The Language of Statistical Decision Making

Lecture 2
Section 1.3

Robb T. Koether

Hampden-Sydney College

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Outline

Outline

Populations and Samples

Definition (Population)

The population is the set of all individuals *of interest* to the study.

Definition (Sample)

A sample is a set of individuals in the population from which data were obtained. Their characteristics were observed or measured.

Populations and Samples

- In our coin-tossing experiment,
  - What was the sample?
  - What was the population?
  - Is it practical to sample the entire population?

Outline

Inferences

Definition (Statistical inference)

A statistical inference is a conclusion that is drawn about the population, based on what was observed in the sample.

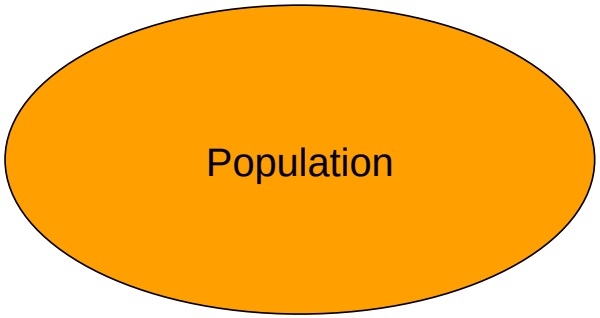
Inferences

- In the coin-tossing experiment, what did we observe?

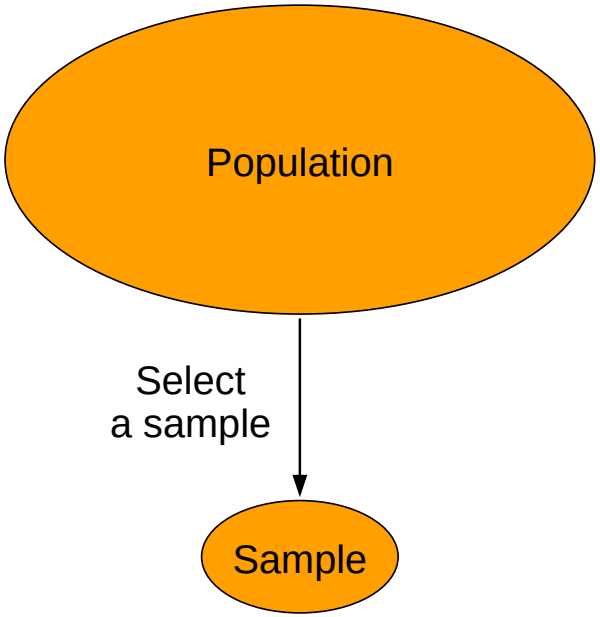
Inferences

- In the coin-tossing experiment, what did we observe?
- Based on that observation, what inference did we make about the coin?

Samples and Inferences



Samples and Inferences



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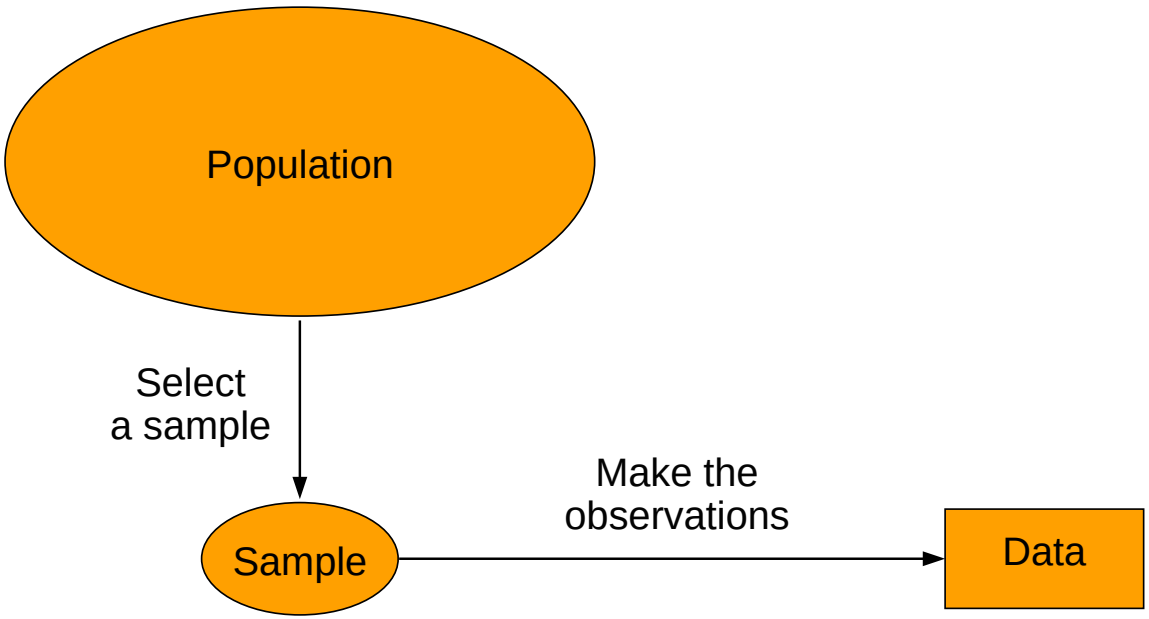

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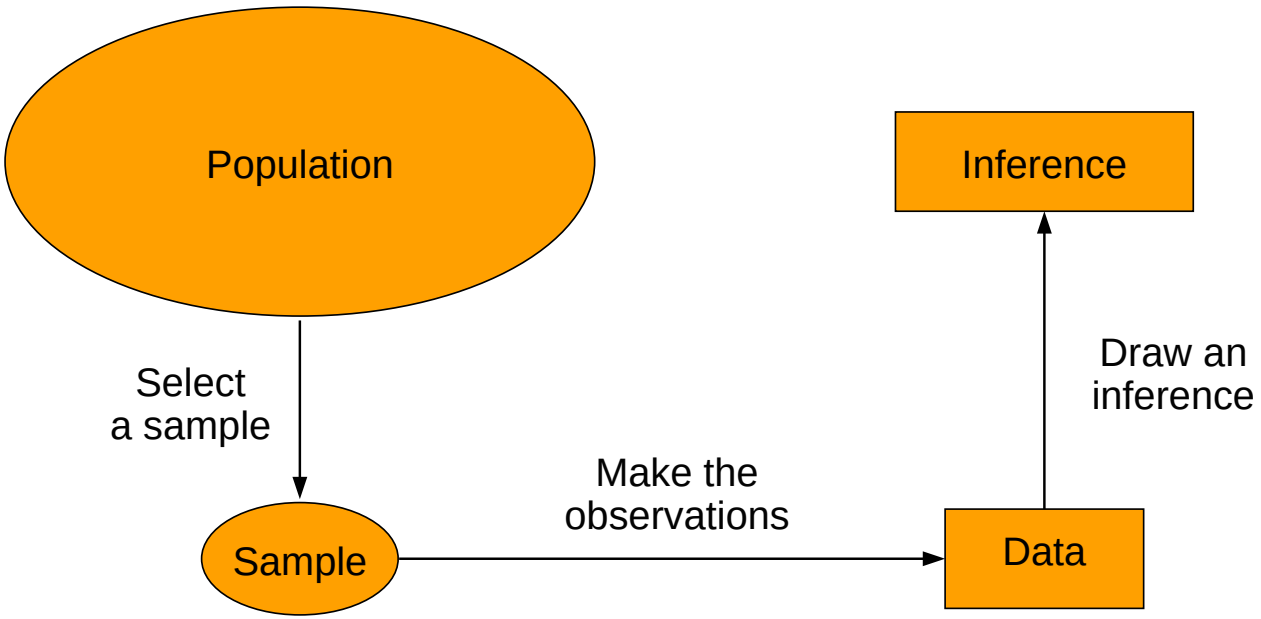

