♦

Logistic Regression

Difficulty	Middle 🎈
Select	main

📌Title : Logistic Regression

Summary

- For binary classification
- Uses Maximum likelihood to find best fit
- We use the sigmoid function to map probability

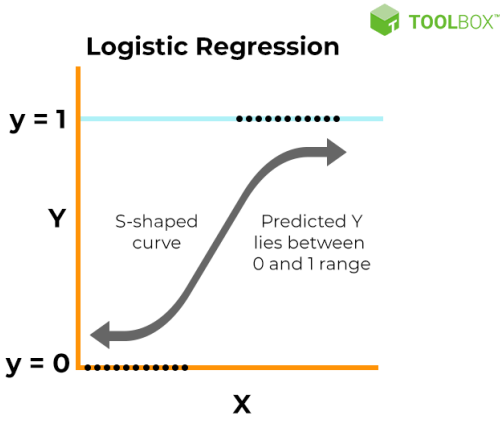
▼ Google Collab Practice 💻

▼ Things to further Research 🔎

- Wald's Test
- Maximum Likelihood Algorithm

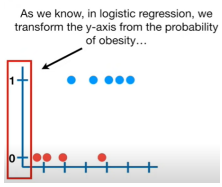
Logistic Regression Bigger Picture

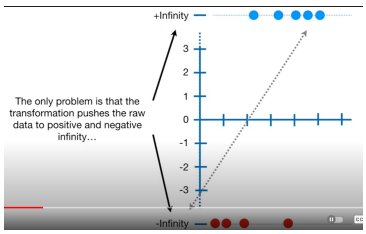
- Type of Machine learning algorithm that classifies True or False
- By fitting an "S" Shaped logistic Function (Ex: Sigmoid)
- We can have multiple features that contribute to the output. However, we must choose the features wisely.
  - Wald's Test is used for this reason
- To be able to fit the Logistic Regression we use → Maximum Likelihood Algorithm



Logistic Regression Algorithmic Steps

1. Transform the normal x-y coordinate to x and log(Odds)





2. Try to plot the best straight line
    a. Start with a random line
    b. Draw the S shaped function representing the log(odds) graph (Log(odds) → S graph)

$$p = \frac{e^{log(odds)}}{1 + e^{log(odds)}}$$

    c. Calculate the likelihood by using the observed status (labels)

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likelihood_One = p1 * p2 * p3 ...
likelihood_zero = (1- p5) * (1-p4) * ...
Likelihood = (likelihood_One) * (likelihoof_zero)
#note 1: likelihood_One -> this point is suppose to be one, so what is the probability given ?
#note 2: likelihood_zero -> this suppose to be zero, so what is the probability given that it will not happen?
# the goal is to maximize the likelihood, because this means that the probabilities were closely correct
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    d. Rotate line until optimal fit (Maximum likelihood)

“S” shaped Logistic Functions

$$P(S) = \frac{1}{1 + e^{-x}} = \frac{e^{x}}{e^{x} + 1}$$

Why do we usually use sigmoid function?

1. Loss function learns faster
2. Statistically related to Normal distribution
3. We don’t have a specific boundary for the input, it can be from negative to positive infinity
4. Rate of change is captured

Loss function of Sigmoid function

- Loss function is the derivative

$$\frac{dp}{ds} = \frac{e^{-s}}{(1 + e^{-s})^2} = \frac{1}{1 + e^{-s}} \frac{e^{-s}}{1 + e^{-s}} = p(1 - p)$$