Three-Way Interactions

- Interaction terms sometimes include three variables. (More than three would be very difficult to interpret.)
- In blood pressure study, say we also record whether a participant exercises using dummy variable *exer*.
- Three-way interaction, *drug*×*male*×*exer*, is variable that only equals 1 if all three indicator variables are 1.
- When we include power of one variable, we should also include all lower-order powers.
- Similarly, when we include interaction term, we must include all interactions that include subsets of those variables.

Including Three-Way Interaction Term

$$\begin{aligned}\text{Bp} = \beta_0 &+ \beta_1 \,\text{drug} + \beta_2 \,\text{male} + \beta_3 \,\text{exer} \\ &+ \beta_4 \,\text{drug} \times \text{male} + \beta_5 \,\text{drug} \times \text{exer} + \beta_6 \,\text{male} \times \text{exer} \\ &+ \beta_7 \,\text{drug} \times \text{male} \times \text{exer} + u\end{aligned}$$

- Saturated model: includes all variables and their interactions
  - Eight different groups
- Must interpret coefficient β_6 cautiously
  - If non-zero, may be unique combination of dummies with unusually high or low mean value
  - May be more than one combination with high or low value
  - Are combinations that can't be predicted based on two-way interactions