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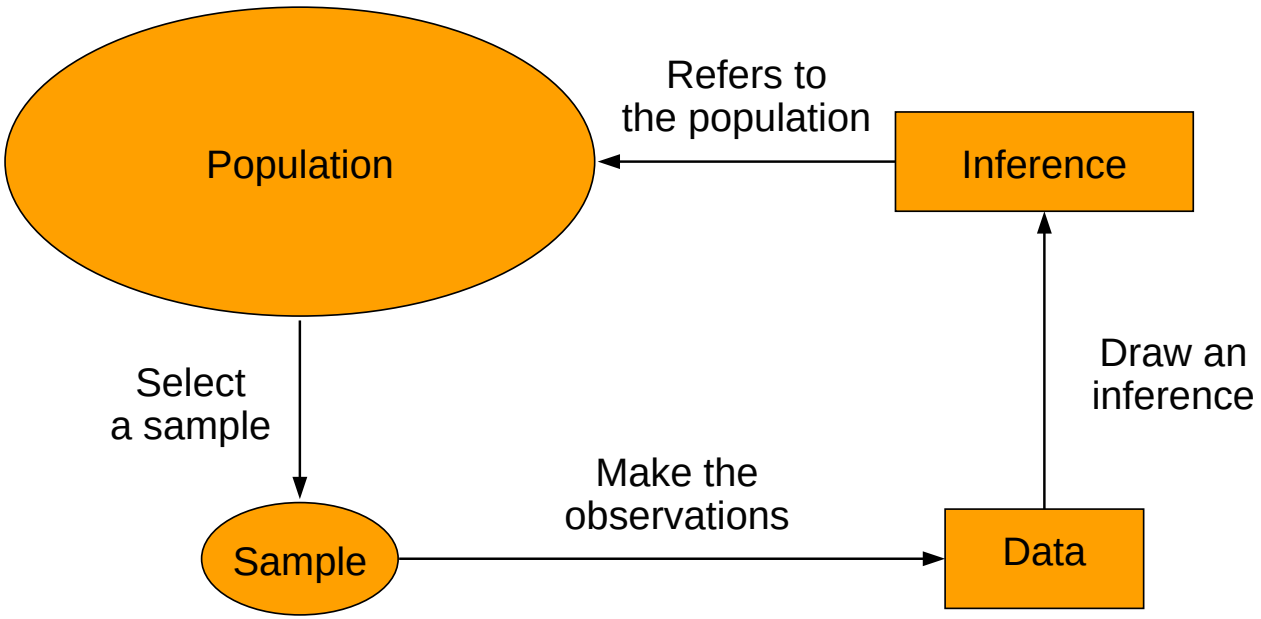

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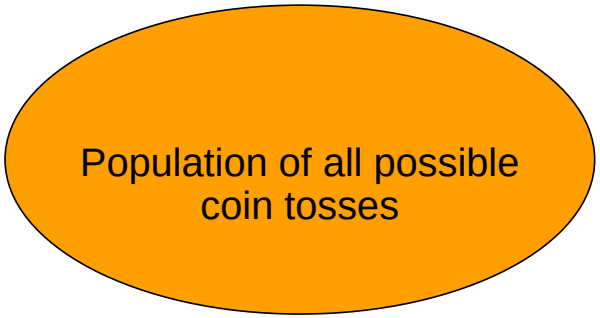

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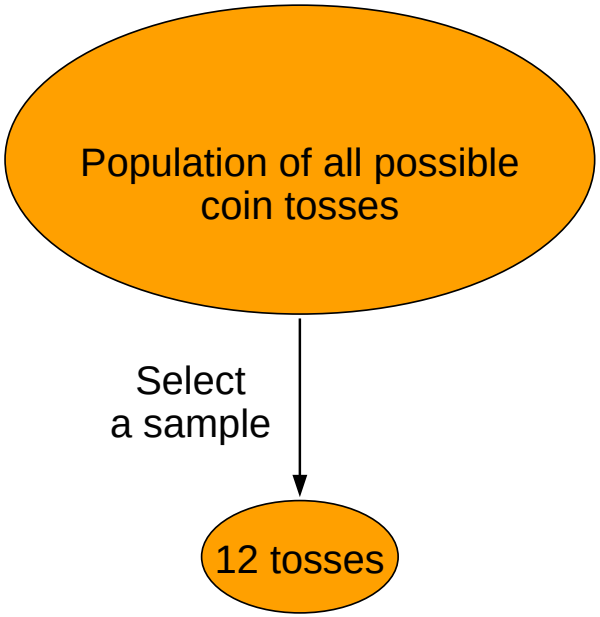

