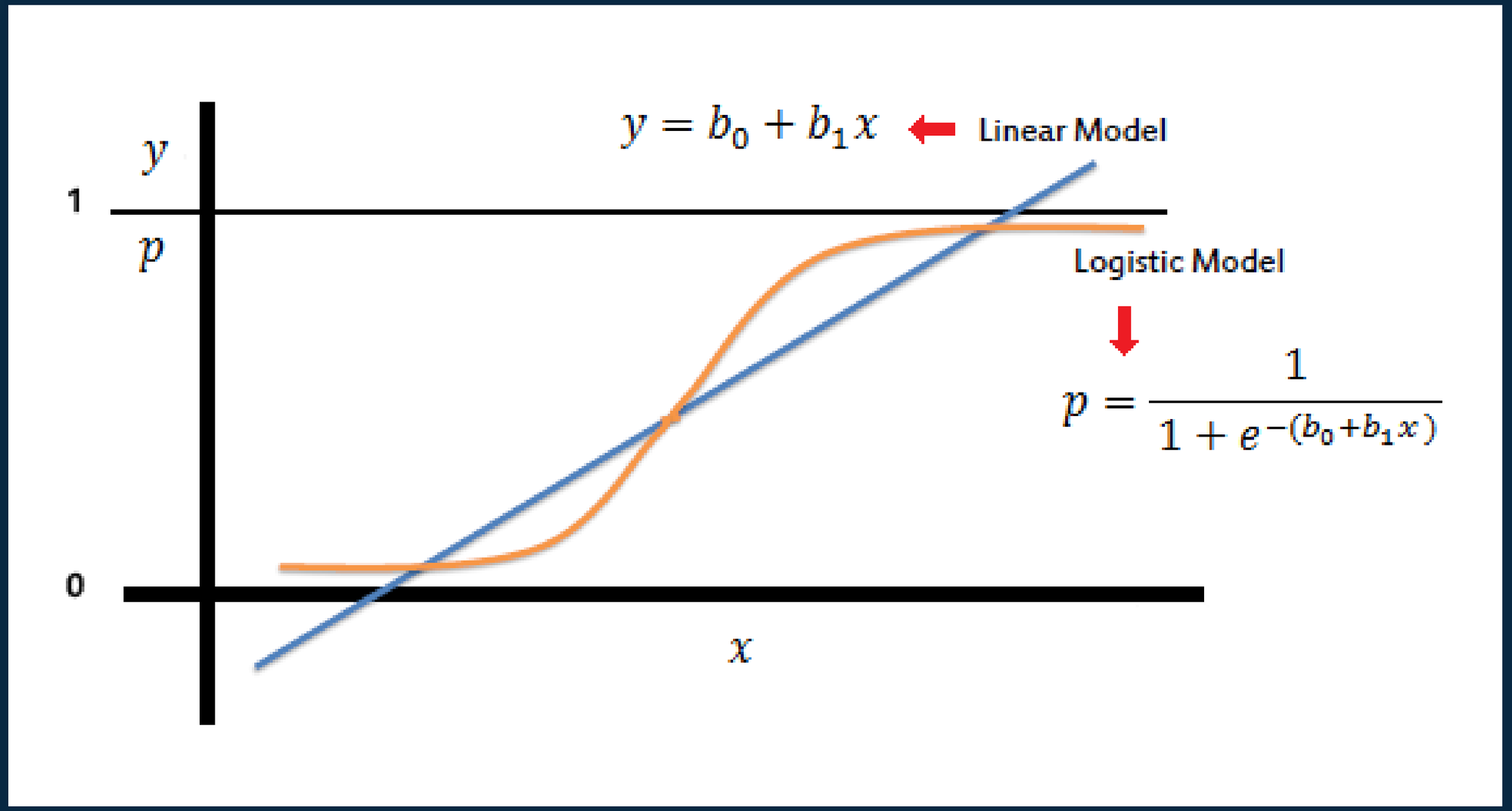
Understanding logistic regression

- The sigmoid function is a mathematical function used to map the predicted values to probabilities. It maps any real value into another value within a range of 0 and 1.

