## **Baseline Models Difference**

As a starting point in Multinomial <u>Logistic Regression</u> we can choose any class to be the **baseline Example** 

- Say we have A, B, C classes
- We pick B to be the baseline
   The model estimate

$$\log\left(rac{\Pr(\mathrm{Y}{=}\mathrm{A})}{\Pr(Y=B)}
ight)=ec{X}ec{eta}_A$$

$$\log\left(rac{\Pr( ext{Y=C})}{\Pr(Y=B)}
ight) = ec{X}ec{eta}_C$$

After adding exponent for both sides we get

$$rac{P(Y=A)}{P(Y=B)} = e^{ec{X}ec{eta}_A} \ rac{P(Y=C)}{P(Y=B)} = e^{ec{X}ec{eta}_C}$$

Let 
$$S_A = e^{ec{X}ec{eta}_A} S_C = e^{ec{X}ec{eta}_C}$$

$$P(A) + P(B) + P(C) = 1$$

$$P(C) = S_C P(B)$$

$$P(A) = S_A P(B)$$

$$P(B) = P(B)$$

$$S_A P(B) + P(B) + S_C P(B) = 1$$

$$egin{aligned} P(B)(S_A + S_C + 1) &= 1 \ P(B) &= rac{1}{S_A + S_C + 1} &= rac{1}{1 + e^{ec{X}ec{eta}_A} + e^{ec{X}ec{eta}_C}} \ P(A) &= rac{e^{ec{X}ec{eta}_A}}{1 + e^{ec{X}ec{eta}_C}} \ P(C) &= rac{e^{ec{X}ec{eta}_A}}{1 + e^{ec{X}ec{eta}_C}} \end{aligned}$$

Why Baseline is needed?

Cause probabilities must sum to 1

$$P(Y = A) + P(Y = B) + P(Y = C) = 1$$

 $\bullet \ \, {\rm Only} \,\, K-1 \,\, {\rm sets} \,\, {\rm of} \,\, {\rm classes} \,\, {\rm are} \,\, {\rm needed} \,\, {\rm to} \,\, {\rm model} \,\, K \,\, {\rm model}$