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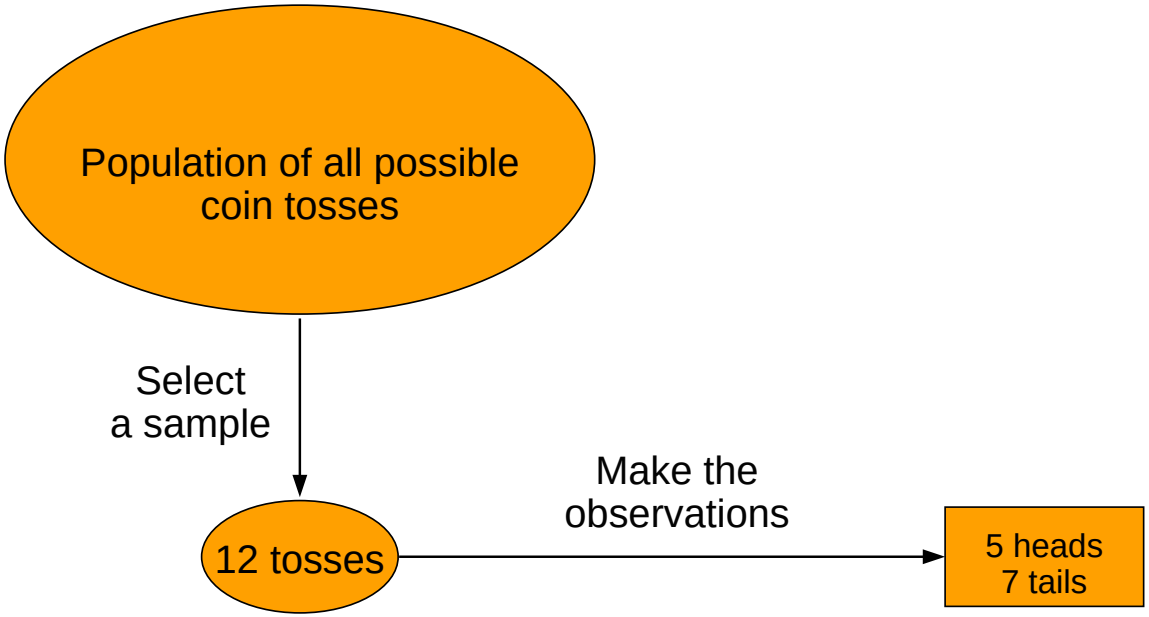

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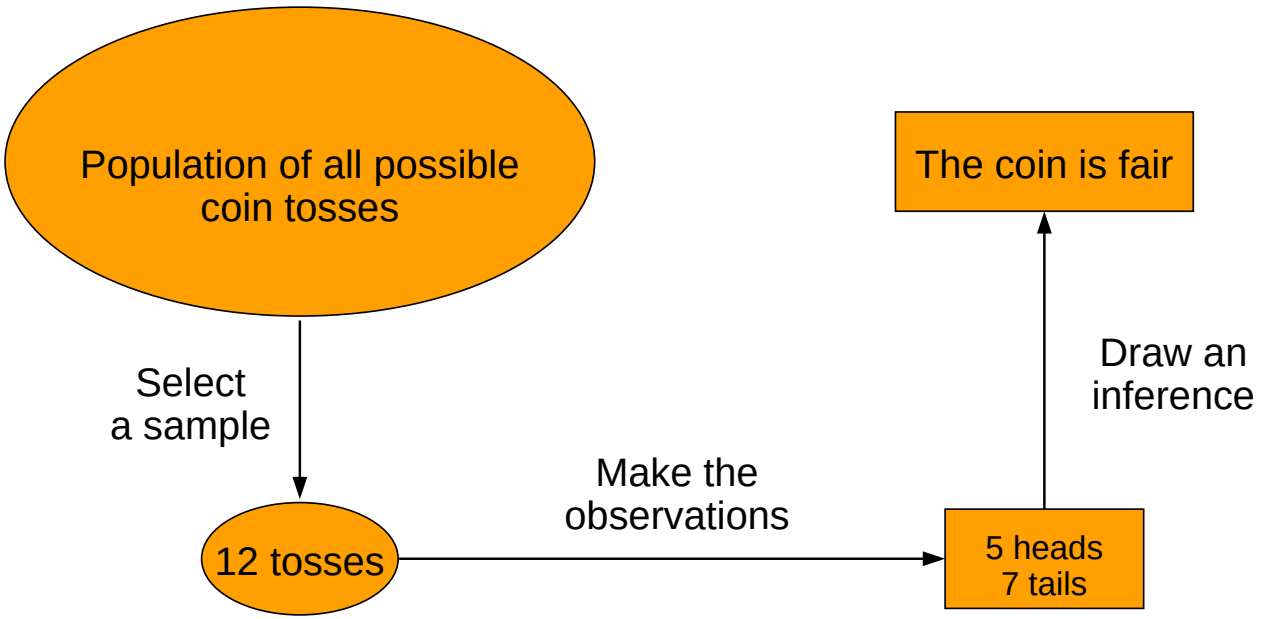

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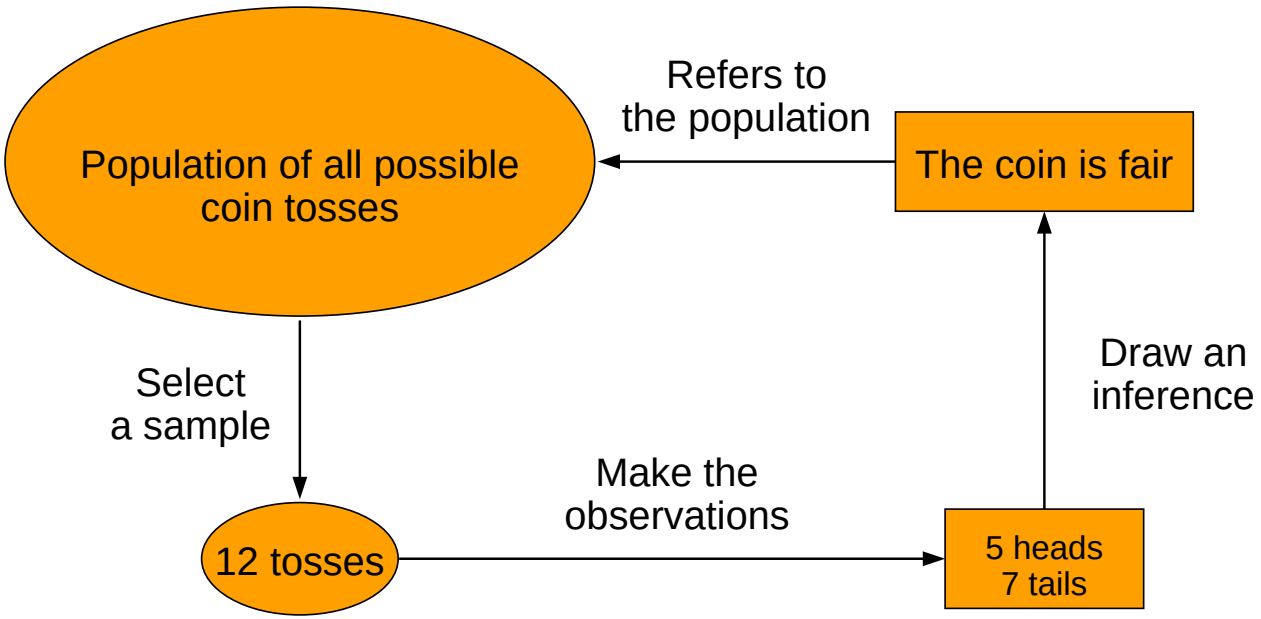


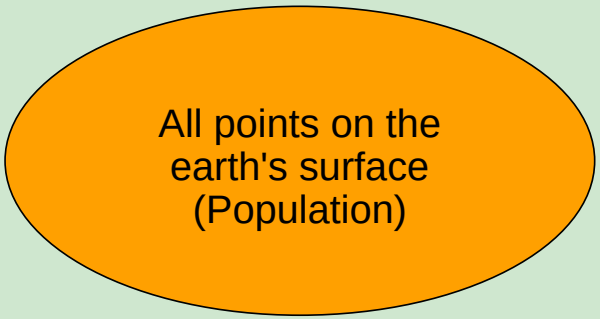
Samples and Inferences

Example (Samples and Inferences)

- Is the earth getting warmer?
- How can we tell?

