Hypothesis Testing I: Making Decisions

Introduction to Data Science Algorithms

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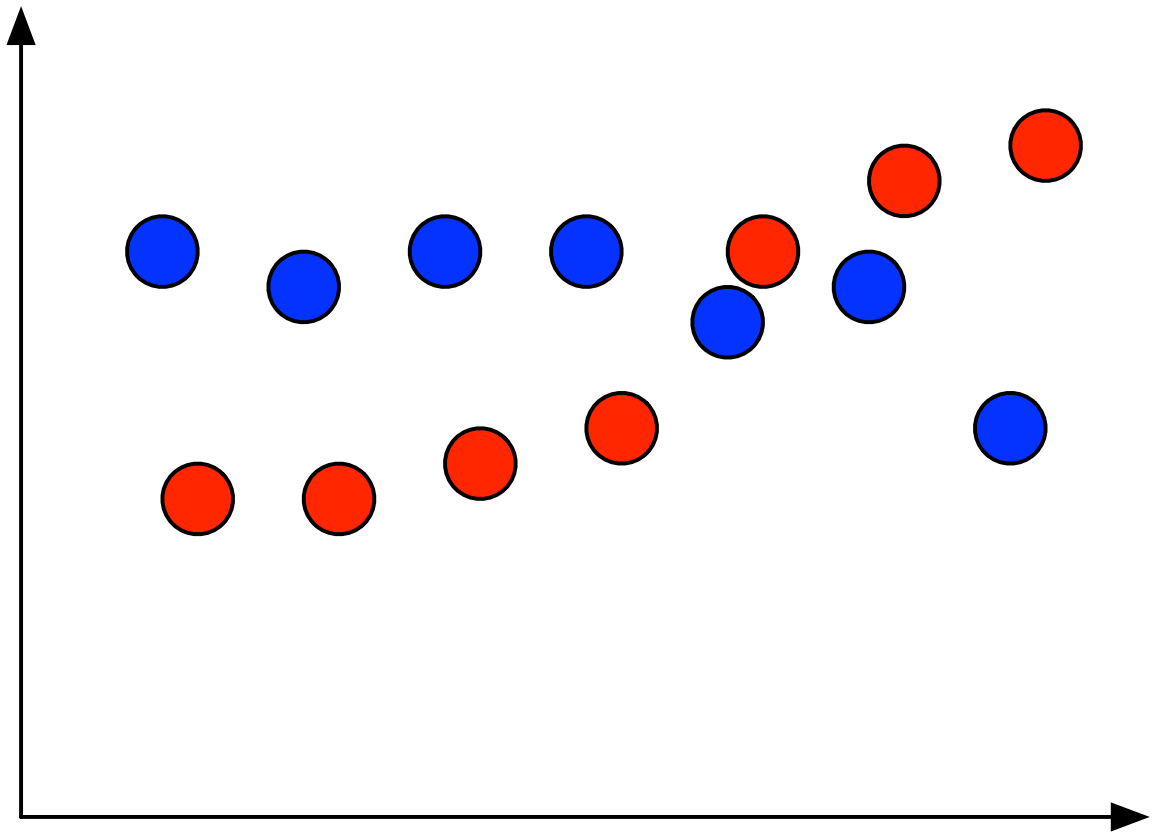
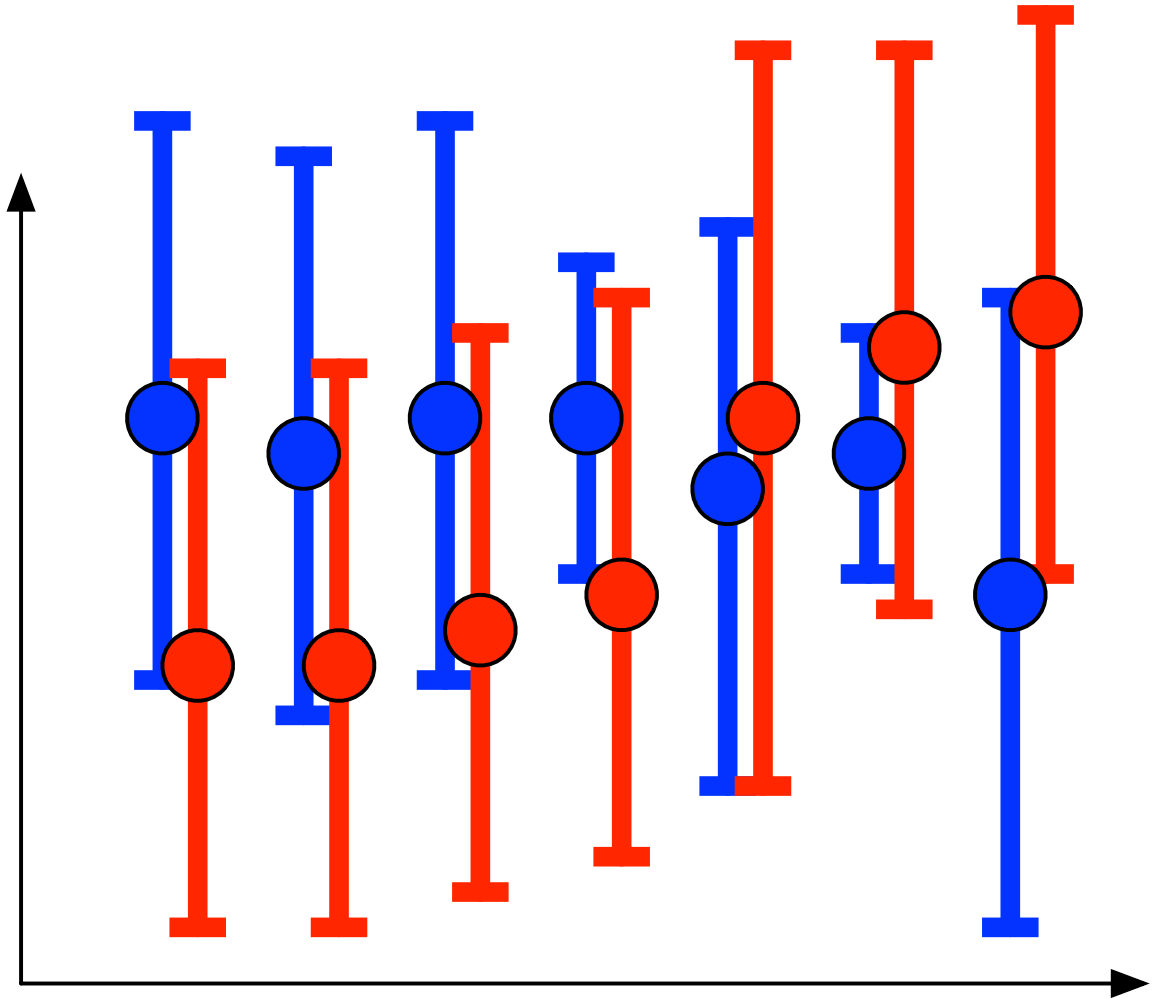
Point Estimates Lie



