Causation: Observational Designs

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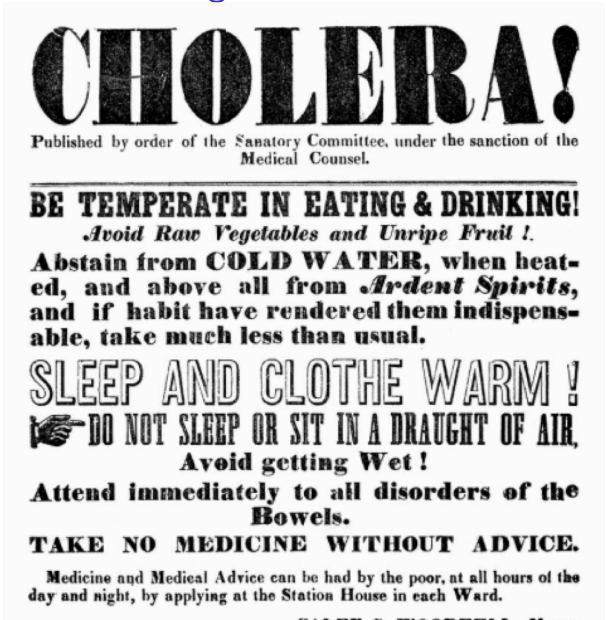
- Observational studies: observe what happens in the world, and try to draw inferences from it.

1854 cholera outbreak in London

A COURT FOR KING CHOLERA.

No understanding on the cause



CHOLERA!

Published by order of the Sanatory Committee, under the sanction of the Medical Counsel.

BE TEMPERATE IN EATING & DRINKING!

Avoid Raw Vegetables and Unripe Fruit !.

Abstain from COLD WATER, when heated, and above all from *Ardent Spirits*, and if habit have rendered them indispensable, take much less than usual.

SLEEP AND CLOTHE WARM !

DO NOT SLEEP OR SIT IN A DRAUGHT OF AIR.

Avoid getting Wet !

Attend immediately to all disorders of the Bowels.

TAKE NO MEDICINE WITHOUT ADVICE.

Medicine and Medical Advice can be had by the poor, at all hours of the day and night, by applying at the Station House in each Ward.

A systematic approach

- Is Cholera everywhere?

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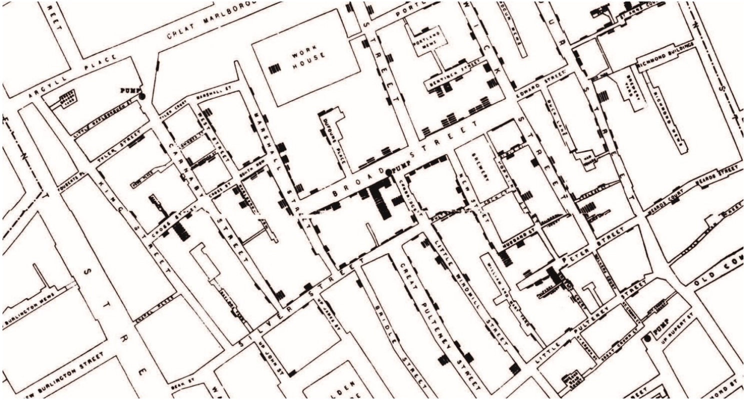
A systematic approach

- Is Cholera everywhere?
- Are there any patterns?
- Could these patterns exlain the outbreak?

John Snow: Observational Study



GREAT MARLBOROUGH STREET
PUMP
WORK HOUSE
PORTLAND MEWS
RICHMOND BUILDINGS
BREWERY
PETER STREET
BRIDLE STREET
GOLDEN SQUARE
ARCHER STREET

A Good Observational Study

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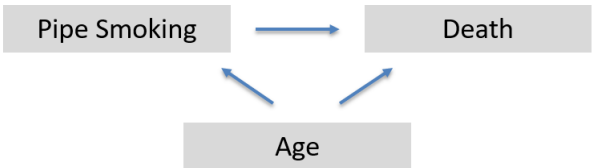

Does shaking hands with a presidential candidate at a rally increase the chances a person will vote in the election?

Subclassification

- One way to limit the influence of confounders is to narrow the study to *focus on similar participants*

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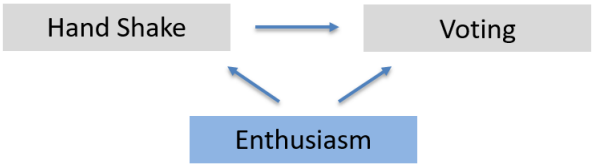

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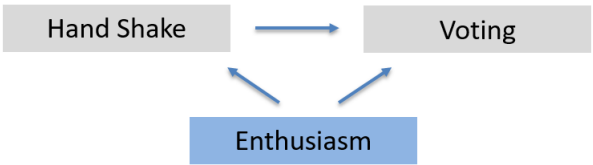

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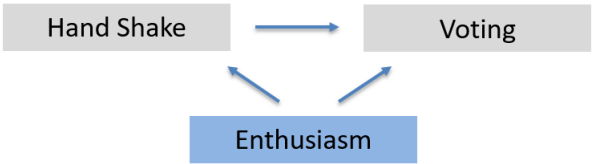