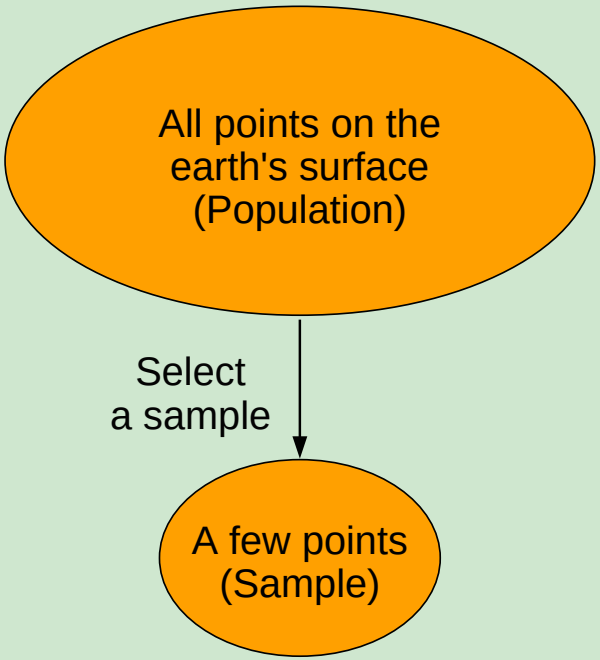
Samples and Inferences

Example (Samples and Inferences)



Samples and Inferences

Example (Samples and Inferences)



Samples and Inferences

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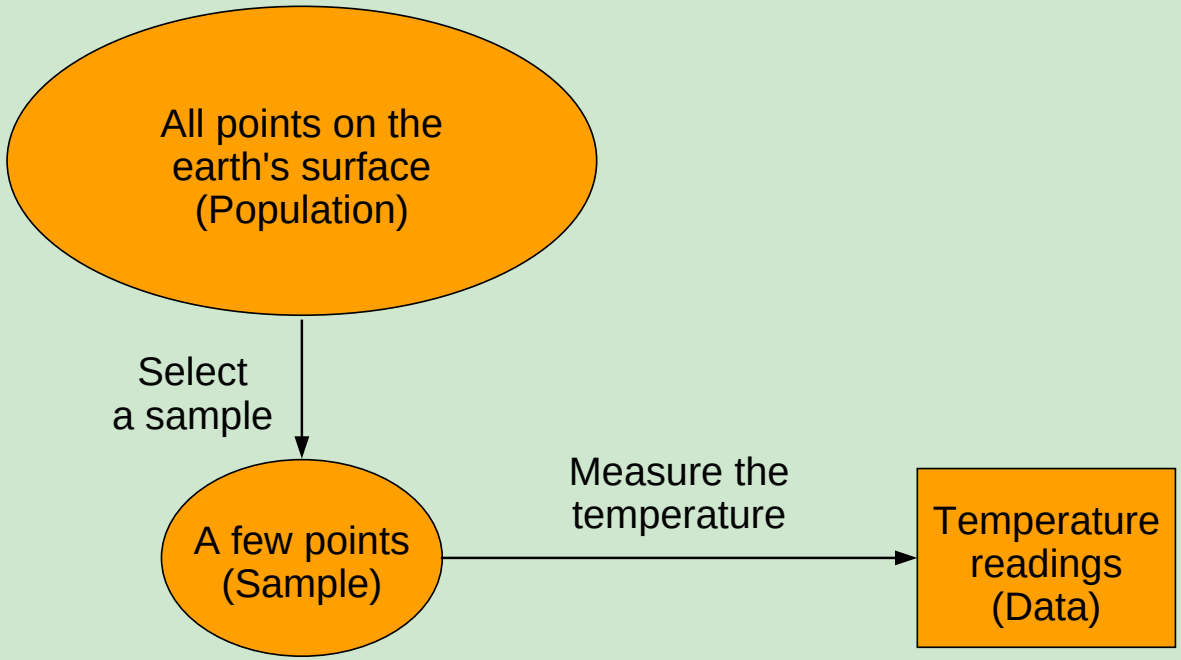
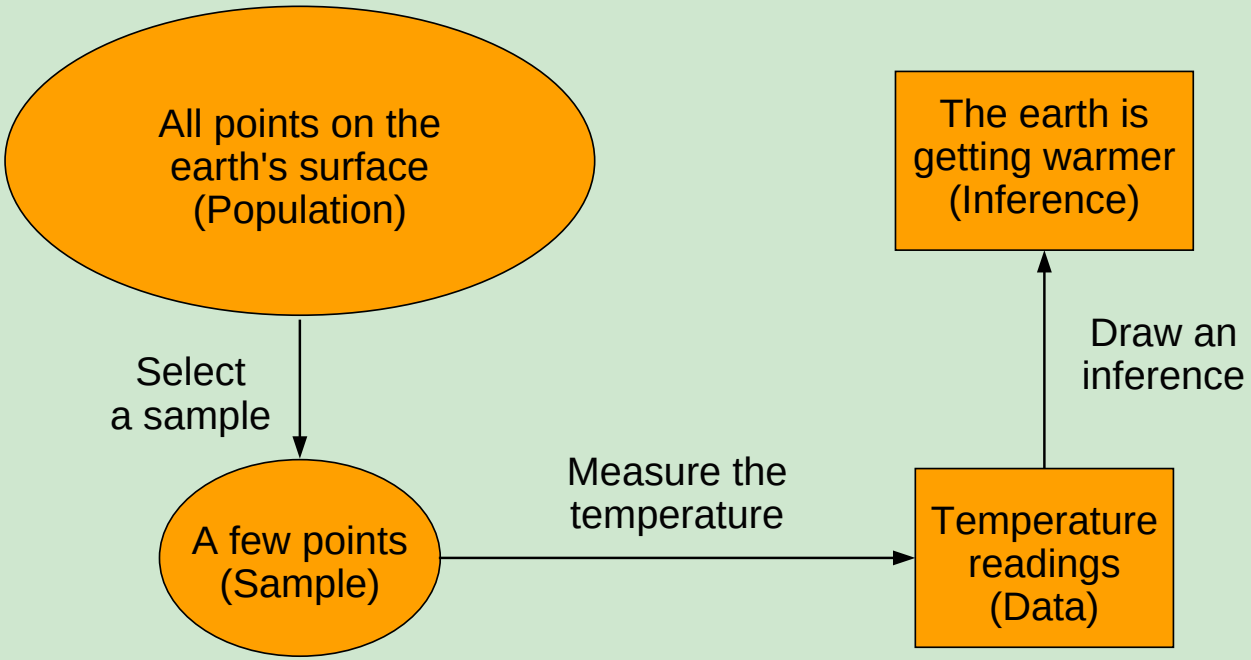


