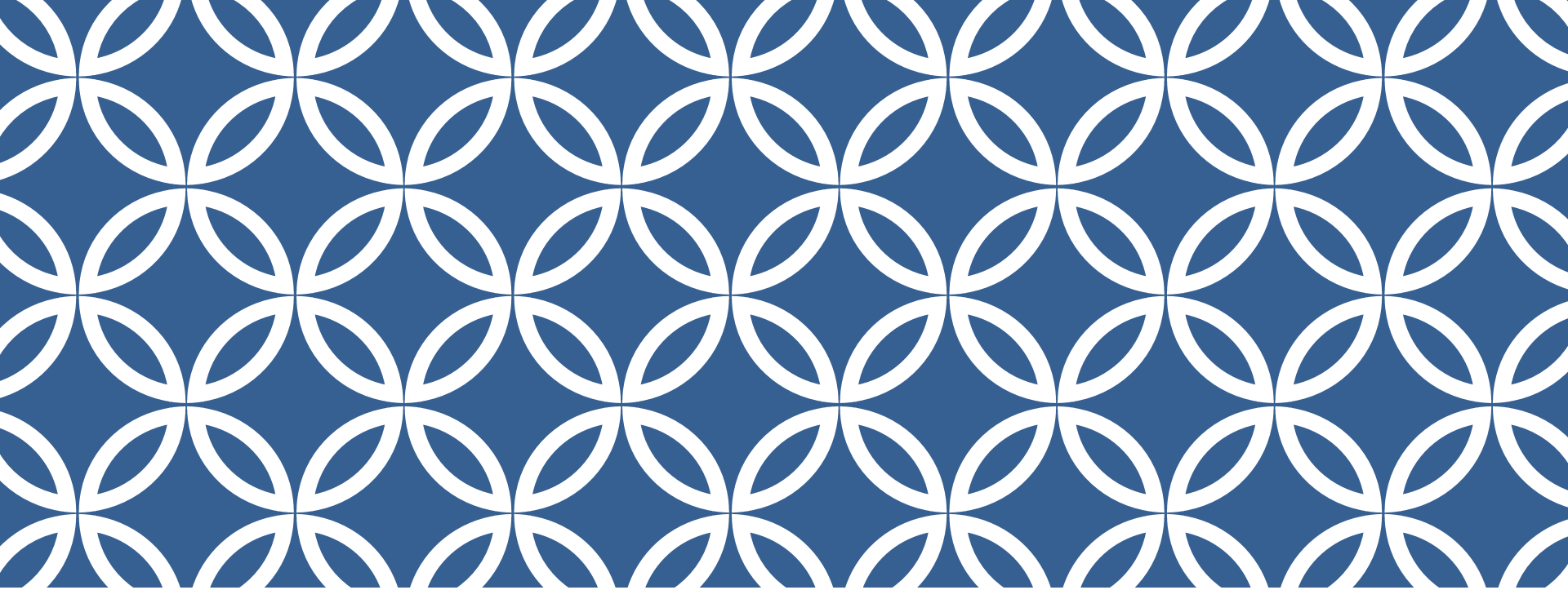


Causality

Importance of Random Assignment

- Null:
  - In the population, the distributions of the birth weights of the babies in the two groups are the same. (They are different in the sample just due to chance.)
- Alternative:
  - In the population, the babies of the mothers who smoked weigh less, on average, than the babies of the non-smokers.

Causality

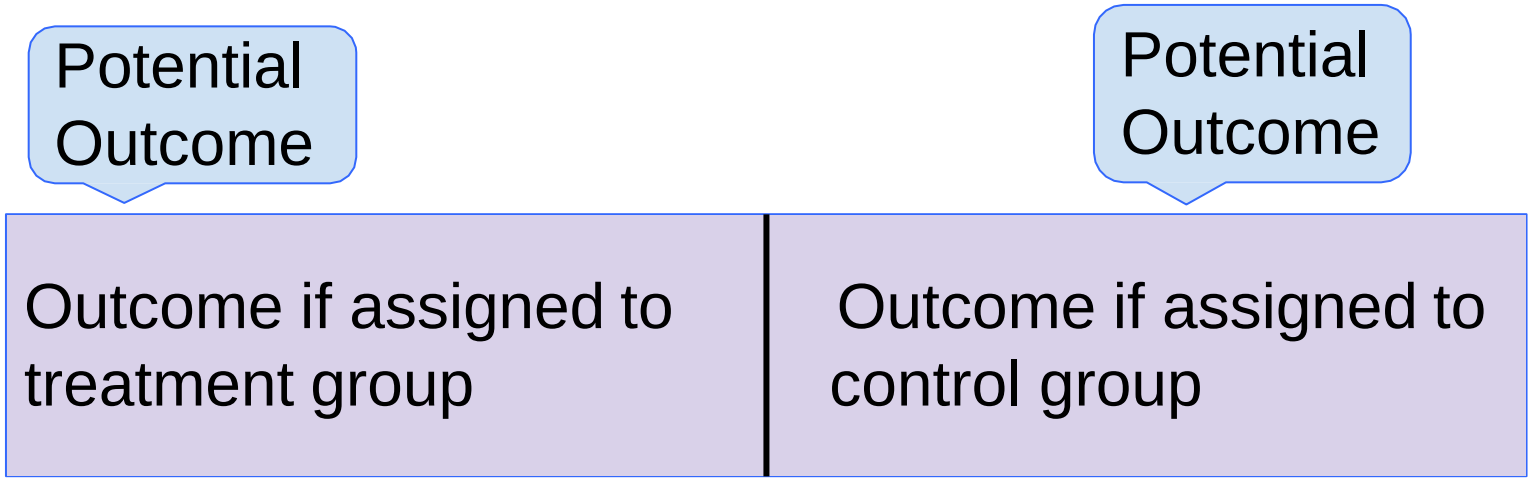
Randomized Controlled Experiment

- Sample A: **control group**
- Sample B: **treatment group**
- **If the treatment and control groups are selected at random, then you can make causal conclusions.**
- Any difference in outcomes between the two groups could be due to
  - chance
  - the treatment

