

Econ 270 Lecture 4

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Descriptive vs Inferential Statistics

- ▶ What we've done so far is describe data using basic statistics
- ▶ Ideally, we want to make inferences using data
- ▶ We'll need some basic probability theory to do this

Introduction to Probability

- ▶ Probability is a mathematical framework for describing random events
- ▶ How do we define random?

Random Examples

- ▶ A flip of a coin
- ▶ Radioactive decay
- ▶ A critical hit in Pokemon
- ▶ The temperature tomorrow
- ▶ Your height

The role of information

- ▶ Random is not necessarily the opposite of deterministic
- ▶ The key element of random events is information
- ▶ A coin flip is random when we don't know the inputs

Subjective Probabilities

- ▶ Different individuals may assess a random event differently
 - ▶ The probability that you're 6 feet tall is very different from my perspective than from yours
- ▶ But this doesn't mean that probability is a subjective opinion
 - ▶ Most assessments of probability are terrible!

CIA Guidelines for probability

100% certainty		
The General Area of Possibility	93%	Give or take almost 6 % Almost certain
	75%	Give or take about 12 % Probable
	50%	Give or take about 10 % Chances about even
	30%	Give or take about 10 % Probably not
	7%	Give or take about 5 % Almost certainly not
0% Impossibility		

Red Card

Same Data, Different Conclusions

Twenty-nine research teams were given the same set of soccer data and asked to determine if referees are more likely to give red cards to dark-skinned players. Each team used a different statistical method, and each found a different relationship between skin color and red cards.

Referees are
**three times as
likely** to give red
cards to
dark-skinned
players

**Statistically
significant** results
showing referees are
more likely to give red
cards to dark-skinned
players

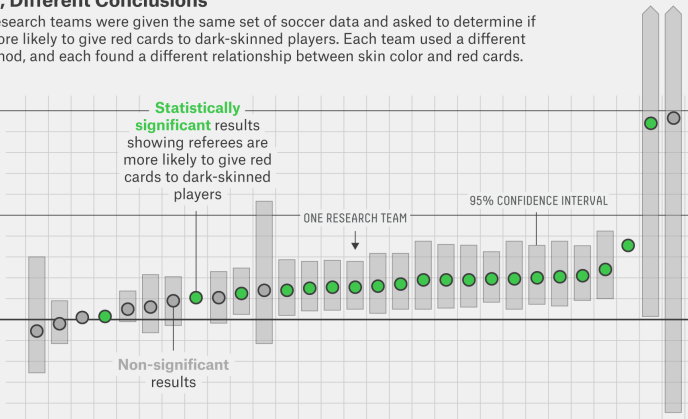
Twice as likely

Equally likely

Non-significant
results

ONE RESEARCH TEAM

95% CONFIDENCE INTERVAL



Coin Shennanigans

- ▶ You Can Load a Die, but You Can't Bias a Coin (Gelman and Nolan, 2002)
- ▶ Dynamical Bias in the Coin Toss (Diaconis, Holmes, and Montgomery, 2007)
- ▶ Fair coins tend to land on the same side they started: Evidence from 350,757 flips (Bartos et al 2023)

Probability: Process To Data

- ▶ In probability, we make assumptions about the data generating process
 - ▶ coin flips are independent with probability 0.5
 - ▶ students enter a classroom at a Poisson rate of 2 per minute
- ▶ Given these, we can calculate the likelihood that different patterns of data will appear
 - ▶ 500 heads in 1000 coin flips?
- ▶ Probability is pure math - the question is whether our assumptions match reality

Statistics: Data To Process

- ▶ In statistics, we assume some incomplete knowledge of the world
 - ▶ Coin flips are independent, but that the probability of heads is unknown
- ▶ Given the data, we then make inferences about what the 'true' proportion of heads is
- ▶ There's never a 'correct' answer in statistics.
 - ▶ Some approaches are more reasonable than others