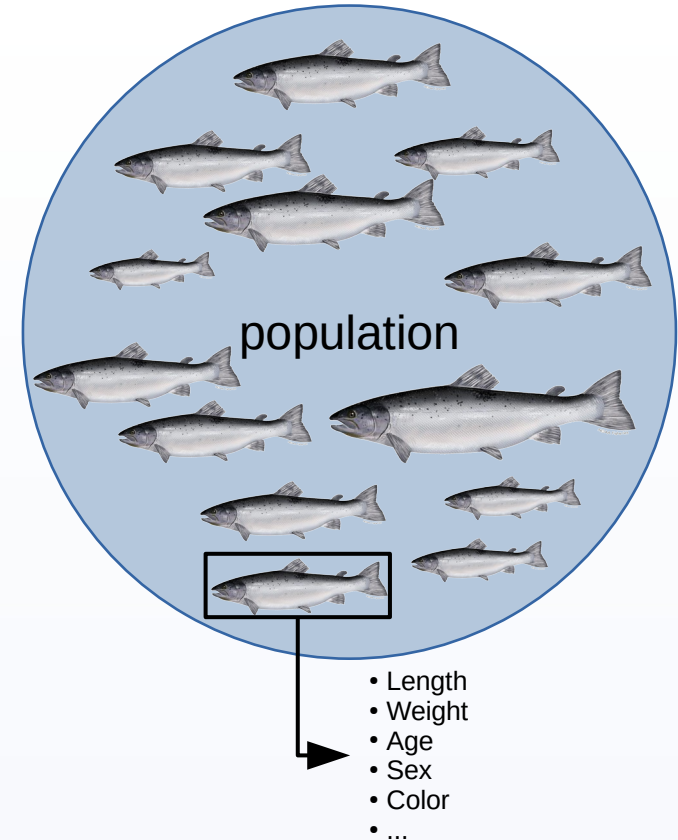


EGM101 – Skills Toolbox

Week 6, Part 1: Variables and Relationships

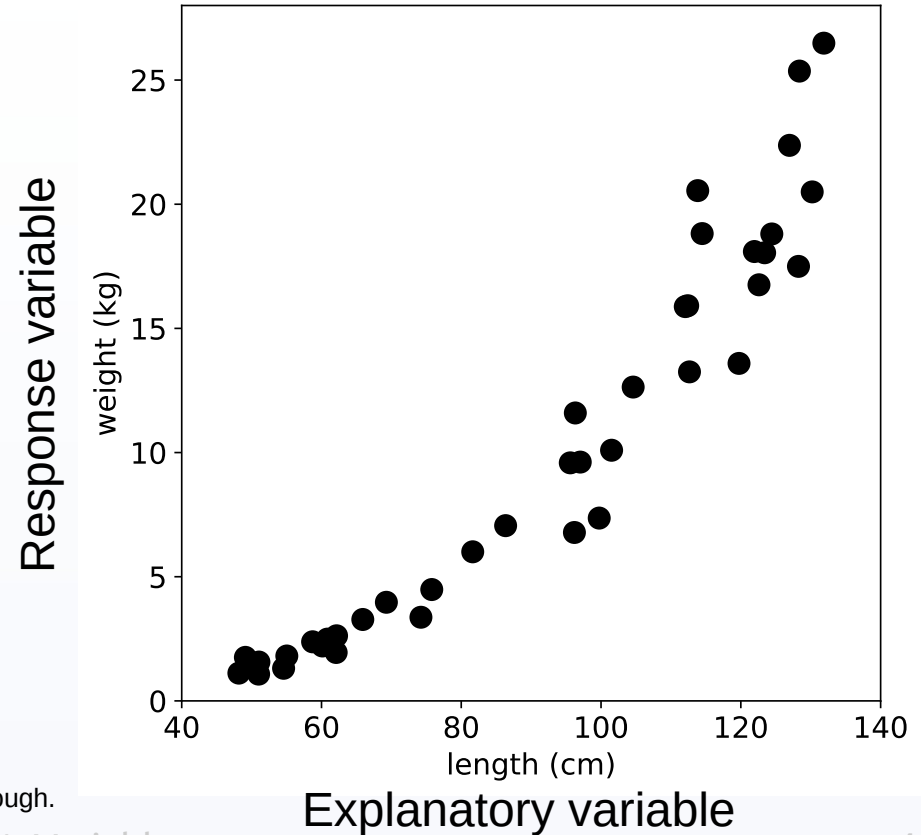
1. Variables and Relationships
2. Correlation
3. (Linear) Regression
4. Coefficient of Determination
5. Outliers
6. Interpolation and Extrapolation

