# Interference

## STSCI/INFO/ILRST 3900: Causal Inference
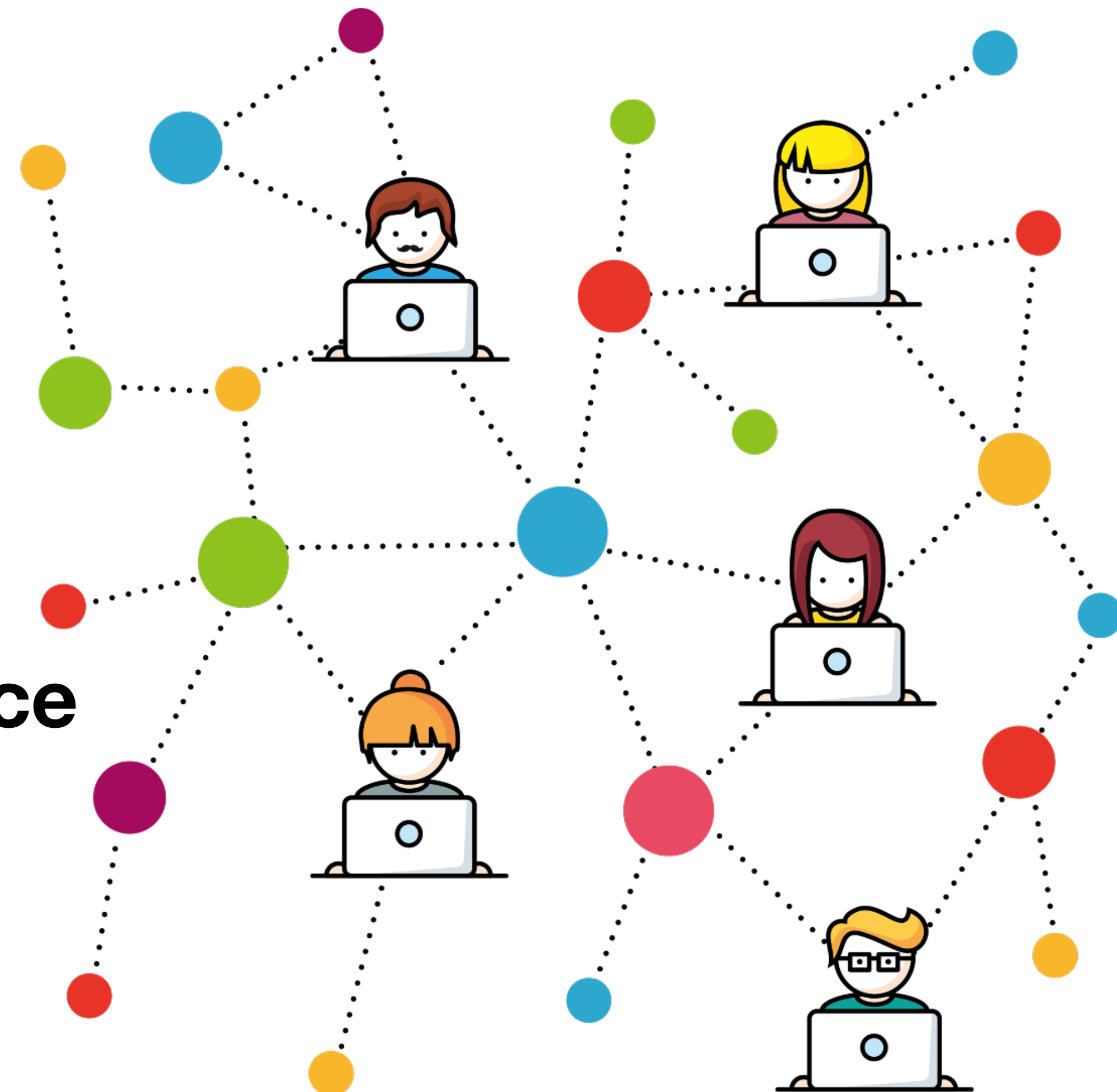
**September 17, 2025**

# Agenda

- **Reminders and Announcements**

- **Interference**

- **Homework Check-in and Questions**

# Reminders and Announcements

- HW 2 due Friday (September 19) by 5pm

  - Submit a PDF from RMarkdown via Canvas

- Office Hours

  - **Sam**: Tuesday 4-5pm in 350 CIS Building

  - **Filippo**: Thursday 4-5pm in 321A CIS Building

  - **Shira**: Monday 5-6pm in 329A CIS Building

# Class Discussion

## What is interference?

- What did you discuss in your groups?

# Class Discussion

**What is interference?**

- Good causal questions involve precise treatments (**consistency**) that exist (**positivity**).

