# Data Collection

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Math 141, 2/15/21

## Outline

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- Discuss principals of data collection
- Compare and contrast observational studies and random experiments

Section 1

## Principles of Data Collection

## Populations and Samples

- Every statistical investigation must begin by clearly identifying the **population** to be studied, the **variables** to be measured, and the **sample** from which measurements will be taken.

# Sampling

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  - Properties of probability allow us to quantify uncertainty.
  - In isolation, a single random event may seem arbitrary. But in aggregate, a collection of random events is predictable.
- By following basic procedures for randomly selecting a sample, we can be certain that the results fall within a specified margin of the true value a particular percentage of the time.

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  - In fact, it is necessary that such underrepresentation samples are possible, in order to quantify *extreme* events.

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  - **Self-selection**, where membership in the sample is voluntary (leading to correlation between results and traits promoting participation)
  - **Convenience**, where "randomization" is performed by selecting a convenient block of individuals in the population (leading to strong correlation between members of the sample)

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- Suppose a year later, the restaurant still has 3.5 stars, but now with 1000 reviews. Does the verdic change?
- Suppose a second Thai restaurant opens up nearby, with a yelp rating of 4 stars with 1000 reviews. Can we conclude Portlanders prefer the second restaurant to the first?

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    2. Random experiment, where individuals are assigned to group and a random treatment is assigned.
- Usually, only random experiments may allow researchers to conclude a causal link between explanatory and response variables.

Section 2

## Observational Studies

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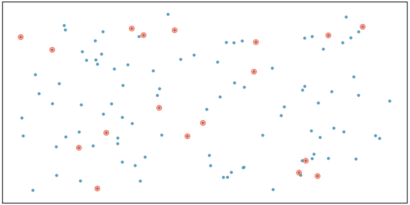
  - Women with healthy pregnancies have a higher rate of nausea during the 1st trimester than those with an unhealthy pregnancy, which often inhibits desire for coffee/tea in individuals who previously consumed these beverages.
  - As a result, women with early pregnancy complications (leading to increased risk of miscarriage) are less likely to stop consuming caffiene.

# Sampling Methods (SRS)

- **SRS**: Randomly select individuals from the population so that each individual has equal likelihood of being selected.



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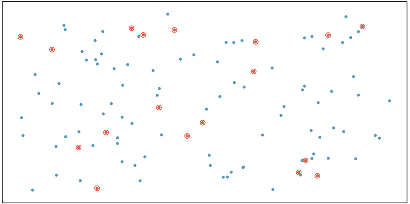

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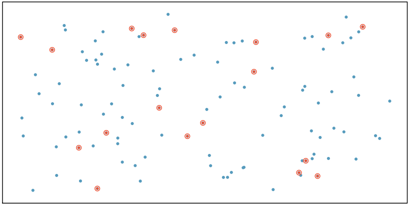

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- Disadvantages:
  - May not be as precise as other sampling techniques
  - Can be difficult to perform in practice

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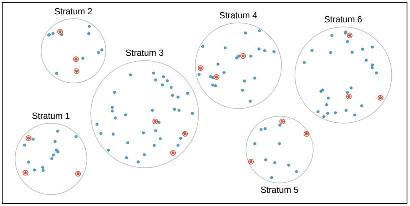

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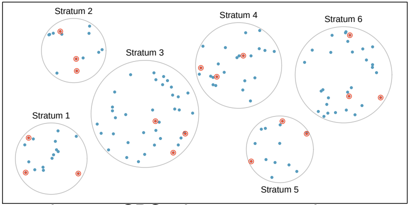

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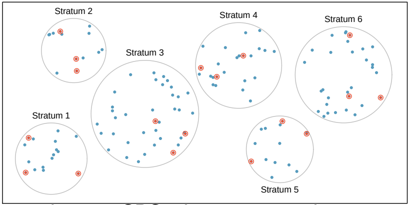

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  - Statistical analysis is more complex
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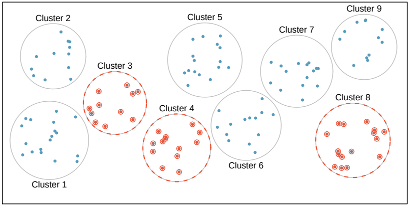

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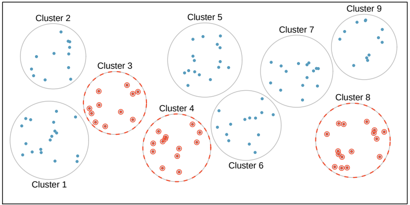

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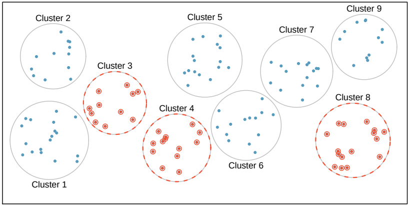

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Section 3

## Experiments

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    4. **Blocking**: If variables are suspected to affect response variable, subjects are first grouped into blocks based on these variables.

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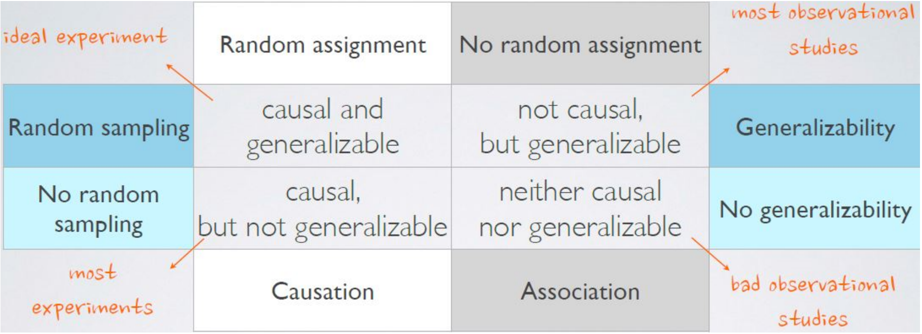
- It is suspected that nitrate supplements may effect professional and amateur athletes differently, and so subjects are blocked for pro status:
  1. Divide SRS into pro and amateur blocks.
  2. Randomly assign pro athletes to treatment and control groups.
  3. Similarly, randomly assign amateur athletes to treatment and control groups.
  4. Ensure pro/amateur status is equally represented in treatment and control groups.

# Random Sampling vs. Random Assignment



| ideal experiment | Random assignment | No random assignment | most observational studies |
|---|---|---|---|
| Random sampling | causal and generalizable | not causal, but generalizable | Generalizability |
| No random sampling | causal, but not generalizable | neither causal nor generalizable | No generalizability |
| most experiments | Causation | Association | bad observational studies |