Logistic Regression

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Logistic Regression

- A supervised ML algorithm, used to solve primarily two class classification problem.
- It is a linear model, can learn linear relationships between features and target attribute.

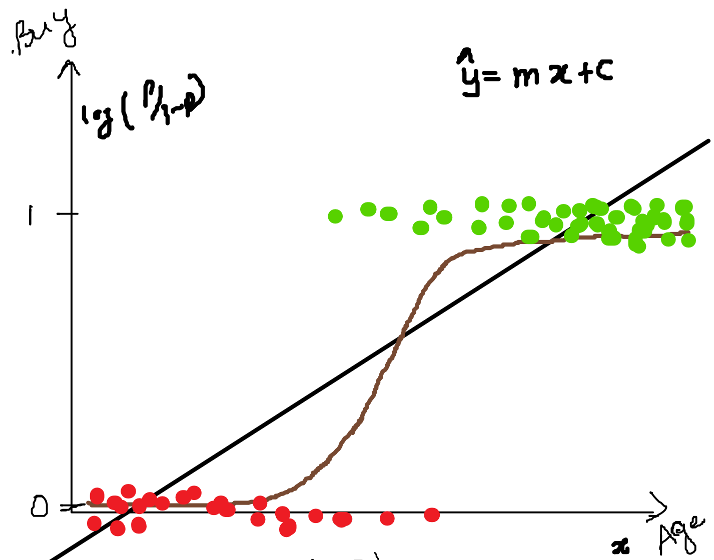
Linear Regression $\xrightarrow{\text{Sigmoid}}$ Logistic Regression

Sigmoid | logistic

$$f(x) = \frac{1}{1+e^{-x}} \qquad f(x) \rightarrow (0,1)$$

$$\frac{1}{1+e^{-\hat{y}}} = \frac{1}{1+e^{-(mx+c)}} = p$$

$p =$ probability of observation to be in class 1



If $p \geq 0.5 \Rightarrow$ class 1

$p < 0.5 \Rightarrow$ class 0

$$\frac{1}{1+e^{-\hat{y}}} = p$$

$$\frac{1}{1+e^{-(mx+c)}} = p$$

$$1 = p\left(1+e^{-(mx+c)}\right) \Rightarrow e^{-(mx+c)} = \frac{1}{p} - 1 = \frac{1-p}{p}$$

$$e^{mx+c} = \frac{p}{1-p}$$

$$\rightarrow \boxed{\log\left(\frac{p}{1-p}\right) = mx+c}$$

Linear Regression	Logistic Regression
Regression	Classification

Regression

$$\hat{y} = mx + c$$

Cost | Error → MSE

$$E = \frac{1}{n}\sum(y-\hat{y})^2$$

Classification

$$\log\left(\frac{P}{1-P}\right) = mx + c$$

cost | Error → binary crossentropy

$$\boxed{E} = -\frac{1}{n}\sum\left(y\log P - (1-y)\log(1-P)\right)$$

$\boxed{MLE}$

Actual → A | y
c1 → 0
c2 → 1

model 1
C1 → 0.45 → 0
C2 → 0.55 → 1

Model 2
C1 → 0.05 → 0
C2 → 0.90 → 1

E → c1 | m1 → log(1-P)

c1 | m1 → $-\log P$

$\log P$