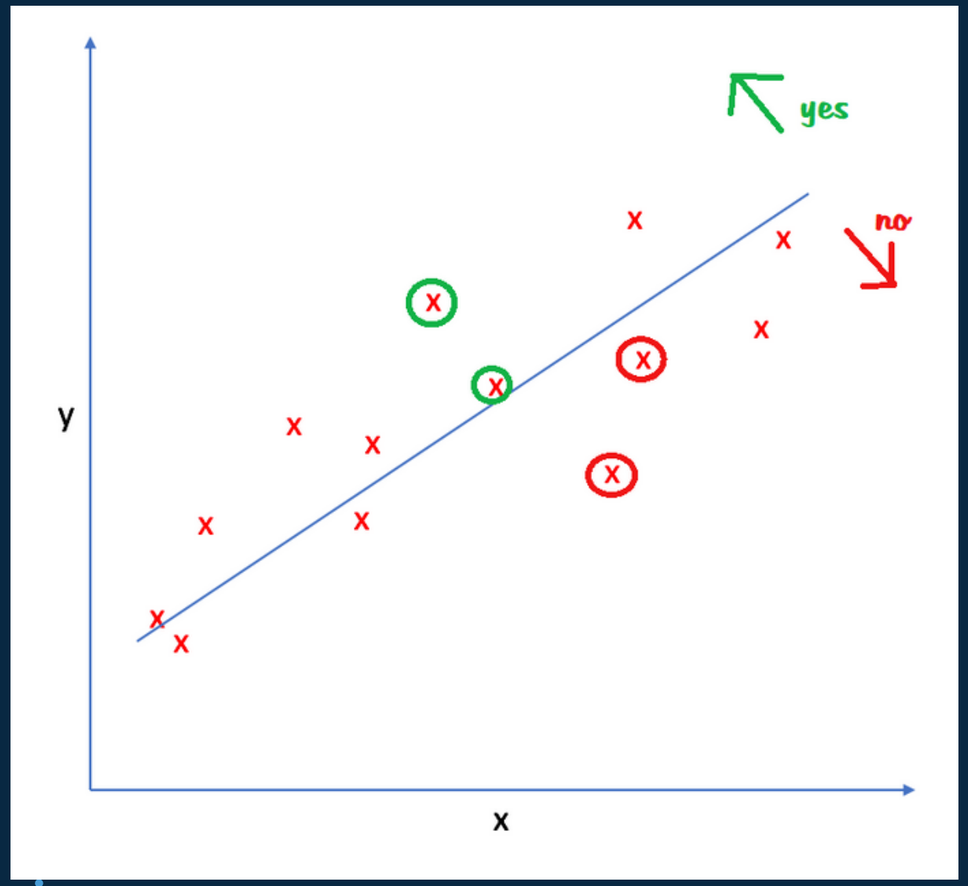
- The value of the logistic regression must be between 0 and 1, which cannot go beyond this limit, so it forms a curve like the "S" form. The S-form curve is called the Sigmoid function or the logistic function.

- $\sigma(z) = 1 / (1 + e^{(-z)})$
- where z is the linear equation: $z = \beta0 + \beta1x1 + \beta2x2 + ... + \beta nxn$

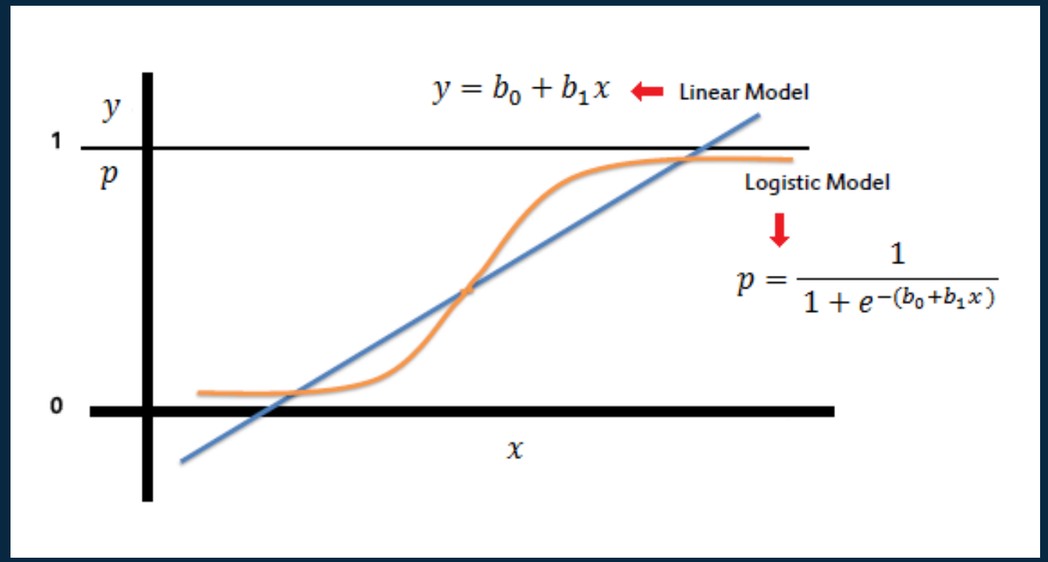
Here, $\beta0$, $\beta1$, $\beta2$, ..., βn are the coefficients of the regression equation and x1, x2, ..., xn are the independent variables.


$y = b_0 + b_1 x$
Linear Model
y
1
p
Logistic Model
$p = \frac{1}{1 + e^{-(b_0 + b_1 x)}}$
0
x

Where did these terms come from?



- This line is the line of best fit given out by logistic regression.
- If this line is seen as a boundary the closer a point gets near it the harder it its to classify it.(likelihood)
- The farther it gets it is easier to classify
- This can be related with probability



- Thus as we have the probability as the result we need to convert the the best fine line's range from 0 to 1
- We must also keep in mind of the conclusions that we made earlier.
- Range of the function is (-∞, +∞)
- Thus we can see that the sigmoid function makes the result value from 0 to 1

Evaluation metrics

- Accuracy: Measure of the total number of predictions a model gets right, including both True Positives and True Negatives.
- Recall: Indicates the percentage of the response values (that we are interested in) were'actually captured by the model.
- Precision: Measures the percentage of the predicted response values (that we are interested in) that were correct.