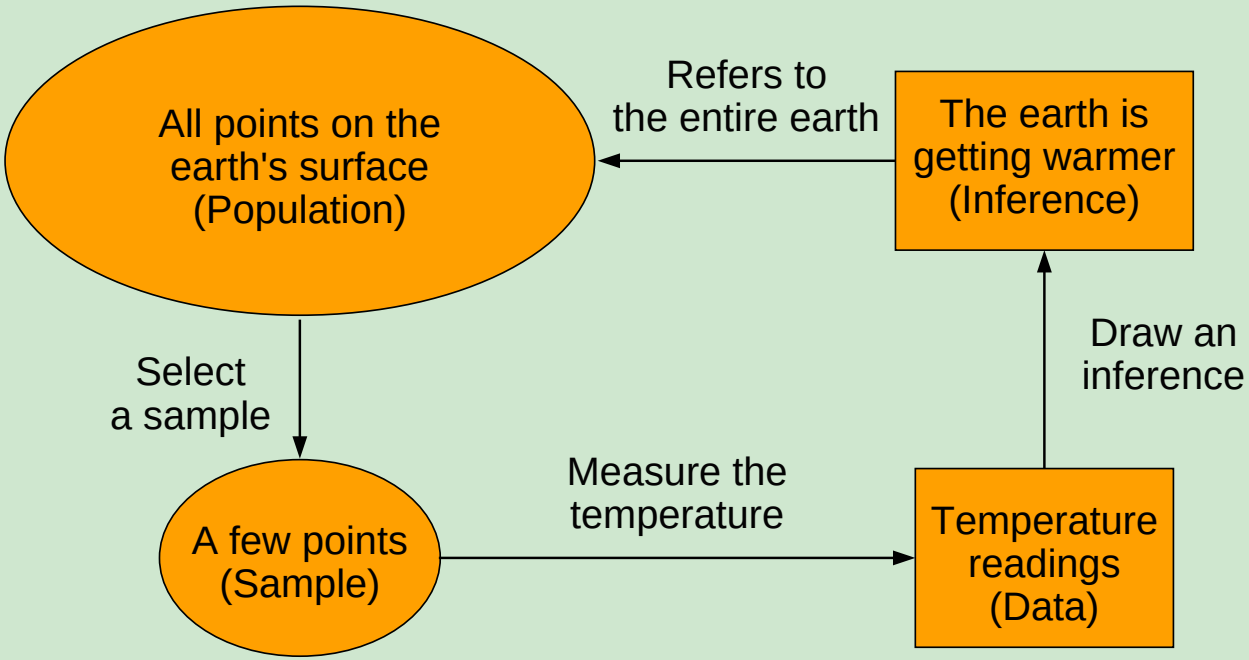
Samples and Inferences

Example (Samples and Inferences)



Samples and Inferences

Example (Samples and Inferences)



Outline

Hypotheses

Definition (Hypothesis)

A hypothesis is a statement that is proposed to explain an observed phenomenon.

- In statistics the “phenomenon” is what was observed in the sample.
- The hypothesis is a statement about the population that explains the phenomenon.

Hypotheses

Example (The Coin-Toss Experiment)

- When we tossed the coin, it landed heads 5 out of 12 times.
- That was not 50% of the tosses. How do we explain it?
- One hypothesis could be that the coin is not fair, but it is biased towards heads. Perhaps the probability of heads is $\frac{5}{12}$.
- What is another hypothesis?

Hypotheses

Example (Global Warming)

- Suppose our temperature measurements of the earth are warmer on the average (than in the past).
- One hypothesis is that we observed warmer temperatures at the few places we observed because the earth is getting warmer.
- What is another hypothesis?

Null Hypothesis

Definition (Null Hypothesis)

The null hypothesis H_0 is the conventional belief about the population, or the status quo, or the neutral position.

- It assumes no special effect, only chance.
- It requires no special justification.
- That is, it receives the benefit of the doubt.

Alternative Hypothesis

Definition (Alternative (or Research) Hypothesis)

The alternative hypothesis H_1 is an alternative to the null hypothesis.

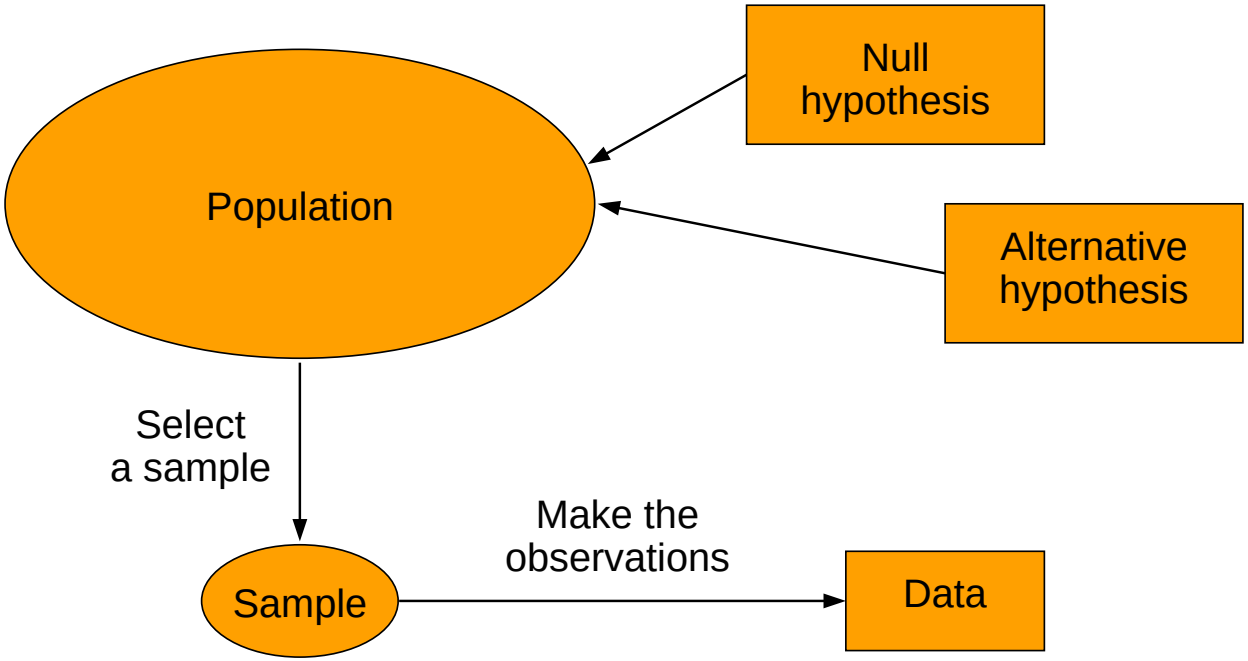
- It assumes an effect other than chance.
- It requires evidence for its justification.
- That is, it bears the burden of proof.