- Interference occurs when an individual's outcome can be affected by the treatment of others in the population

# Class Discussion
## What is interference?

Example: Advertisements

- Your friend sees an ad for a new Coca Cola flavor. You don't see it, but the next time you see them, they have a can of it. You buy a can next time you go to the store.

- You didn't interact with the ad, yet you were possibly affected through your friend!

- You friend's treatment "interfered" with your outcome

# Class Discussion

**What is interference?**

- Example: Advertisements

  - Under **NO interference**, your outcome is only dependent on your own treatment

    - You buying the new Coca Cola flavor only has to do with whether or not you saw the ad

  - Under **interference**, your outcome may depend on the treatment of your friends

    - You buying the new Coca Cola flavor depends not only on whether or not you saw the ad, but whether or not your friends saw it

# Class Discussion

## What is interference?

- Your friend sees an ad for a new Coca Cola flavor. You don't see it, but the next time you see them, they have a can of it. You buy a can next time you go to the store.

- What are the possible treatment combinations in this scenario?

# Class Discussion

## What is interference?

- Your friend sees an ad for a new Coca Cola flavor. You don't see it, but the next time you see them, they have a can of it. You buy a can next time you go to the store.

- The possible treatment combinations in this scenario are:

    1. You and your friend both see the ad

    2. You see the ad, your friend does not see it

    3. You do not see the ad, your friend does

    4. Neither you nor your friend see the ad

# Class Discussion
**What is interference?**



- Possible Treatment Combinations:

  1. You and your friend both see the ad

  2. You see the ad, your friend does not see it

  3. You do not see the ad, your friend does

  4. Neither you nor your friend see the ad

- Do the following notations make sense? Why or why not?

$$Y_{you}^{ad} \quad \text{or} \quad Y_{friend}^{no\ ad}$$

# Class Discussion
**What is interference?**

Let $a_1$ be your treatment and $a_2$ be your friend's.

1. You and your friend both see the ad

2. You see the ad, your friend does not see it

3. You do not see the ad, your friend does

4. Neither you nor your friend see the ad

- How do we change the notation to reflect the interference?

From $Y_1^{a_1}$ and $Y_2^{a_2}$ to ... ?

# Class Discussion
**What is interference?**



Let $a_1$ be your treatment and $a_2$ be your friend's.

1. You and your friend both see the ad $(a_1 = 1, \, a_2 = 1)$

2. You see the ad, your friend does not see it $(a_1 = 1, \, a_2 = 0)$

3. You do not see the ad, your friend does $(a_1 = 0, \, a_2 = 1)$

4. Neither you nor your friend see the ad $(a_1 = 0, \, a_2 = 0)$

- We change the notation to reflect the interference?

From $Y_1^{a_1}$ and $Y_2^{a_2}$ to $Y_i^{a_1, a_2}$

# Class Discussion

Write the potential outcome notation for yourself when **no interference** is present **versus** when **interference** is present. Let $a_1$ be your treatment and $a_2$ be your friend's.

| NO Interference | Your friend is treated | Your friend is not treated |
| --- | --- | --- |
| You are treated | | |
| You are not treated | | |

| Interference | Your friend is treated | Your friend is not treated |
| --- | --- | --- |
| You are treated | | |
| You are not treated | | |

# Class Discussion

Write the potential outcome notation for your friend when **no interference** is present **versus** when **interference** is present. Let $a_1$ be your treatment and $a_2$ be your friend's.

| NO Interference | Your friend is treated | Your friend is not treated |
|---|---|---|
| You are treated | $Y_1^{a_1=1}$ | $Y_1^{a_1=1}$ |
| You are not treated | $Y_1^{a_1=0}$ | $Y_1^{a_1=0}$ |

| Interference | Your friend is treated | Your friend is not treated |
|---|---|---|
| You are treated | $Y_1^{a_1=1,a_2=1}$ | $Y_1^{a_1=1,a_2=0}$ |
| You are not treated | $Y_1^{a_1=0,a_2=1}$ | $Y_1^{a_1=0,a_2=0}$ |

# Class Discussion

Write the potential outcome notation for your friend when **no interference** is present **versus** when **interference** is present. Let $a_1$ be your treatment and $a_2$ be your friend's.

| NO Interference | Your friend is treated | Your friend is not treated |
| --- | --- | --- |
| You are treated | $Y^{a_1=1}$ | $Y^{a_1=1}$ |
| You are not treated | $Y_1^{a_1=0}$ | $Y_1^{a_1=0}$ |

Two potential outcomes per person

| Interference | Your friend is treated | Your friend is not treated |
| --- | --- | --- |
| You are treated | $Y^{a_1=1,a_2=1}$ | $Y^{a_1=1,a_2=0}$ |
| You are not treated | $Y_1^{a_1=0,a_2=1}$ | $Y_1^{a_1=0,a_2=0}$ |

Four potential outcomes per person

# Class Discussion

- In the most general settings, everyone can affect everyone's outcomes

$$Y_1^{a_1, a_2, \cdots, a_n}$$

- That's $2^n$ different possible potential outcomes per person!