- Recall:
 - **Variable**: some characteristic that will have different values for each member of the population
- Examples:
 - Fish length, weight, ...
 - Annual income
 - Opinion of government

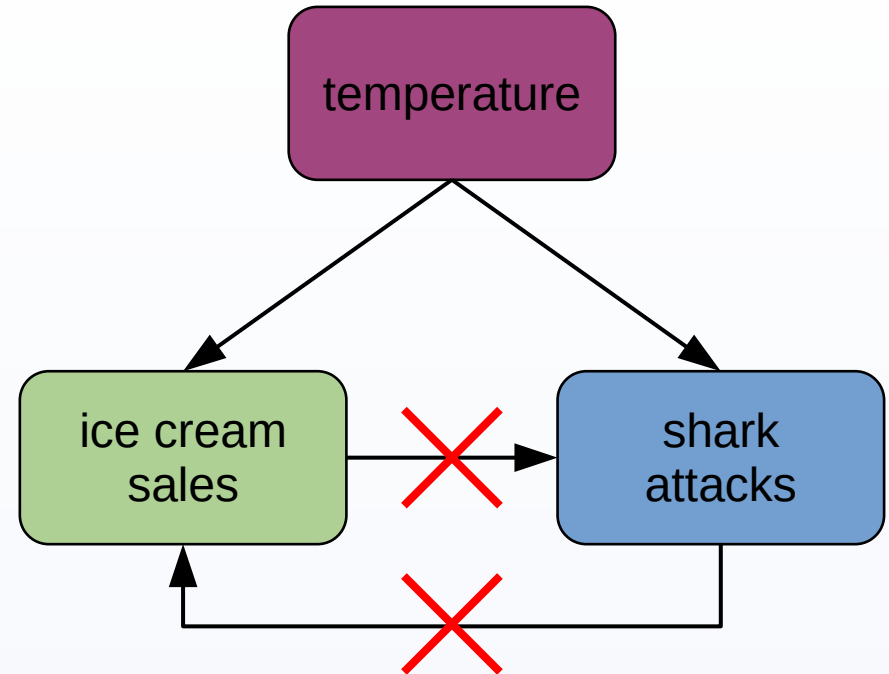


- Interested in how variables **relate** to each other
 - Independent variable**: variable whose value does not depend on another variable
 - Also called “**explanatory**” variable*
 - Dependent variable**: variable that (may) depend on the value of another variable
 - Also called “**response**” variable
- Normally on a graph:
 - Horizontal (x) axis: explanatory (independent)
 - Vertical (y) axis: response (dependent)
- Examine variation of response variable, based on value of explanatory variable(s)
 - Association**: there is some relationship between the variables
 - NB: this does **not** imply a **causal** relationship!

*not necessarily interchangeable, though.



- **Causality**: a change in one variable causes a change in the other
- Not all associations are due to causality!
 - No relationship at all
 - **Confounding variables**
- Example: shark attacks and ice cream sales*

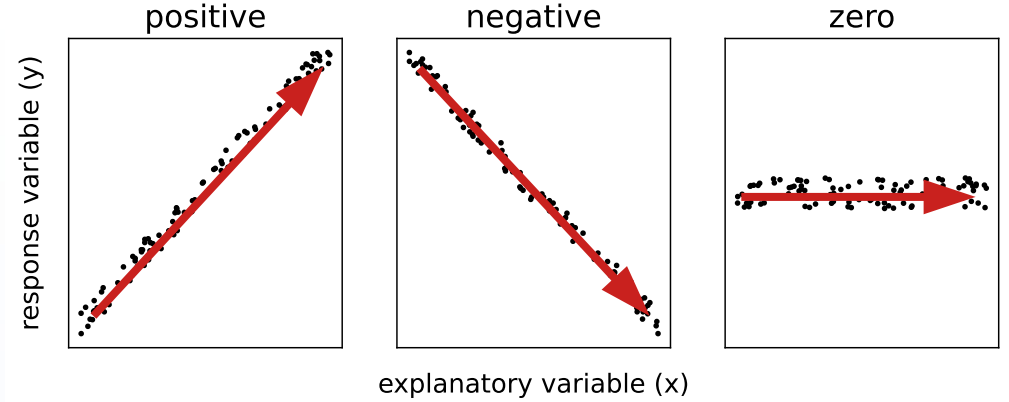


*I believe it is a legal requirement to use this example in an introductory statistics lecture.