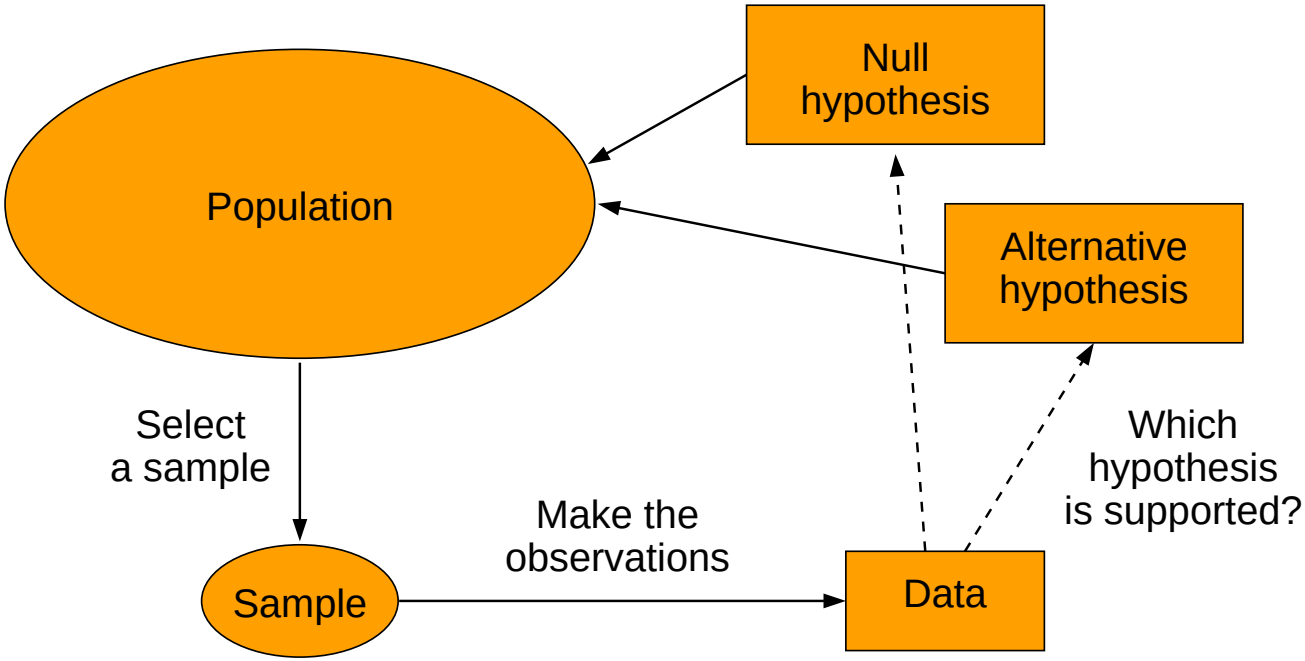
Alternative Hypothesis

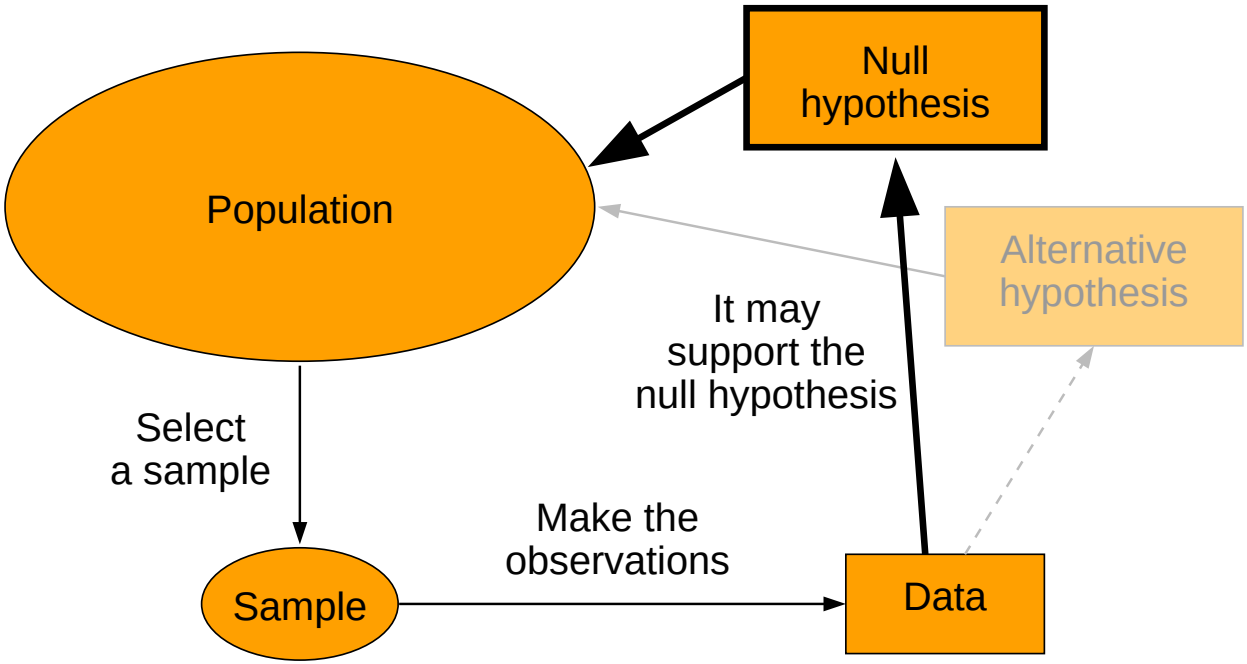
- In the coin-tossing experiment, the hypotheses are
  H_0 : The coin is fair.
  H_1 : The coin is not fair.