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$$Avg_{Enthusiastic\ Handshake} = Avg_{Enthusiastic\ No\ Handshake}$$

Longitudinal Studies

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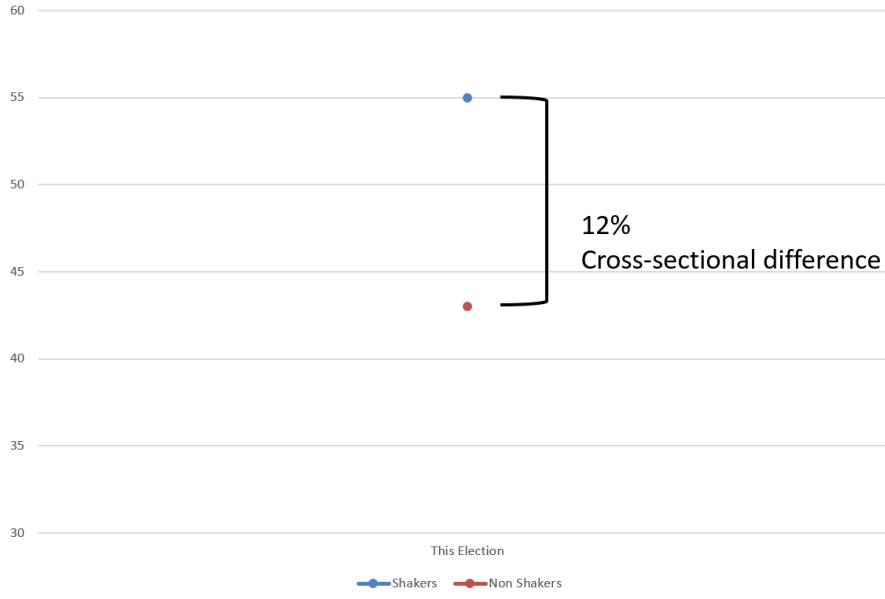
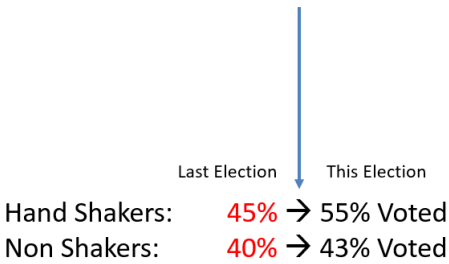
$$\text{Effect of Hand Shake} = Turnout_{After} - Turnout_{Before}$$


60
55
50
45
40
35
30
12%
Cross-sectional difference
This Election
Shakers
Non Shakers

We want to observe behavior before the handshake



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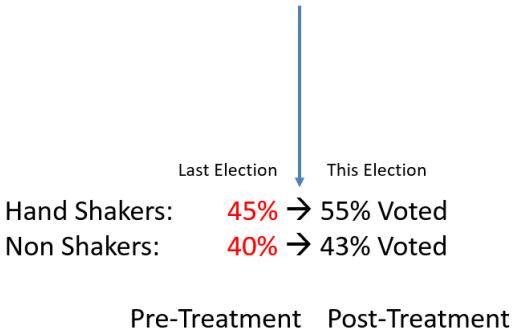
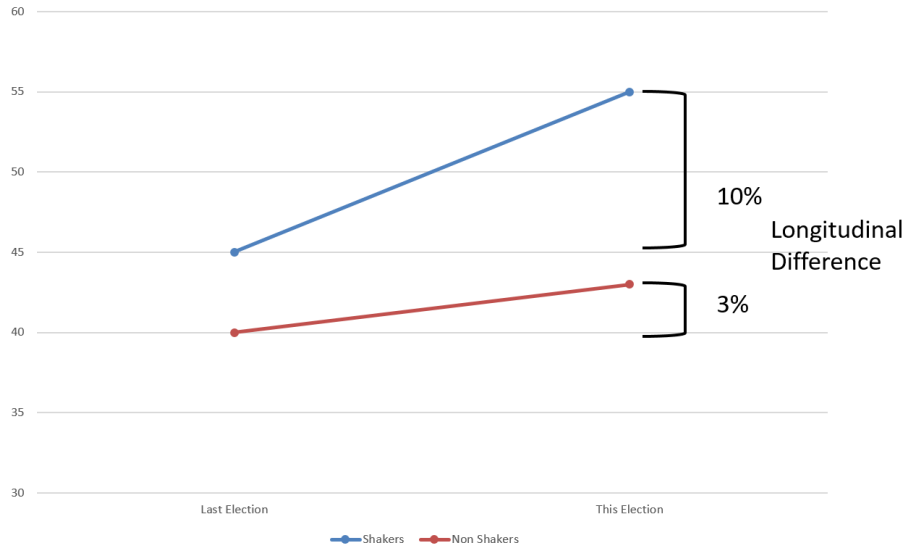
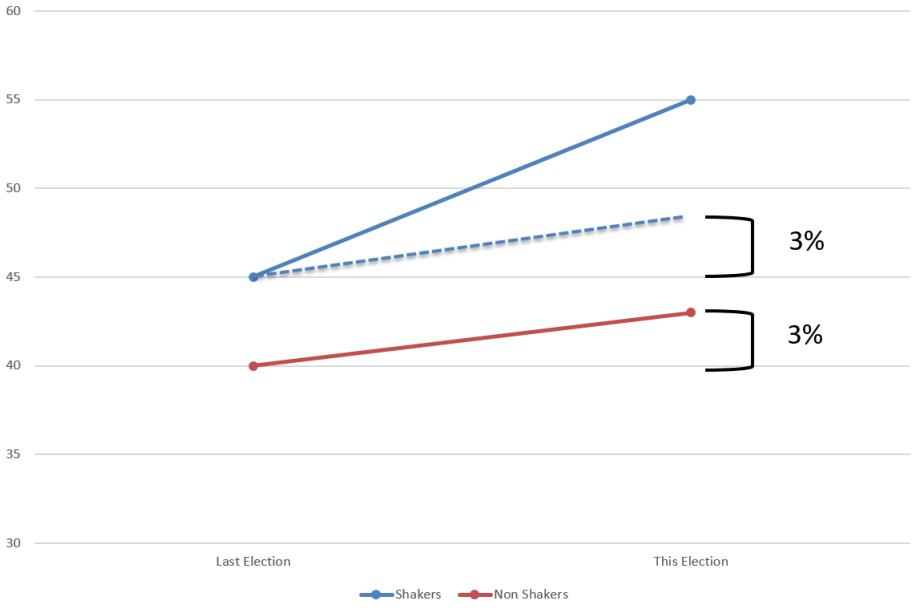



