# Ch. 15 - GLM

Monday, April 18, 2022 2:50 PM

## Types of Variables: Quantitative, Qualitative

The general mathematical form for a linear function of a single variable is

$$y = \beta_0 + \beta_1 x \tag{15$$

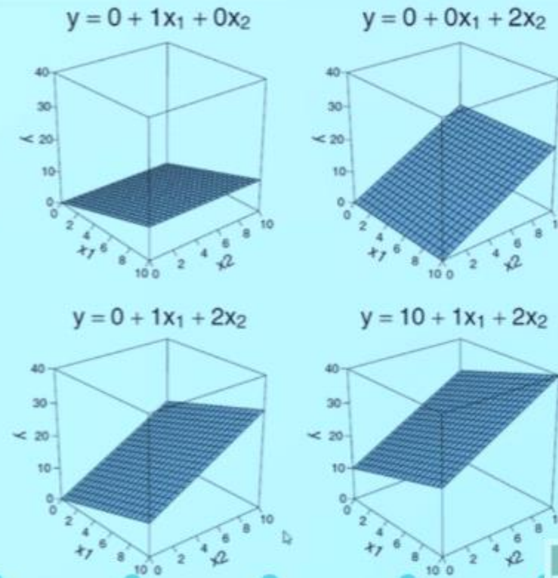
## Lines - Nice and Easy!

- In general, a linear combination of *K* predictor variables has the form:

$$\begin{aligned} y &= \beta_0 + \beta_1 x_1 + \cdots + \beta_K x_K \\ &= \beta_0 + \sum_{k=1}^{K} \beta_k x_k \end{aligned} \tag{15.2}$$

## Lines - Nice and Easy!

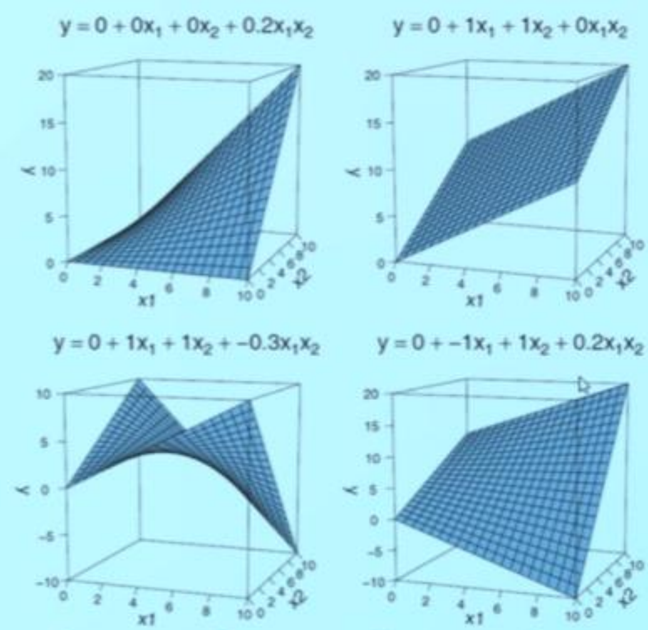
**Figure 15.2:**
Example of linear functions of two variables, $x_1$ and $x_2$. Upper left: Only $x_1$ has an influence on y. Upper right: only $x_2$ has an influence on y. Lower left: $x_1$ and $x_2$ habe an additive influence on y. Lower right: Nonzero intercept is added.