(Demo)

Before the Randomization

- In the population there is one imaginary ticket for each of the 31 participants in the experiment.
- Each participant's ticket looks like this:



The Data

16 randomly picked tickets show:

	Outcome if assigned to control group

The remaining 15 tickets show:

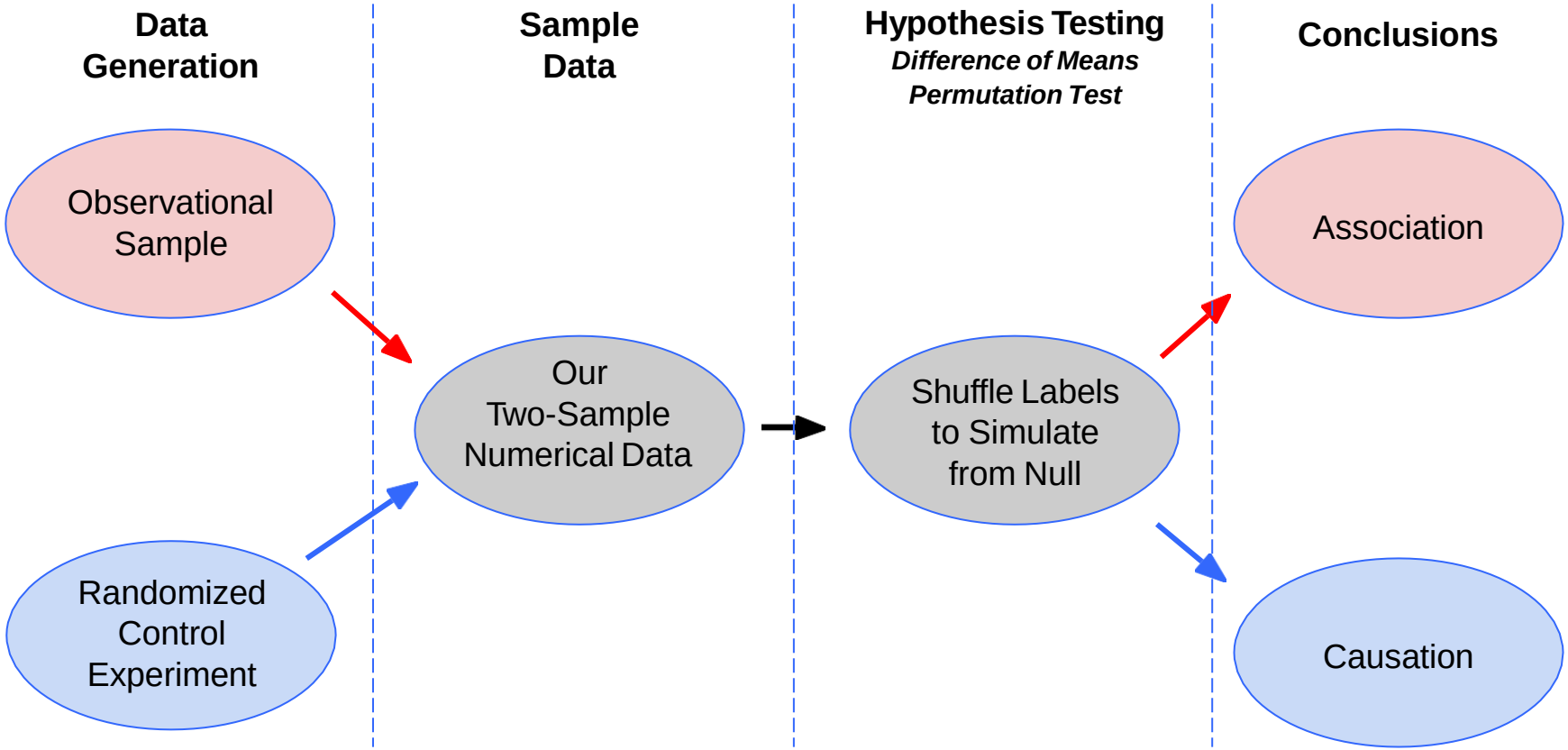
Outcome if assigned to treatment group	

The Hypotheses

- **Null:**
  - In the population, the distribution of all potential control scores is the same as the distribution of all potential treatment scores.
  - Or; the treatment has no effect
- **Alternative:**
  - In the population, more of the potential **treatment** scores are 1 (pain improves) than the potential **control** scores.

(Demo)

Random Assignment & Shuffling



An Error Probability

Can the Conclusion be Wrong?

Yes.

	Null is true	Alternative is true
Test favors the null		
Test favors the alternative		

An Error Probability

- The cutoff for the *P*-value is an error probability.
- If:
  - your **cutoff is 5%**
  - and the **null hypothesis happens to be true**
- then there is about a **5% chance** that **your test will reject the null hypothesis**.