

Sp3

Logistic Regression

$D \in \{0, 1\}$, $X_i \in \{0, 1\}$ ~~are~~ are r.v.'s,
response

$$P(D=1) = \frac{e^{\theta x}}{1 + e^{\theta x}} \quad \text{relates } D \text{ to } x.$$

$$\underline{X} = (1, X_1, \dots, X_k), \quad \underline{\theta} = (\theta_0, \theta_1, \dots, \theta_k)$$

Then

$$\begin{aligned} P(\underline{D}; \underline{\theta}) &= \prod_{i: D_i=1} \frac{e^{\theta x_i}}{1 + e^{\theta x_i}} \prod_{i: D_i=0} \frac{1}{1 + e^{\theta x_i}} \\ &= \frac{e^{\theta \sum_{i: D_i=1} x_i}}{(1 + e^{\theta x_i})^n} \end{aligned}$$