Point Estimates Lie



So how can you make a decision?

- Error bars help, but not systematic
- Make the point that decisions need to not just look at single estimates but *distributions*
- Statistical Test: Deciding whether a hypothesis is true or not

Statistical Test Lingo

- Null hypothesis
- test statistic
- p-value
- p-hacking

Null hypothesis

Null Hypothesis

A statement that can be validated through a statistic derived from observations.

- Often status quo
- Goal prove false: “reject the null”
- Phrased in terms of distributions

Examples

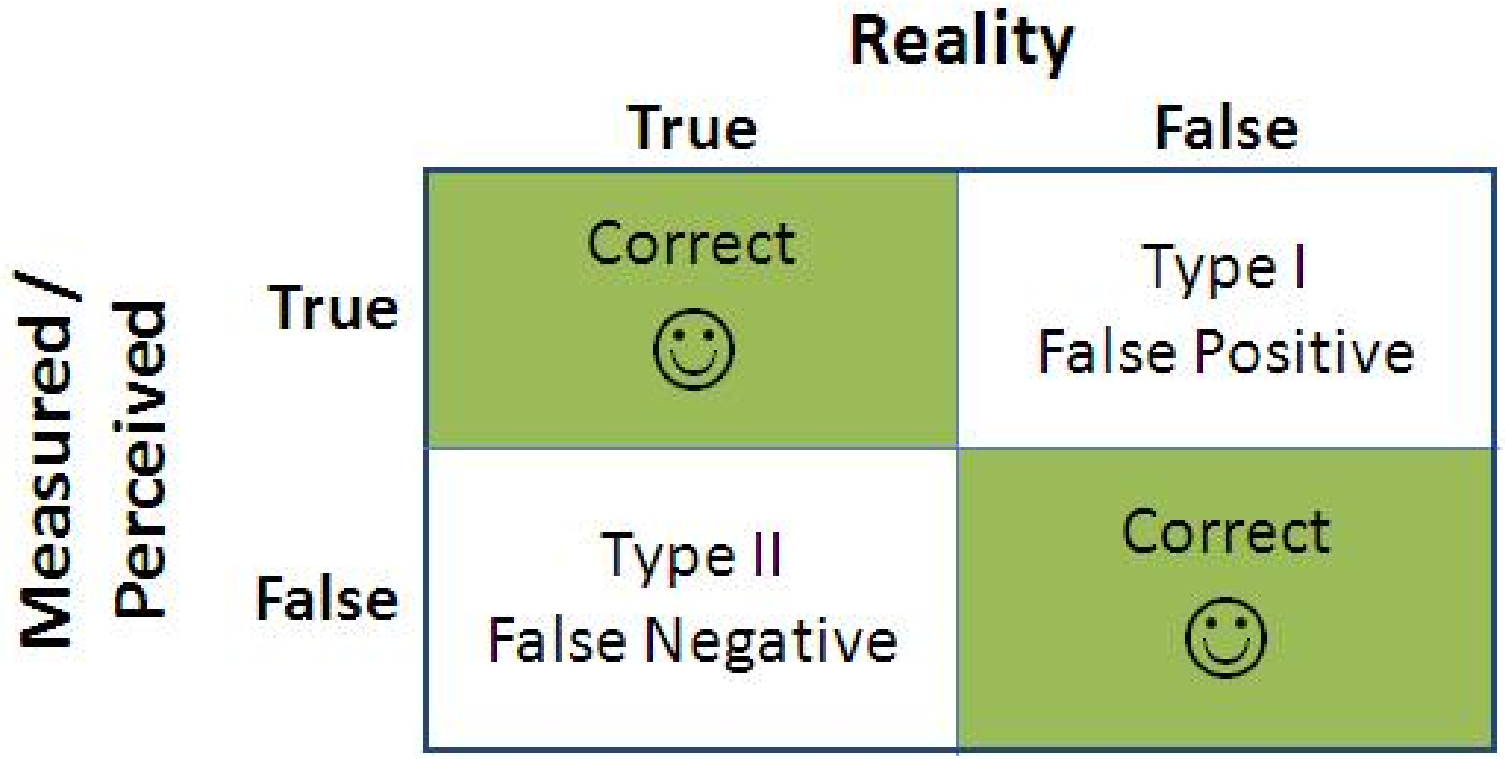
- Average body temperature 98.6?
- Voting republican and education independent?

Body temperature

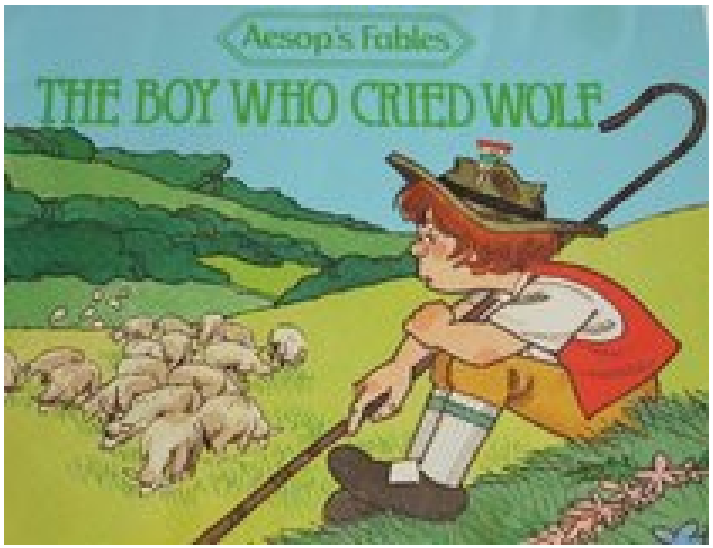
$n = 130$, $\bar{x} = 98.249$, standard deviation $s = 0.7332$.

- Not exactly equal (but wouldn't expect that)
- Is the difference meaningful?
- Null hypothesis, $H_0 : \mu = 98.6$
- Alternative hypothesis, $H_a : \mu \neq 98.6$

