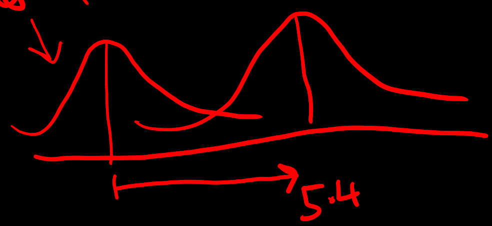
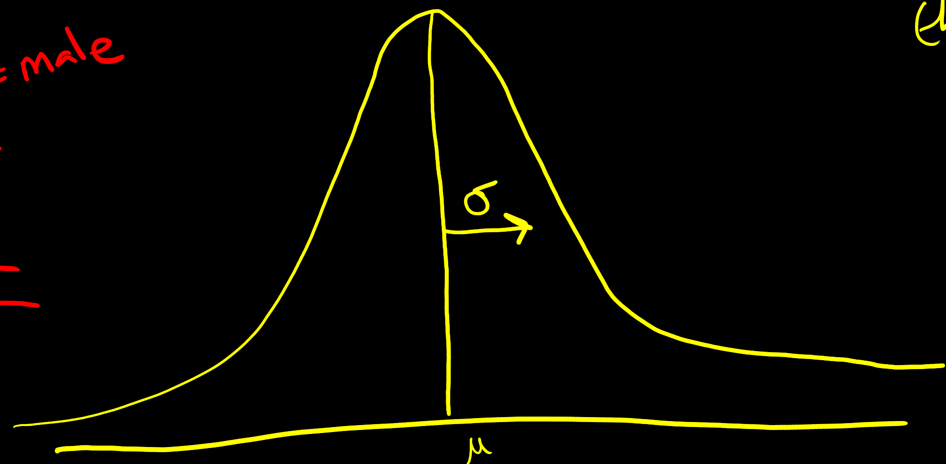
people

170cm
35 age
gender = female

170 cm
35 age
gender = male





weight

age
height

if height increases by 1cm
then μ increases
by ≈ 0.96

people
170cm 170 cm
35age 35 age

people
170cm 171 cm
36age 35 age

outcome

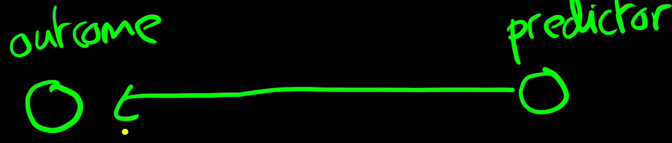
country

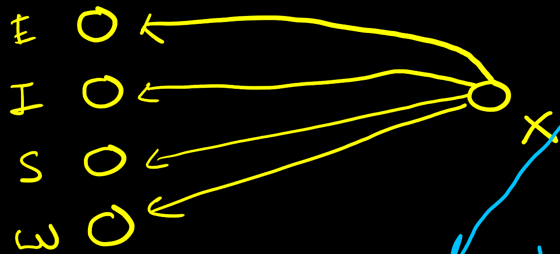
predictor

hair colour

L

$L - 1$





$$\log\left(\frac{P(\text{country} = \text{Eng})}{P(\text{country} = \text{wales})}\right)$$

$$E = \beta_0^E + \beta_1^E x$$

$$I = \beta_0^I + \beta_1^I x$$

$$S = \beta_0^S + \beta_1^S x$$

$$\cancel{W = \beta_0^W + \beta_1^W x} \quad 0$$

$$\log\left(\frac{P(\text{country} = \text{Ire})}{P(\text{country} = \text{wales})}\right)$$

$$\log\left(\frac{P(\text{score} = 2)}{P(\text{score} = 1)}\right) = \underset{-5.9}{\beta_0} + \underset{0.01}{\beta_1}\ \text{gre\_quant}$$

$$y_i \sim N(\underline{\underline{\mu_i}}, \sigma^2)$$

$$\underline{\underline{\mu_i}} = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki}$$

$$\boxed{y_i \sim \text{Poisson}(\underline{\underline{\lambda_i}})}$$

$$? \; \underline{\underline{\lambda_i}} = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki}$$

link

ilink

$$\phi_i = \beta_0 + \sum_{k=}^{K} \beta_k x_{ki}$$

$$\boxed{\log(\lambda_i) = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki}}$$

no. of visits $\sim$ Poisson(λ_i)

$$\log(\lambda_i) = \beta_0 + \beta_1 \times \text{sex}_i$$

$\text{sex}_i = 1$ if person_i = female

$$= -1.44 + 0.42 \times \text{sex}_i$$

if $\text{sex}_i = 0$

$$\boxed{\log(\lambda) = -1.44}$$

if $\text{sex}_i = 1$

$$\boxed{\log(\lambda) = -1.44 + 0.42 = -1.02}$$

$$\log\left(\frac{\lambda}{\mu}\right) = \log(\lambda) - \log(\mu)$$

$$\log(\lambda) - \log(\mu) = \beta_0 + \beta_1 x$$

$$\log(\lambda) = \beta_0 + \beta_1 x + \underline{\underline{\log(\mu)}}$$

offset

outcome ~ x + offset(log(u))

