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Poisson and Gamma Regression

Poisson Regression

Poisson Regression is a **GLM** which is used to model events where we count the results. Here we use:

- $Y_i \sim Poisson(\lambda_i) \ \Rightarrow \ \mathbb{E}[Y_i] = \lambda_i$
- $g(x) = ln(x)$

Thus:

$$g\left(\mathbb{E}[Y|X_1, ..., X_p]\right) = \alpha_0 + \alpha_1 \cdot X_1 + ... + \alpha_p \cdot X_p$$

$\Rightarrow$

$$\boxed{ln\left(\mathbb{E}[\lambda|X_1, ..., X_p]\right) = \alpha_0 + \alpha_1 \cdot X_1 + ... + \alpha_p \cdot X_p}$$

When we have λ_i for every i we can use:

$$\boxed{\mathbb{P}(Y_i = k) = \frac{e^{-\lambda_i} \cdot \lambda_i^k}{k!}}$$

The maximum probability is when $k = \lfloor \lambda_i \rfloor$.

Gamma Regression

Gamma Regression is a **GAM** which is used to model events where we count the results. Here we use:

- $Y_i \sim Gamma(\mu)$
- $g(x) = ln(x)$ or $g(x) = \dfrac{1}{x}$
- $f_0 = b_0$ and $f_1(x) = \dfrac{b_1}{x}$

Thus:

$$g\left(\mathbb{E}[Y|X_1, ..., X_p]\right) = f_0 + f_1(X_1) + ... + f_p(X_p)$$

$\Rightarrow$

$$\boxed{g\left(\mathbb{E}[\mu|X]\right) = b_0 + \frac{b_1}{X}}$$

And here we can replace with $g(x) = ln(x)$ or $g(x) = \dfrac{1}{x}$.