What can happen

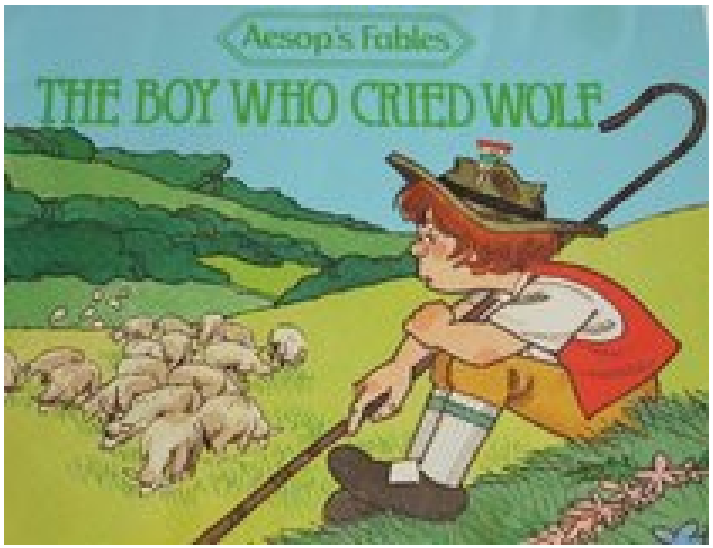


Boy who cried wolf



- Null hypothesis (status quo): no wolf

Boy who cried wolf



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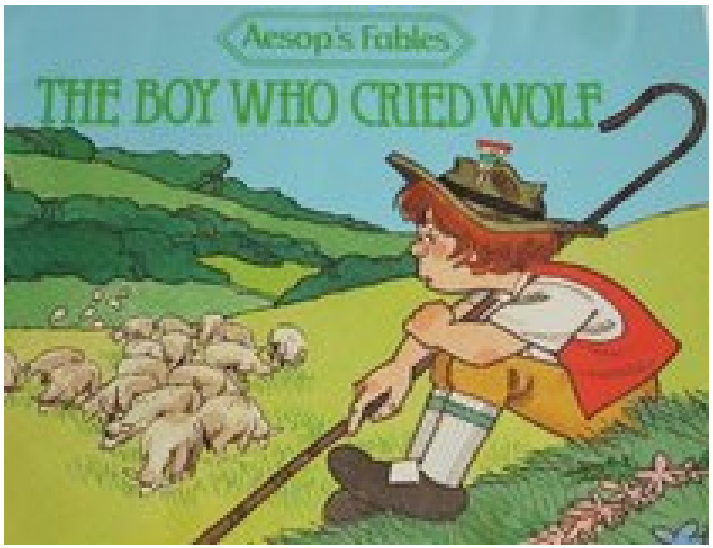

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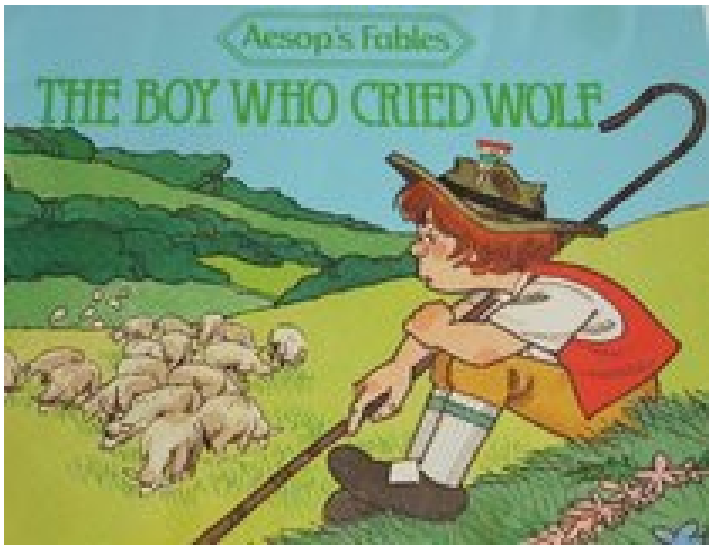

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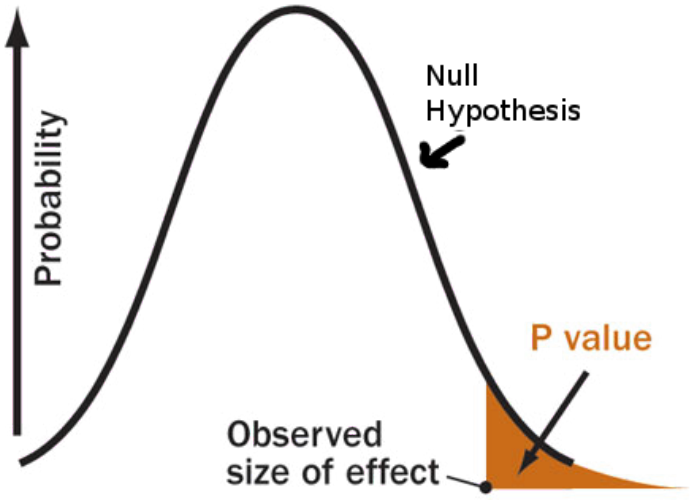
- Type I and Type II in that order

Test Statistic

- Measurement of how far observations deviate from null hypothesis (e.g., $\bar{x}$ far from μ)
- Test statistic is paired with a distribution that measures deviation
- Lower probability test statistics let you reject the null

p-value



- Probability of null hypothesis being true
- Lower is better
- Common critical values α: 0.05, 0.01
- We'll see examples in a bit

p-hacking

- Rerunning / changing experiments to reject the null
- Discuss at the end of today