Interactions

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Definition

- Effect of given predictor variable depends on level or value of other predictor variable
- Examples:
  - Regression of `Body Weight` on `Breast Circumference` is different for different breeds
 - Effect of `Breed` on `Body Weight` is different for different male and female animals

Types of Interactions

- continuous by continuous
- continuous by categorical
- categorical by categorical

Continuous by Categorical

- In a model, expected value of response depends on regression variable plus discrete factor
- Example: Regression of `Body Weight` on `Breast Circumference` plus the factor `Breed`
- Interaction is present, if regression of `Body Weight` on `Breast Circumference` is different for different breeds

Interaction Plot
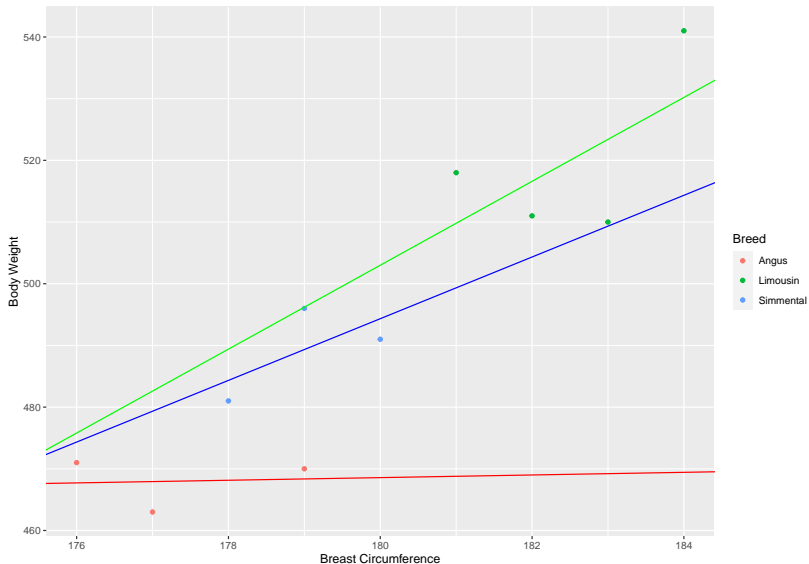
Interaction Model

▶ Start with model without interactions

$$y_i = b_0 + b_1 \times BC_i + b_2 \times BrLi_i + b_3 \times BrSi_i + e_i$$

▶ Assume linear relationship of b_1 with `Breed`

$$b_1 = a + b_4 \times BrLi + b_5 \times BrSi$$

▶ Insert

$$y_i = b_0 + (a + b_4 \times BrLi + b_5 \times BrSi) \times BC_i + b_2 \times BrLi_i + b_3 \times BrSi_i + e_i$$

▶ Simplify

$$y_i = b_0 + a \times BC_i + b_2 \times BrLi_i + b_3 \times BrSi_i$$
$$+ b_4 \times BrLi \times BC_i + b_5 \times BrSi \times BC_i + e_i$$

Continuous by Continuous

- ▶ Similar to continuous by categorical
- ▶ No interaction

$$y_0 = b_0 + b_1 \times BC_i + b_2 \times HE_i + e_i$$

- ▶ Interaction by dependence of one regression coefficient on other coefficient

$$b_1 = b_3 + b_4 \times HE_i$$

$$y_0 = b_0 + b_2 \times HE_i + b_3 \times BC_i + b_4 \times HE_i \times BC_i + e_i$$

Categorical by Categorical