What's in a Relationship?

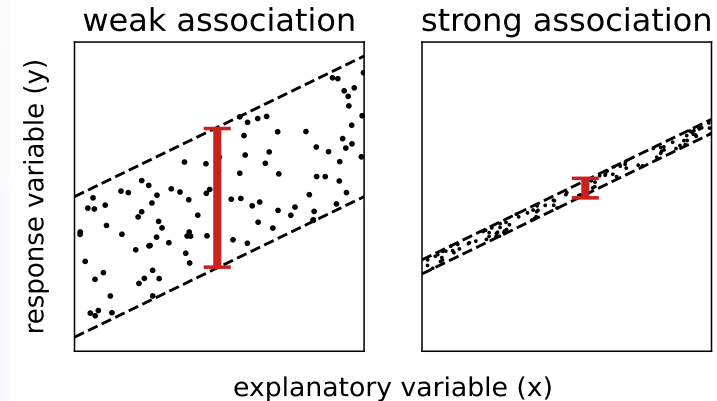
- Direction

- **Positive:** $x \uparrow, y \uparrow$
- **Negative:** $x \uparrow, y \downarrow$
- **Zero:** no change



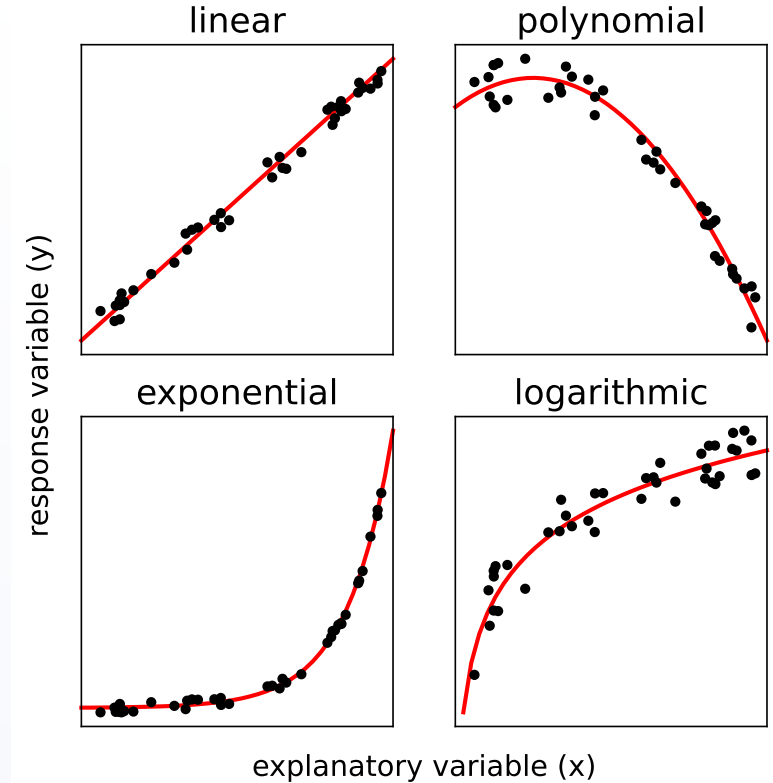
- Strength/consistency

- **Weak:** large spread of y for fixed x
- **Strong:** small spread of y for fixed x



Types of Relationships

- Linear
 - Graph makes straight line
- Nonlinear (Curvilinear):
 - Polynomial: $(x + c)^n$
 - Exponential: a^x
 - Logarithmic: $\log_a(x)$



- A big part of statistics (science more generally) is understanding the relationships between variables
 - Response variables
 - Explanatory variables
- Consider:
 - Causality
 - Direction, strength, form of relationship
- Not all relationships are causal (more on this later)

- Illowsky and Dean, Chapter 12.1
- Caswell, Chapters 9.1, 9.2
- Weiss, Chapter 4.2
- Explanatory Variables Explained [[Prof. Essa](#)]
- What is a variable? [[Jim Frost](#)]