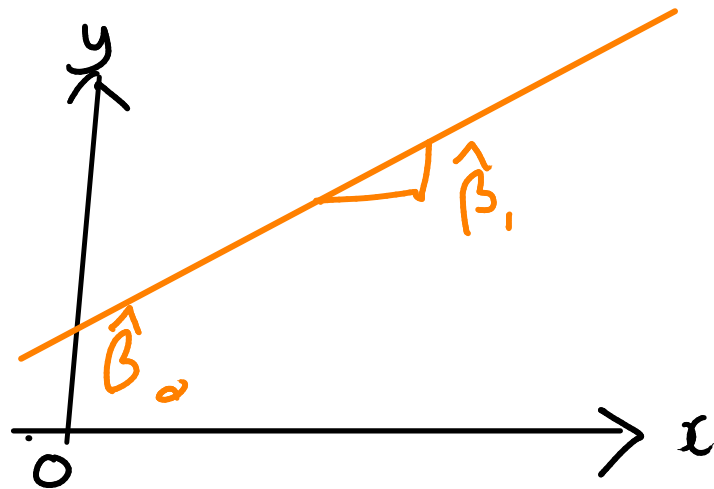
The background of the slide features a stylized globe on the left side, partially obscured by a dense pattern of binary code (0s and 1s) that recedes into the distance, creating a sense of depth and digital connectivity. The overall color palette is a mix of light blues, purples, and whites.

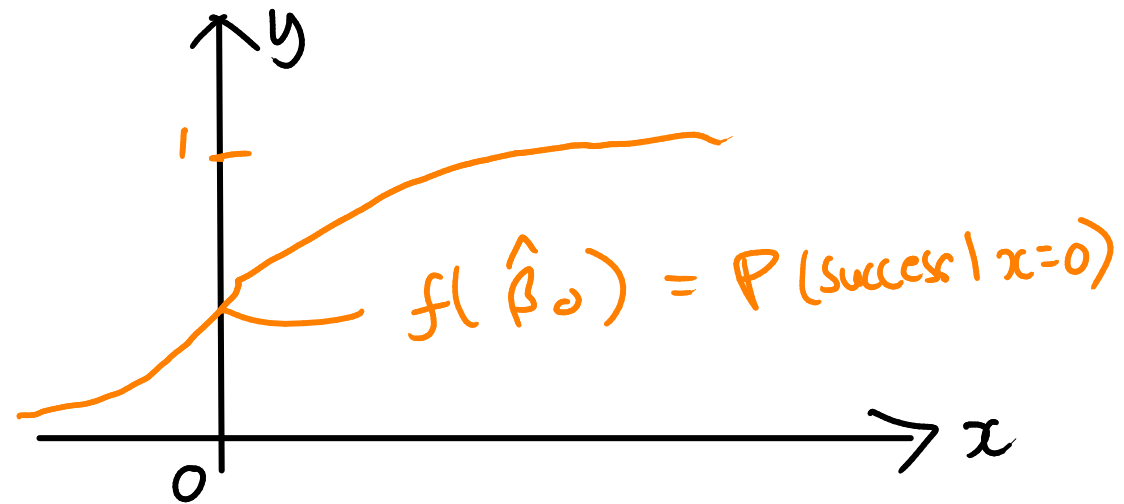
# Foundations of Data Science: Logistic regression - Interpretation of logistic regression coefficients