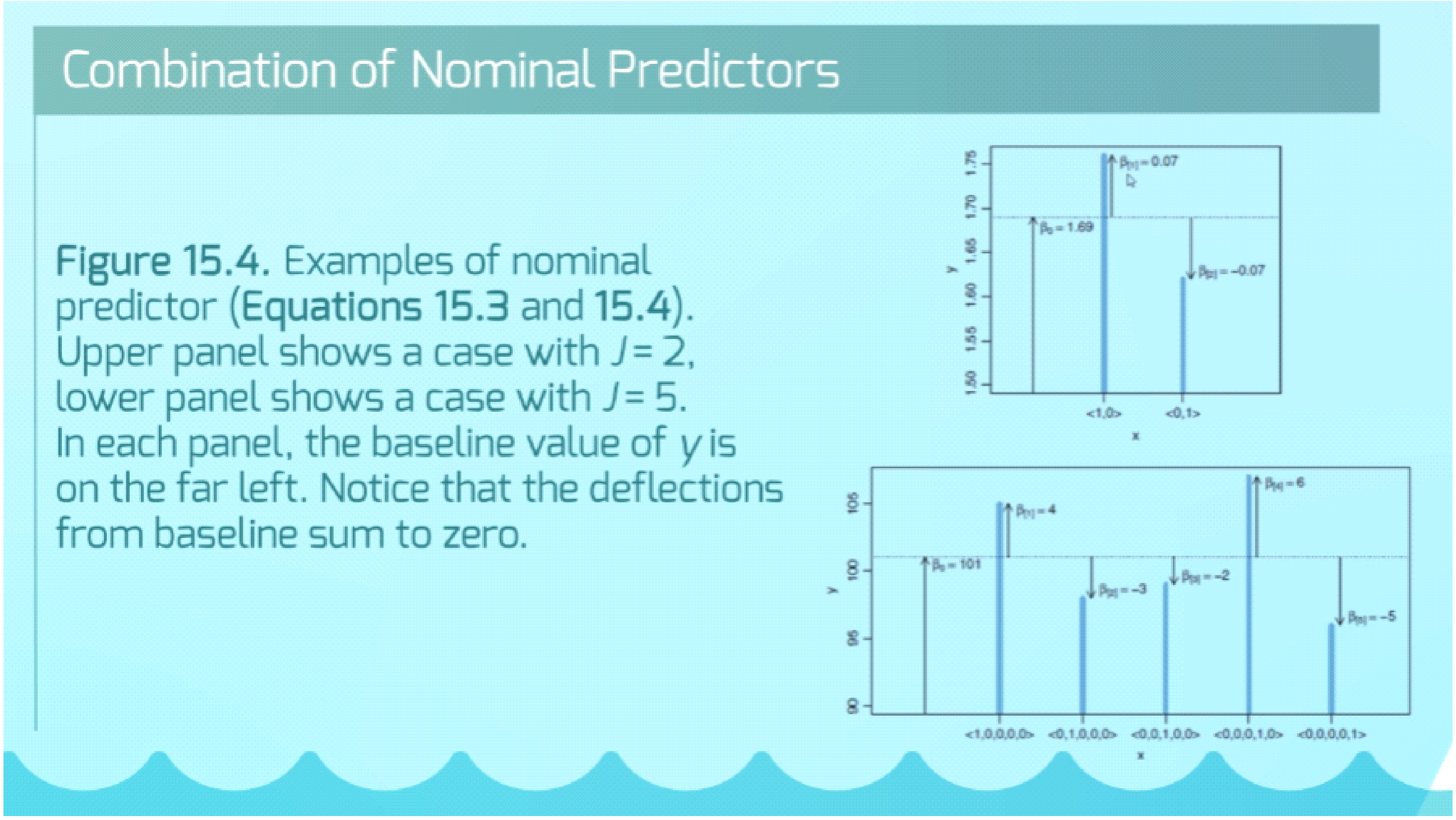



Lines - Nice and Easy!

