# Higher Order Models

DASC 512

# Higher Order Models

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k + \epsilon$$

We may want to model relationships that are more complex than simple linear relationships, such as

- Quadratic relationships: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_1^2$
- Interactions: $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$
- Logarithmic relationships: $y = \beta_0 + \beta_1 \ln(x_1)$
- Exponential relationships: $y = \beta_0 + \beta_1 e^x$

# Quadratic Terms

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_1^2 + \epsilon$$

$\beta_0$: The $y$-intercept

$\beta_1$: The shift (moves curve along the $x_1$ axis)

$\beta_2$: The rate of curvature.

# Example: Shot putters

Let’s look at a dataset that uses maximum power clean (i.e., weight-lifting) to predict personal best shot put for 28 collegiate women’s shot putters

# Interaction Terms

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2$$

We've talked previously about interaction effects with categorical variables

- The same interpretation applies to quantitative variables

The level of $x_1$ changes the slope of the effect of $x_2$

- The slope for $x_1$ is now $\beta_1 + \beta_3 x_2$
- The slope for $x_2$ is now $\beta_2 + \beta_3 x_1$

# Example: Frequency Spectrum

Let’s look at some published data on message force and power spectrum by transmission frequency

# Next time…

Qualitative Variables