Section 4F. Logistic Regression with More Classes

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Logistic Regression: More than two classes

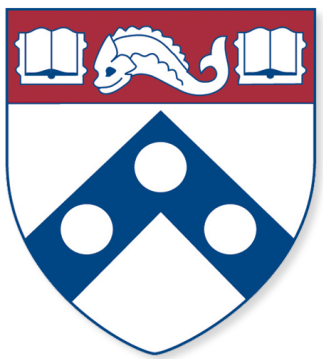
So far, we have considered the case when the output classes are $\mathcal{C} = \{0, 1\}$. How about if we have K classes?

- We can use a multiclass logistic regression

$$\Pr(Y = k|X) = \frac{e^{\beta_{0k} + \beta_{1k} X_1 + \cdots + \beta_{pk} X_p}}{\sum_{\ell=1}^{K} 1 + e^{\beta_{0\ell} + \beta_{1\ell} X_1 + \cdots + \beta_{p\ell} X_p}}$$

- We can find estimates $\widehat{\beta}_{0\ell}, \widehat{\beta}_{1\ell}, \ldots, \widehat{\beta}_{p\ell}$ for $\ell = 1, \ldots, K$ using the Maximum Likelihood Criterion
- We can make predictions for an input $\mathbf{x}$ using the functions

$$\widehat{p}_k(\mathbf{x}) = \frac{e^{\widehat{\beta}_{0k} + \widehat{\beta}_{1k} x_1 + \cdots + \widehat{\beta}_{pk} x_p}}{\sum_{\ell=1}^{K} 1 + e^{\widehat{\beta}_{0\ell} + \widehat{\beta}_{1\ell} x_1 + \cdots + \widehat{\beta}_{p\ell} x_p}}$$



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