## Interaction

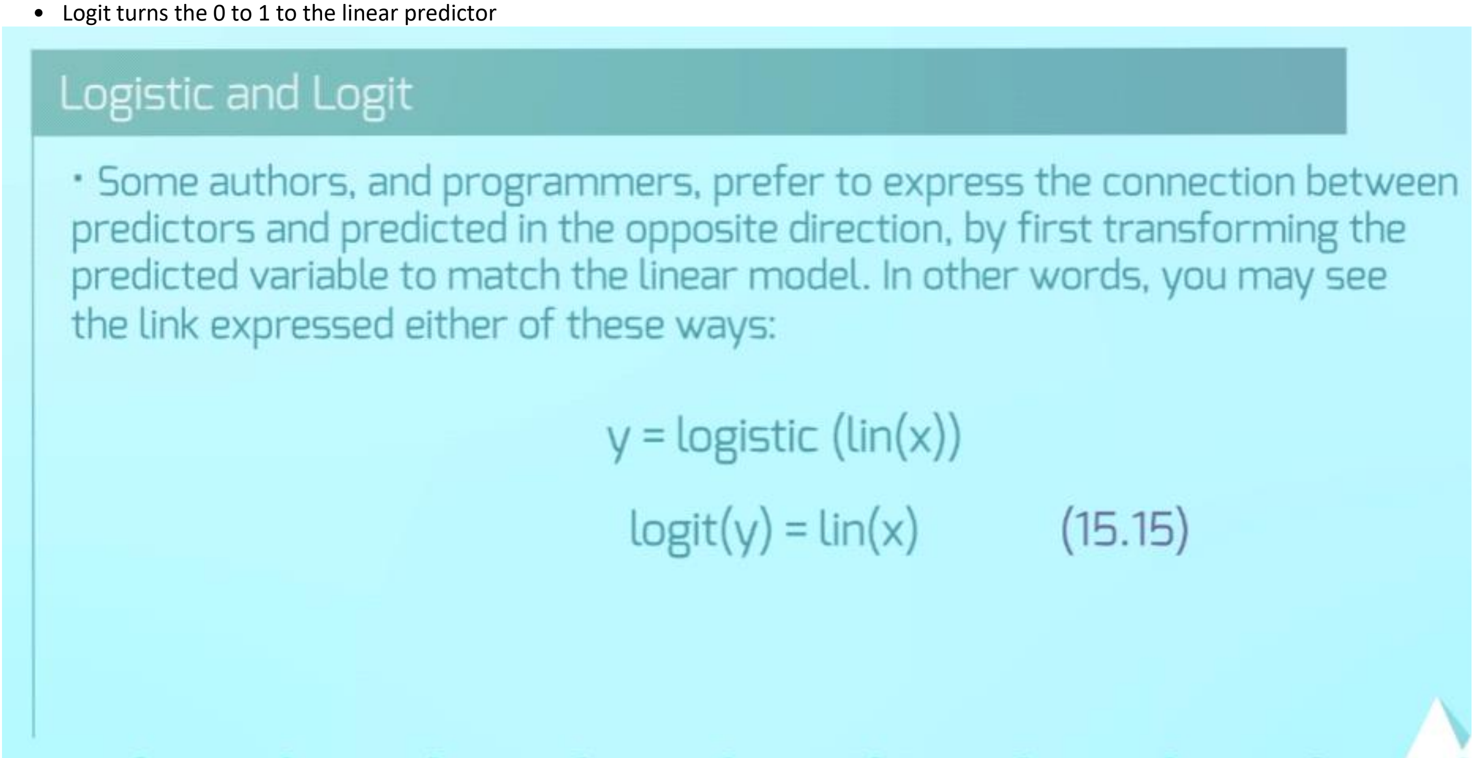
**Figure 15.3:**
Multiplicative interaction of two variables, $x_1$ and $x_2$. Upper right panel shows zero interaction for comparison. Figure 18.8, p. 526, provides additional perspective and insight.






## Logit vs. Logistic

- Logistic turns linear predictor between 0 and 1
- Logit turns the 0 to 1 to the linear predictor




## Generalized Linear Model Components

# G.L.M

1. A probability/density function
2. A linear predictor

$$\eta = \beta_0 + \beta_1 x_1 + \dots + \beta_r x_r$$

$$\eta = X\beta$$

3. A link function

link

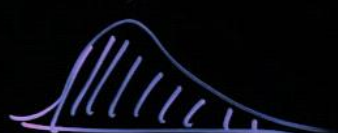
$$g(\mu) = X\beta = \eta$$

# G.L.M

## The exponential family

$$f(y|\theta,\phi) = \exp\left\{\frac{y\theta - b(\theta)}{a(\phi)} + c(y,\phi)\right\}$$

$$\int_y f(y)\,dy = 1$$



$$\frac{d}{d\theta}\int_y f(y)\,dy = \frac{d}{d\theta}1 = 0$$