# Interpretation of $\hat{\beta}_0$

Lin reg



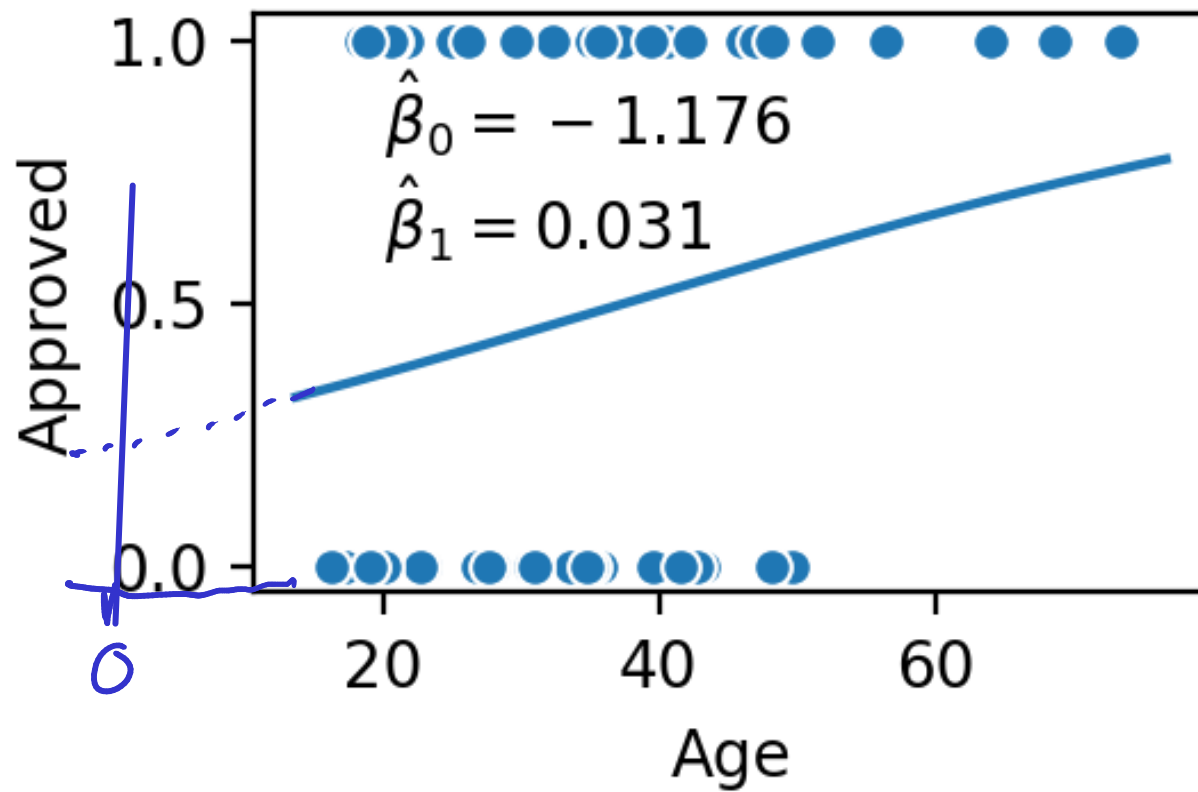
Log. reg



$x=0$

$$\begin{aligned}\Rightarrow f(\hat{\beta}_0 + 0 \cdot \hat{\beta}_1) &= f(\hat{\beta}_0) \\ &= \frac{1}{1 + e^{-\beta_0}}\end{aligned}$$

$$y_1 - 1.176 = 0.236$$



# Log odds

$$\text{Log Odds}(\text{Success}) = \ln \frac{P(\text{Success})}{P(\text{Failure})}$$

$$\begin{aligned} \text{Log odds} &+ 1 \\ \Rightarrow \text{Odds} &\times e \end{aligned}$$

$$= \ln \frac{P(\text{Success})}{1 - P(\text{Success})}$$

P	Odds	Log odds
0.5	1	0
> 0.5	> 1	> 0
< 0.5	< 1	< 0
1	$\infty$	$\infty$
0	0	$-\infty$

Equally likely

Success more likely than failure  
" less " " failure "

# Logit scale

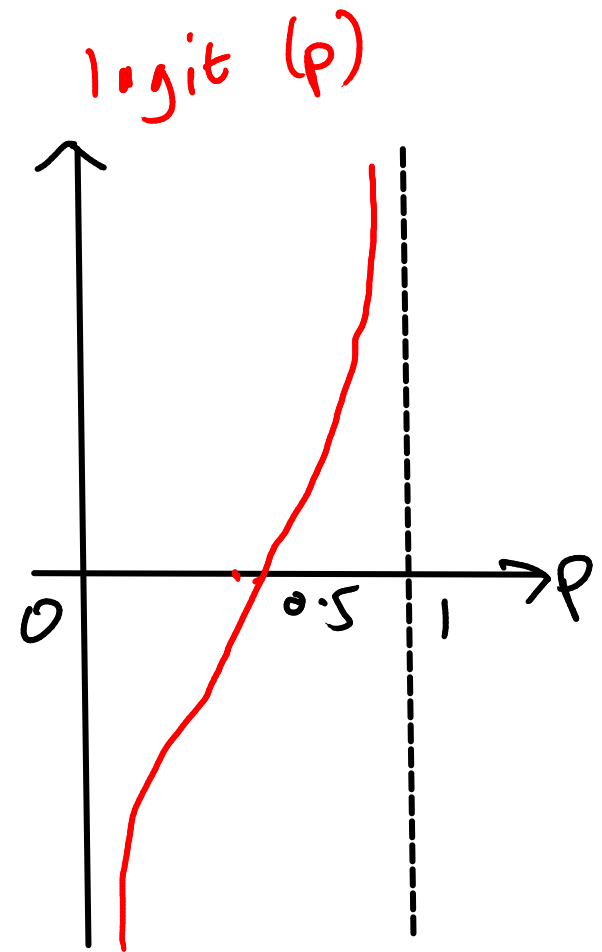
Log odds +1  $\Rightarrow$  Odds increase by factor  $e$

logistic unit = logit

$$f(\hat{\beta}_0) = 0.236$$

$$\hat{\beta}_0 = -1.176$$

$$\text{logit}(p) = \ln \frac{p}{1-p}$$



# Logistic Regression in terms of log odds

Success  $P(Y=1|x) = f(\beta_0 + \beta_1 x) = \frac{1}{1 + e^{-\beta_0 - \beta_1 x}}$  ①

Failure  $P(Y=0|x) = 1 - f(\beta_0 + \beta_1 x) = 1 - \frac{1}{1 + e^{-\beta_0 - \beta_1 x}}$

$$= \frac{e^{-\beta_0 - \beta_1 x}}{1 + e^{-\beta_0 - \beta_1 x}}$$
 ②

Odds  $\frac{P(Y=1|x)}{P(Y=0|x)} = \frac{1}{e^{-\beta_0 - \beta_1 x}} = e^{\beta_0 + \beta_1 x}$

Log odds  $\ln \frac{P(Y=1|x)}{P(Y=0|x)} = \beta_0 + \beta_1 x = \text{logit}(P(Y=1|x))$

## Interpretation of $\hat{\beta}_1$

$$\begin{aligned}\text{Odds} &= e^{\hat{\beta}_0 + \hat{\beta}_1 x} \\ &= e^{\hat{\beta}_0} e^{\hat{\beta}_1 x}\end{aligned}$$

$$\text{OR}(x) = e^{\hat{\beta}_1}$$

Credit e.g.  $\text{OR}(\text{Age}) = e^{0.03} \approx 1.03$

$\Rightarrow$  Every year of age 1.03 times more likely to have loan approved.