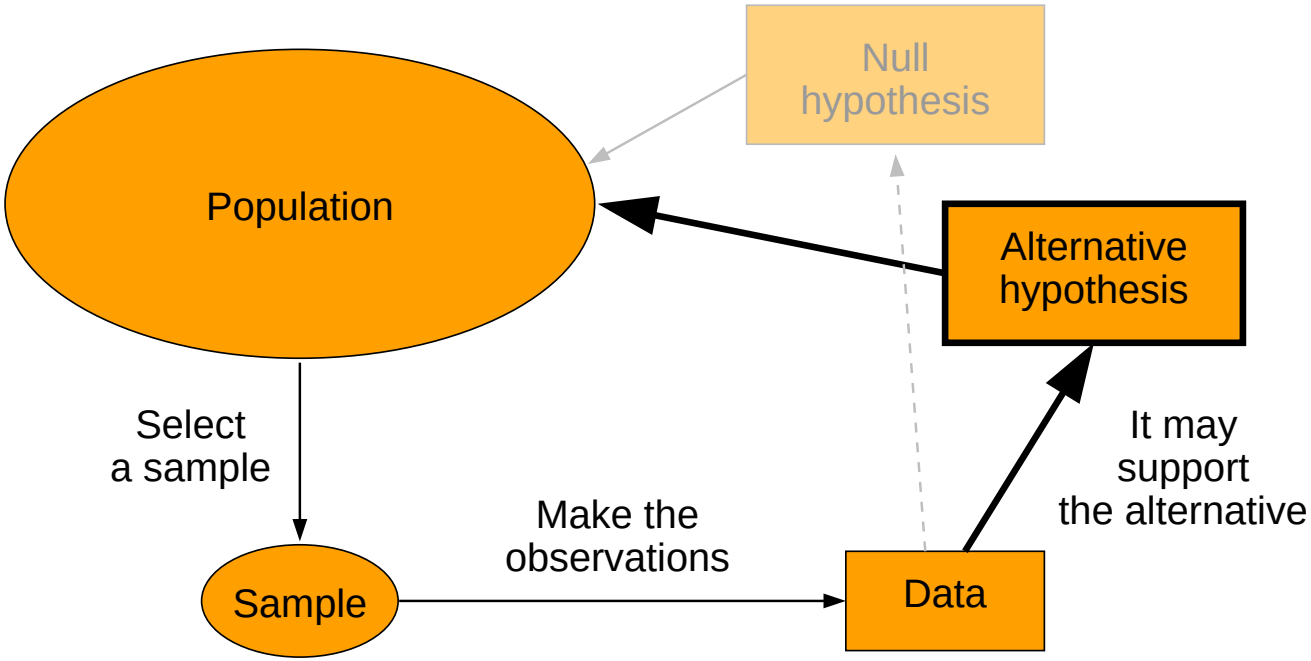
Alternative Hypothesis

- Or we could quantify that as
  H_0 : The probability of heads is $\frac{1}{2}$.
  H_1 : The probability of heads is not $\frac{1}{2}$.


Null
hypothesis
Population
Alternative
hypothesis
Select
a sample
Make the
observations
Sample
Data


Null
hypothesis
Population
Alternative
hypothesis
Select
a sample
Which
hypothesis
is supported?
Make the
observations
Sample
Data


Null
hypothesis
Population
Alternative
hypothesis
It may
support the
null hypothesis
Select
a sample
Make the
observations
Sample
Data


Null
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Population
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Select
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It may
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Make the
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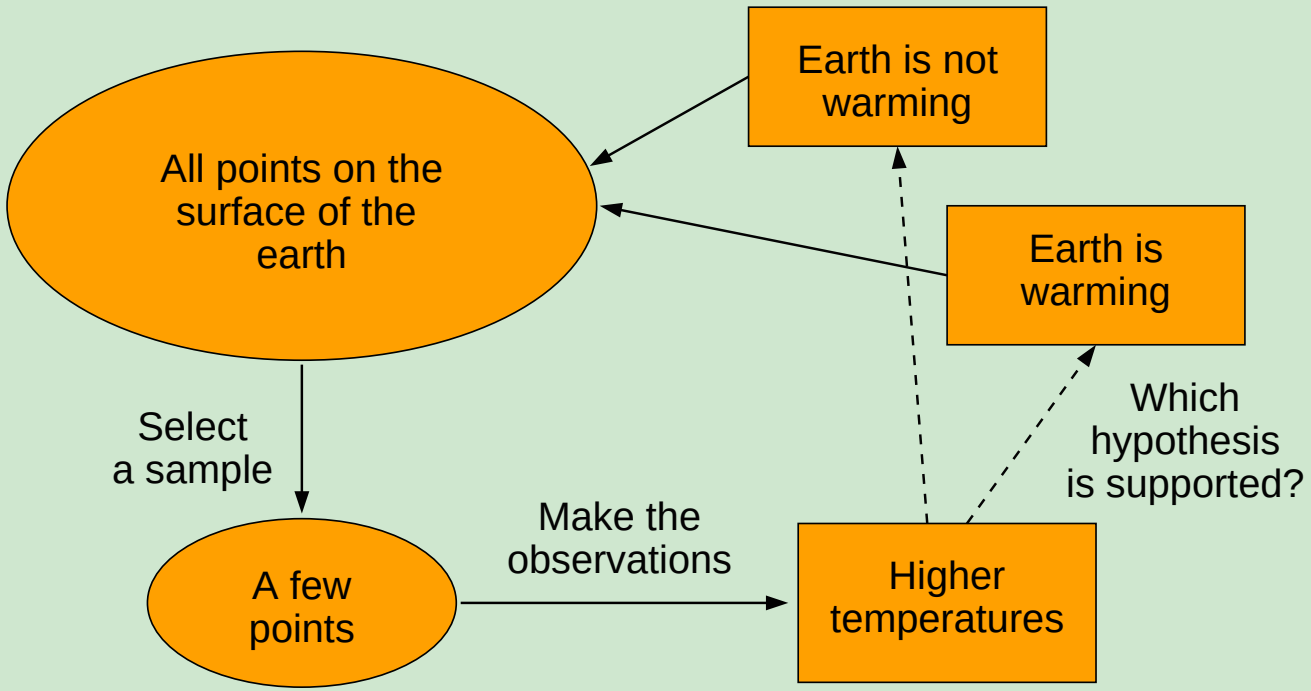
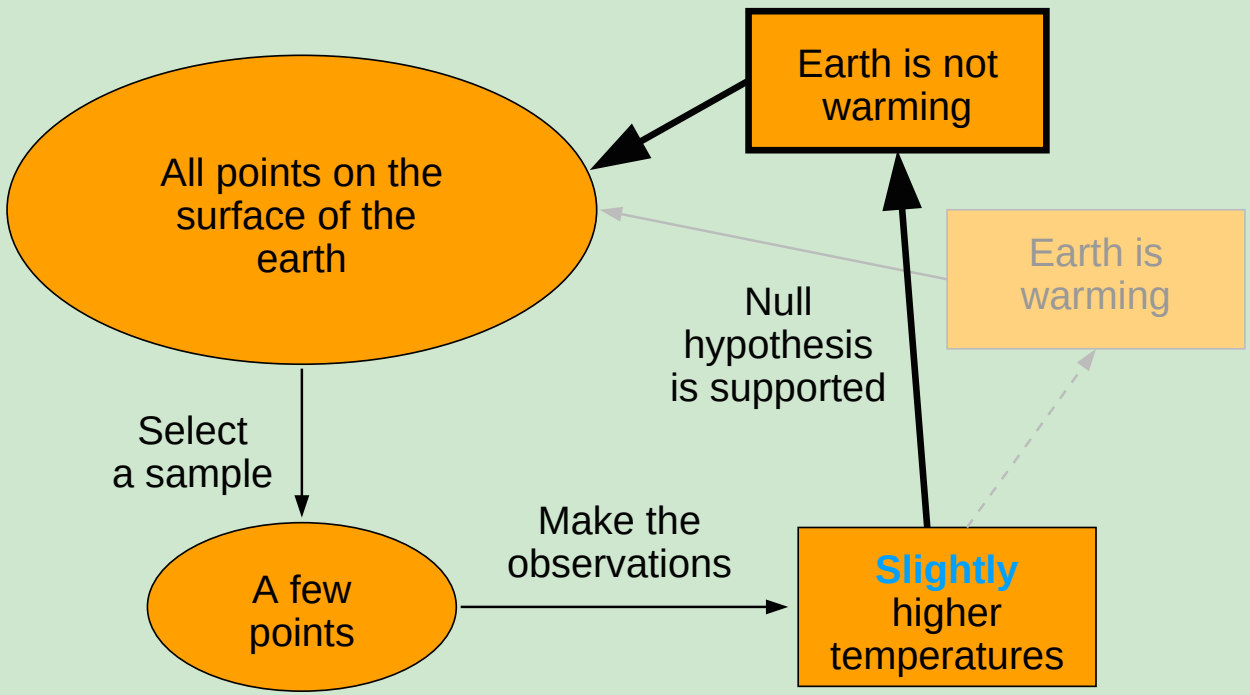
Null and Alternative Hypotheses