Normal linear

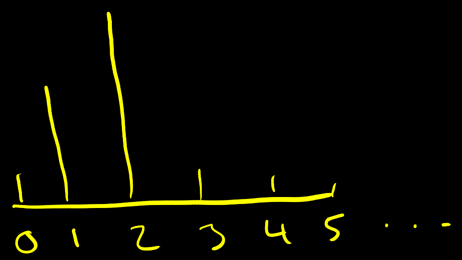
$$y_i \sim N(\underline{\underline{\mu_i}}, \sigma^2)$$

$$\mu_i = \beta_0 + \beta_1 x_i$$

Neg Bin

$$y_i \sim \mathrm{NegBin}(\underline{\underline{\mu_i}}, r)$$

$$\log(\mu_i) = \beta_0 + \beta_1 x_i$$



Pois

Zero

Poisson regression

$$y_i \sim \text{Poisson}(\lambda_i)$$

$$\log(\lambda_i) = \beta_0 + \sum \beta_k x_{ki}$$

$$\theta = P(z_i = 1)$$

Zero inflated Poisson

$$y_i \sim \begin{cases} \text{Poisson}(\lambda_i), & z_i = 0 \\ \text{Zero}, & z_i = 1 \end{cases}$$

$$\log(\lambda_i) = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki}$$

$$\log\left(\frac{\theta_i}{1-\theta_i}\right) = \gamma_0 + \sum_{k=1}^{K} \gamma_k x_{ki}$$

$y_1 \quad y_2 \quad y_3 \ldots \quad y_n$ each $y_i \in \{0, 1\}$

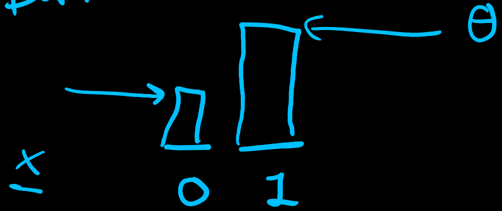
normal linear

for each i in $1 \ldots n$

$$\boxed{y_i \sim N(\mu_i, \sigma^2)}$$

$$\boxed{\mu_i = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki}}$$

Bernoulli



$p(x=1) = \theta$

$p(x=0) = 1-\theta$

logit (log odds)

$$\phi = \log\left(\frac{\theta}{1-\theta}\right)$$

$$\theta = \frac{1}{1+e^{-\phi}}$$

inverse logit

ilogit

$$\boxed{\begin{aligned} &y_i \sim \text{Bernoulli}(\theta_i) \\ &\theta_i = \beta_0 + \sum_{k=1}^{K} \beta_k x_{ki} \end{aligned}}$$

$\theta_i \in (0, 1)$

$\phi_i \in (-\infty, \infty)$

$$\log\left(\frac{\theta}{1-\theta}\right) \xrightarrow{\text{link}} \phi_i \xrightarrow{\text{ilink}} \theta_i$$

$$\phi_i = \beta_0 + \sum_{k=1}^{k=K} \beta_k x_{ki}$$

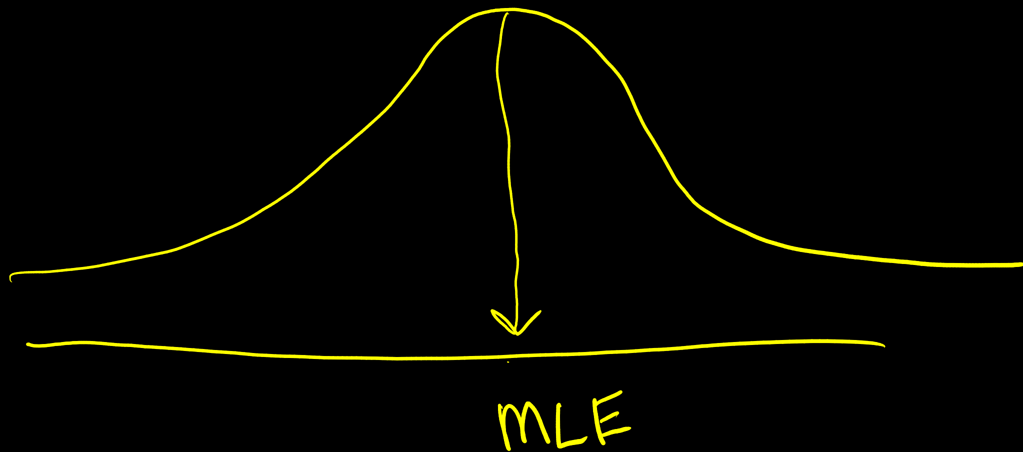
log odds $\longrightarrow$ P

$\log p(\text{data} \mid \beta_{MLE})$

logLik(m5)