- In some settings, assuming no interference can be reasonable

- In other settings, assuming no interference can lead to **very misleading** results (See [What Do Randomized Studies of Housing Mobility Demonstrate?](#) By Michael Sobel, 2006)
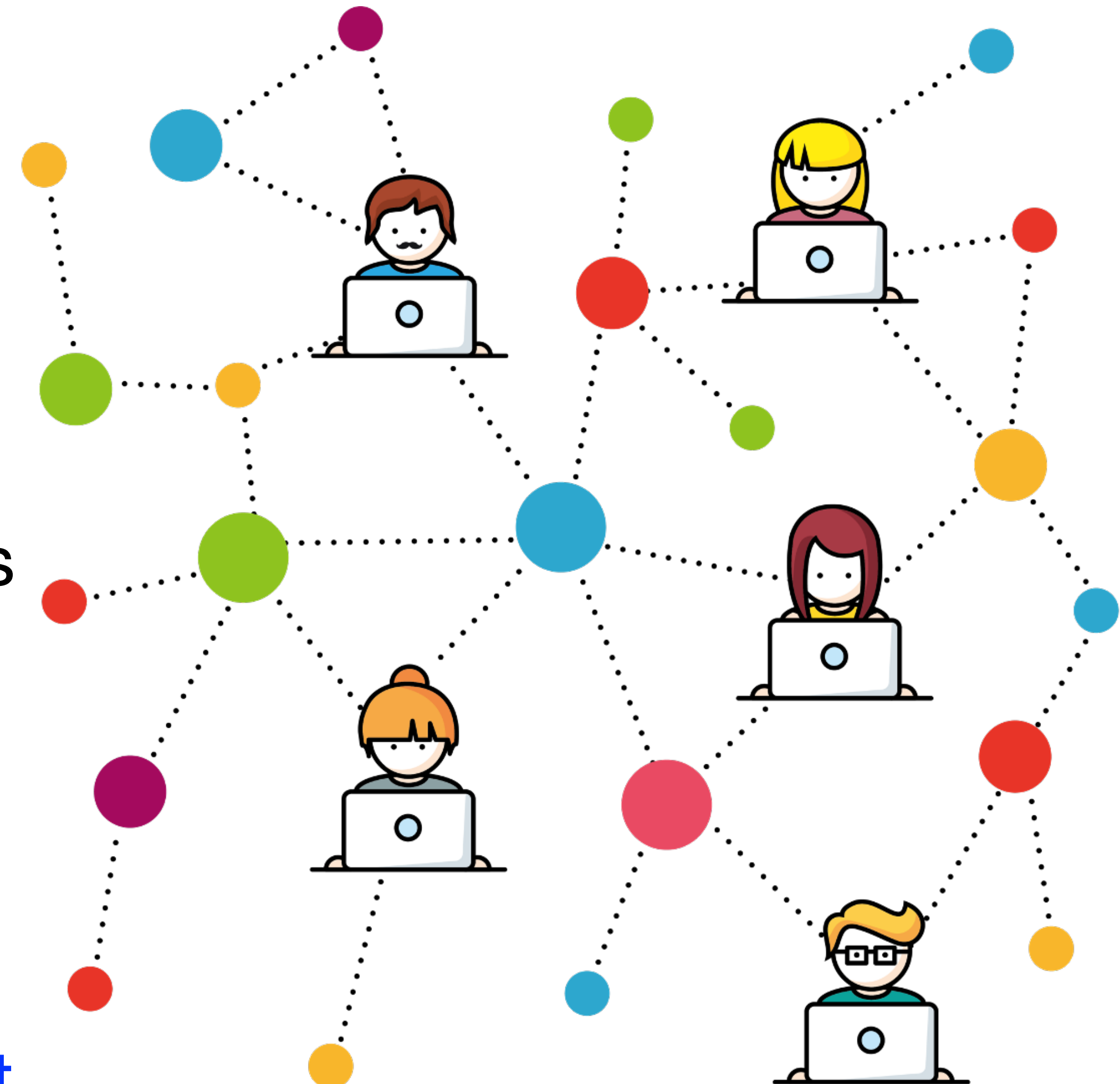
# Problem Set Clarification

- In question 2.8:

   *"Suppose the researchers had first conducted a pilot study in Boston **only**"*

- Assume we don't have the results from Chicago

- We want to estimate the average causal effect of race on callback rates in Chicago

Questions about the HW?