Example (Null and Alternative Hypotheses)



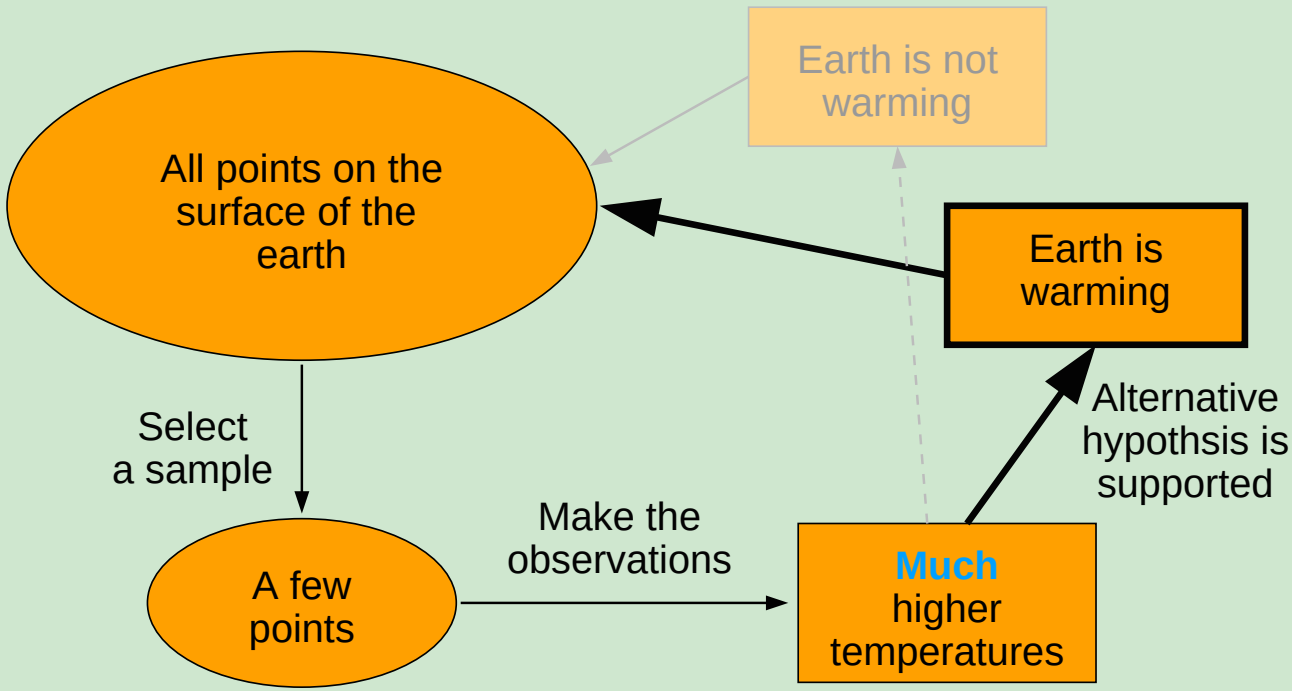
Null and Alternative Hypotheses

Example (Null and Alternative Hypotheses)



Null and Alternative Hypotheses

Example (Null and Alternative Hypotheses)



Concealed Carry Example

Example (Concealed Carry)

- An article[a] appeared Aug 14, 2011 in the Richmond Times-Dispatch titled “Gun crimes drop at Virginia bars and restaurants.”

[a] http://www2.timesdispatch.com/news/2011/aug/14/tdmain01-gun-crime-drops-at-virginia-bars-and-rest-ar-1237278/

Concealed Carry Example

Example (Concealed Carry)

- The article included the following tables (condensed).

Bars and Nightclubs

Category	2009-10	2010-11
Aggravated assault	11	9
Robbery	9	8
Other	1	2

Restaurants

Category	2009-10	2010-11
Aggravated assault	11	9
Robbery	118	116
Other	2	1

- Do the data support the claim in the title?

Outline

Statistical Significance

Definition

The data are called statistically significant if their deviation from what would be expected under the null hypothesis is too great to be attributed to sampling error.

Statistical Significance

Example (Statistical Significance)

- In the coin-tossing, the result of 5 heads and 7 tails was not statistically significant.
- What outcomes would have been statistically significant?

Outline

Assignment

Homework

- Read Section 1.3 - 1.3.2, pages 4 - 11.
- Let's Do It! 1.1, 1.2, 1.3, 1.4.
- Page 67, exercises 1 - 4.