log likelihood

likelihood function



$$\frac{P(\text{data} \mid M_1)}{P(\text{data} \mid M_0)}$$: likelihood ratio

$$\log\left(\frac{P(\text{data} \mid M_1)}{P(\text{data} \mid M_0)}\right) = \underline{\log P(\text{data} \mid M_1) - \log P(\text{data} \mid M_0)}$$

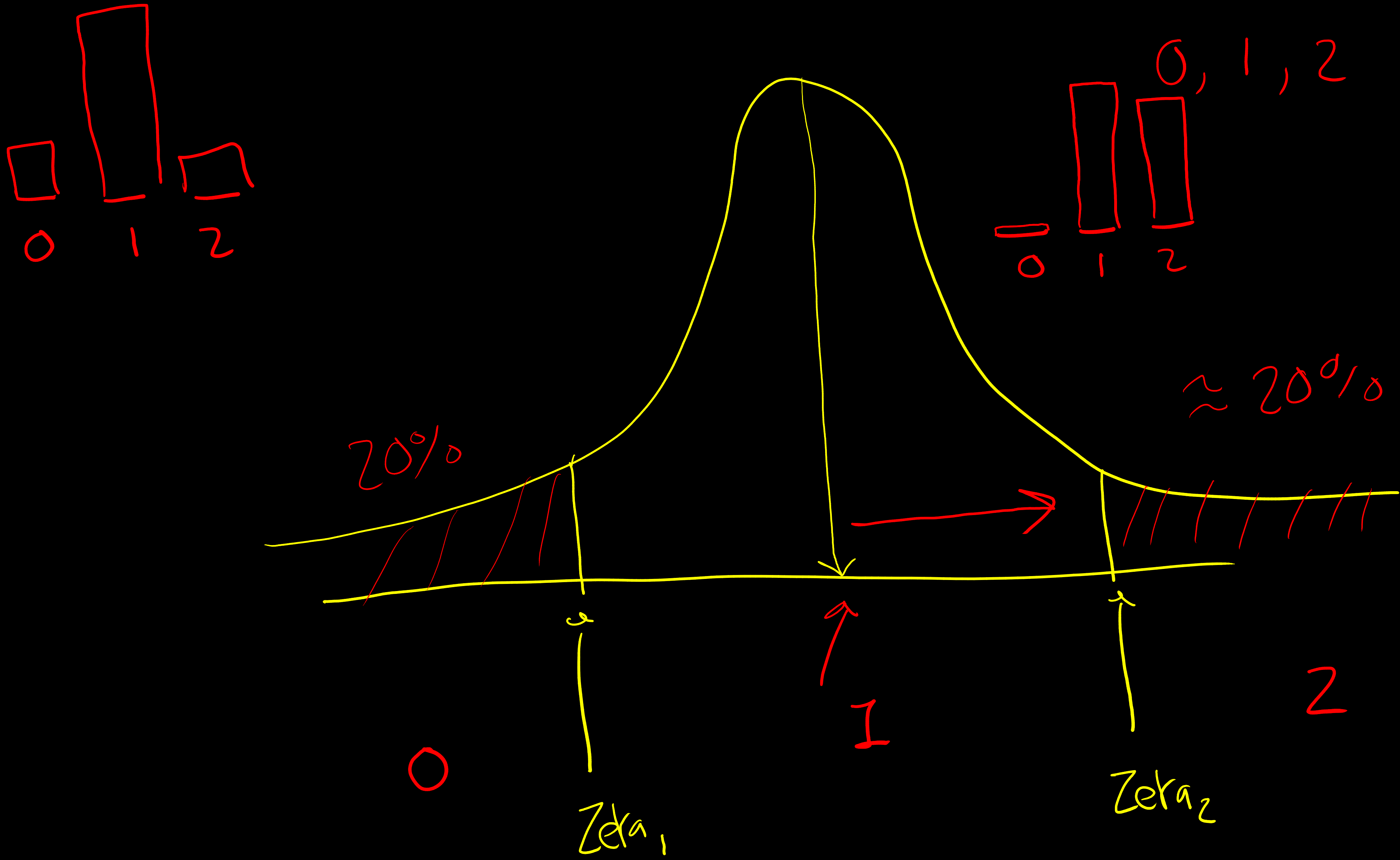
diff. of log likelihood

<u>is</u>

