Lecture 1: Syllabus

- Please look over the syllabus as it has all the details of the class and how it will run.

Lecture 1: Who am I?

- Bill Perry
- Office is in SSB 13
- Phone 218-726-8145
- Email is wlperry_at_d.umn.edu

Lecture 1: My goals

- How do we make observations and hypotheses?
- How do we design an experiment
- How do we collect data?
- How do we organize, clean, summarize, and view the data?
- How do we use statistics to test our hypotheses
  - what tests to use
  - what are the assumptions
  - what are the interpretations

Lecture 1: My expectations

- Communication
- Practice
- Failure
- Learn to correct and troubleshoot

Lecture 1: Science

- Way to acquire knowledge, organize it and apply it back to the real world
- Make predictions and testing these predictions using a falsifiable approach - statistics
- Explanations that cannot be falsified are not science

What is Statistics?

Zar (1999) - “analysis and interpretation of data with view towards objective evaluation of conclusions based on the data”

Lecture 1: Inductive reasoning (Specific → General)

Inductive Reasoning (Specific → General)

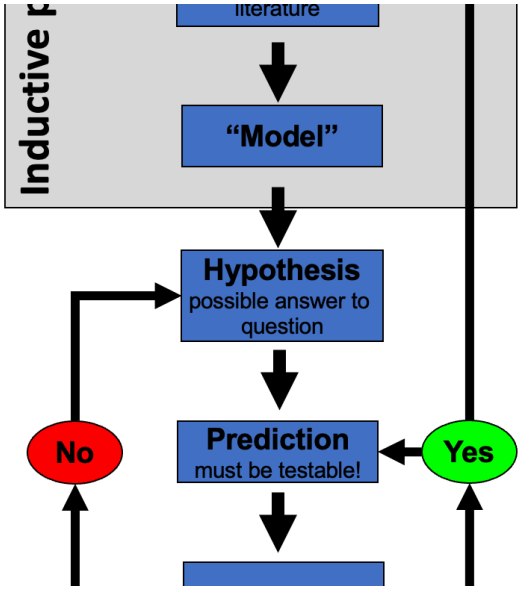
Inductive reasoning involves observing specific cases and using them to form a general conclusion.

Example:

1. Measure **10 pine needles** from a tree - average length is **75 mm**.
2. Measure **10 more needles** from the same tree and gets similar results.
3. Measures needles from second tree - average length is **120 mm** .
4. You **generalize** pine needles from different trees **vary in length**, but each tree tends to have a characteristic range.

Conclusion (Induction): *"Pine needle length varies by tree, but each tree seems to have a typical range of lengths.*

Potential Issue: Conclusion is **not guaranteed** to be true - based on patterns observed in a sample, and there could be exceptions.



Lecture 1: Deductive reasoning (General → Specific)

Deductive Reasoning (General → Specific)

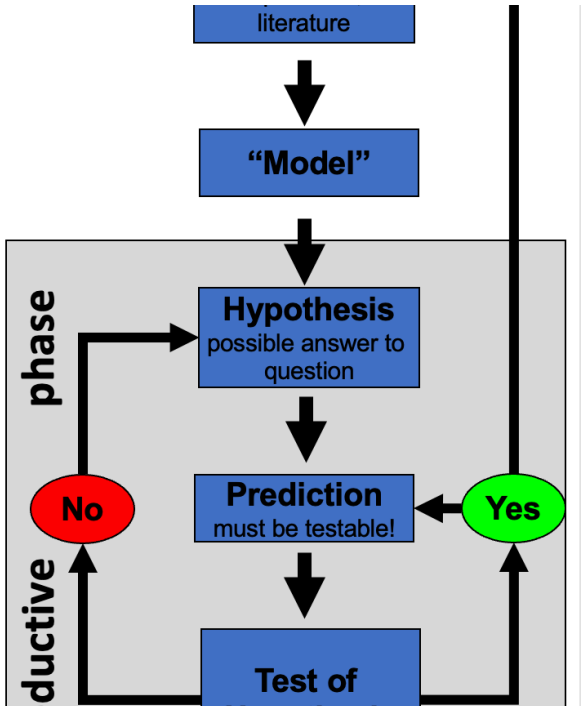
Deductive reasoning starts with a general principle and applies it to a specific case.

Example:

1. **General Principle:** *Pine needles from a species of pine tree have a predictable length range (e.g., 70–80 mm).*
2. **Specific Case:** Collect sample of pine needles and measure them.
3. **Prediction:** Since its the species the needle lengths **should** fall within 70–80 mm.
4. **Measurement:** Check the data and confirm needles fall within this expected range.

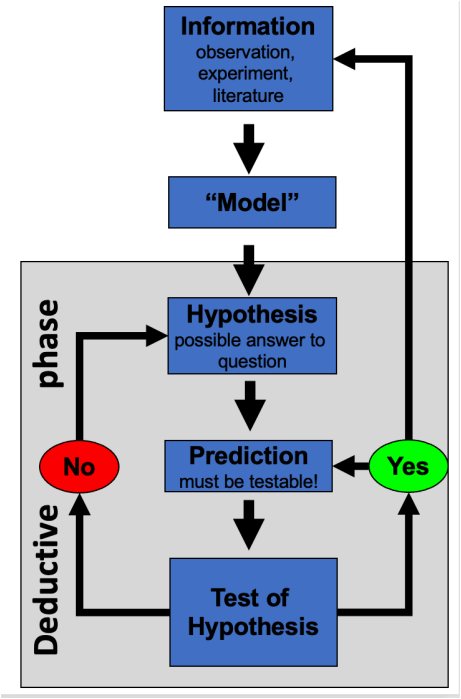
Conclusion (Deduction): *"This tree belongs the species with a needle length range of 70–80 mm, we expect its needle lengths to fall in this range."*

Stronger than induction because it's based on a general rule—but if the assumption (length range) is incorrect, conclusion could still be wrong.



Lecture 1: Reality of reasoning

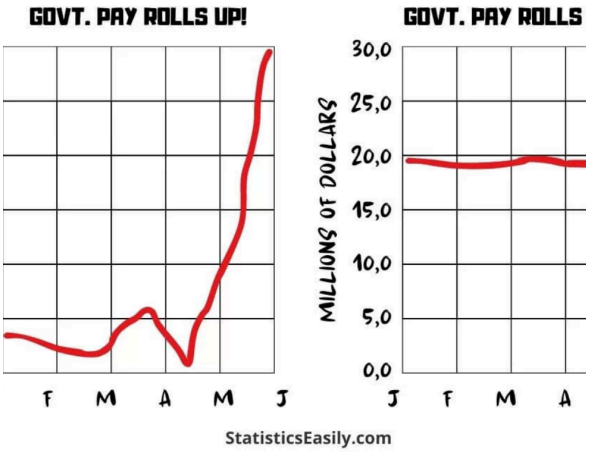
In reality we are doing both of these processes



How do we test hypotheses

Statistics

- Design good experiments
- Design good tests
- Summarize patterns/data
- Use to make probabilistic determinations to see if differences are "real"



Data Types

- **Continuous**
  - numeric
- **Discrete**
  - integer or numerical
- **Categorical**
  - nominal – up, down, right, left…
  - ordinal – order - a, b, c, d or morning, afternoon, evening

Measurements

Data is obtained through measurement

The world is a messy place and how you measure matters

Our measures depend on

- **accuracy** - how close we are to the real value
- **precision** - how close all our measurements are but may not be precise