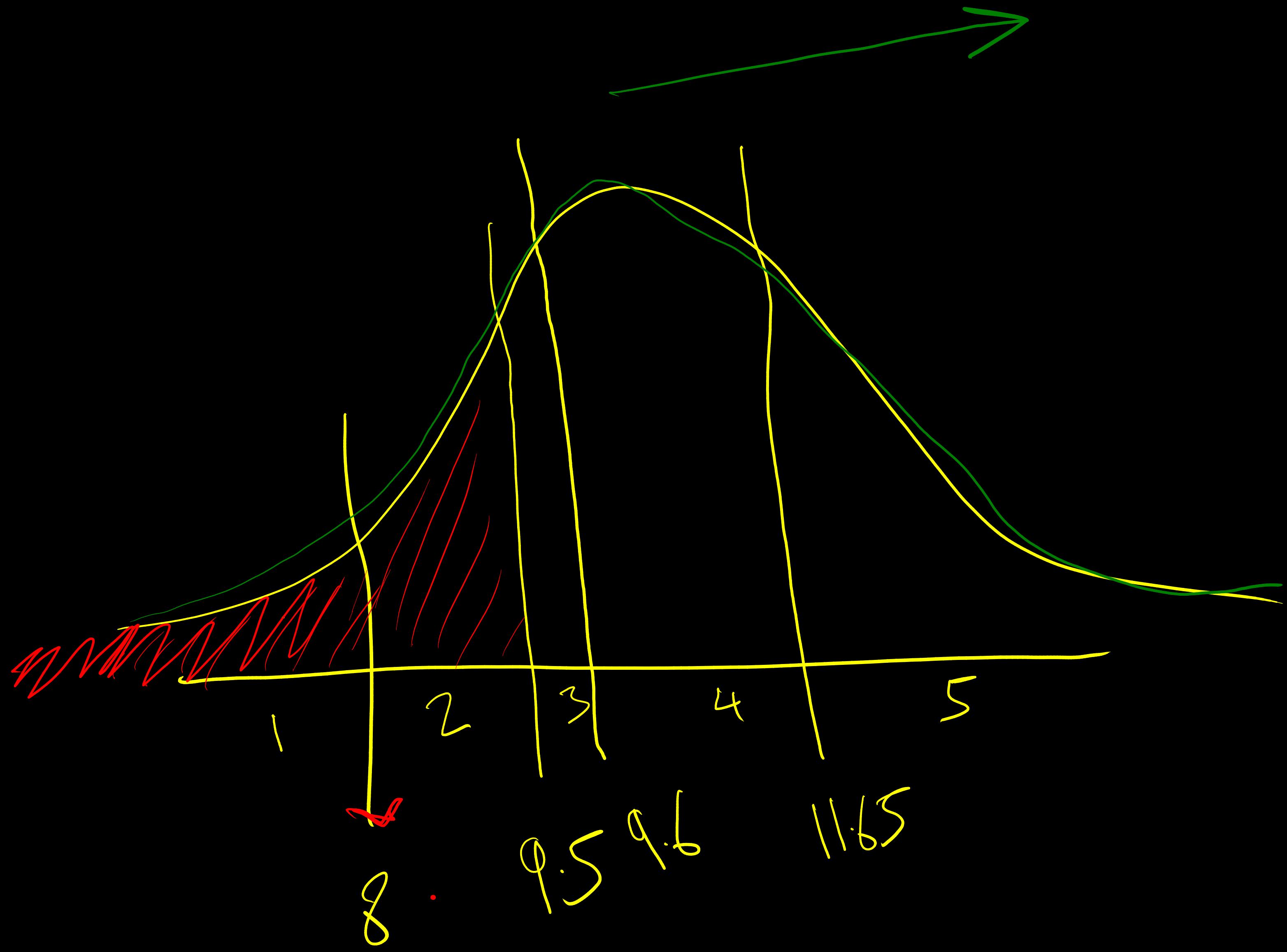
log of the likelihood ratio

-2LL <u>deviance</u>

χ^2



0 1 2
0, 1, 2
0 1 2
20%
≈ 20%
0
1
2
Zera$_1$
Zera$_2$



1
2
3
4
5
8
9.5
9.6
11.65

$\log(\text{odds})$

$e^{?} = \text{odds}$

e euler's number

$e \approx 2.71\ldots\ldots$

$2^{10} = 1024$

$\log_2(1024) = 10$

$10^6 = 1000000$

$\log_{10}(1000000) = 6$