60
55
50
45
40
35
30
10%
Longitudinal Difference
3%
Last Election
This Election
Shakers
Non Shakers

What is the effect of a handshake?

Hand shakers:	10% Increase	55% Voted
Non shakers:	3% Increase (Control)	43% Voted


60
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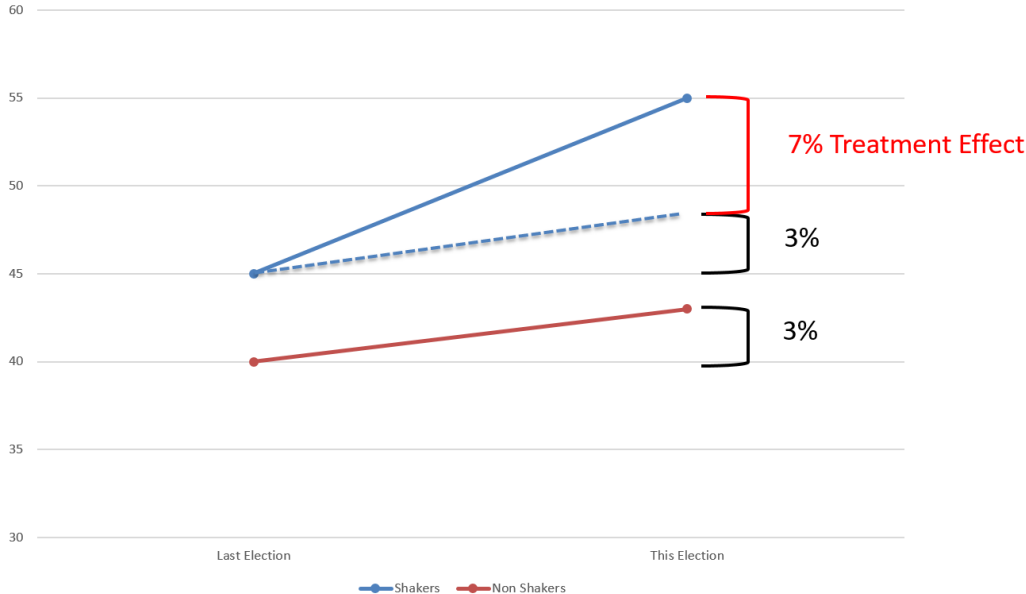
30
3%
3%
Last Election
This Election
Shakers
Non Shakers


60
55
50
45
40
35
30
7% Treatment Effect
3%
3%
Last Election
This Election
Shakers
Non Shakers

Difference-in-Differences Estimator

Average Treatment Effect:

Difference-in-Differences Estimator

Average Treatment Effect:

Avg($Y_{Treatment\,Group}$) - Avg($Y_{Control\,Group}$)

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Difference-in-Differences:

Avg($Y_{Treatment,Post}$ - $Y_{Treatment,Pre}$) - Avg($Y_{Control,Post}$ - $Y_{Control,Pre}$)

Difference-in-Differences Estimator

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(55% - 45%) – (43% - 40%) $=$ *7%* $\sim$ *Treatment Effect*

Difference-in-Differences Estimator

Average Treatment Effect:

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Difference-in-Differences:

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(55% - 45%) – (43% - 40%) $=$ *7%* $\sim$ *Treatment Effect*

10% - 3%

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Difference-in-Differences Estimator

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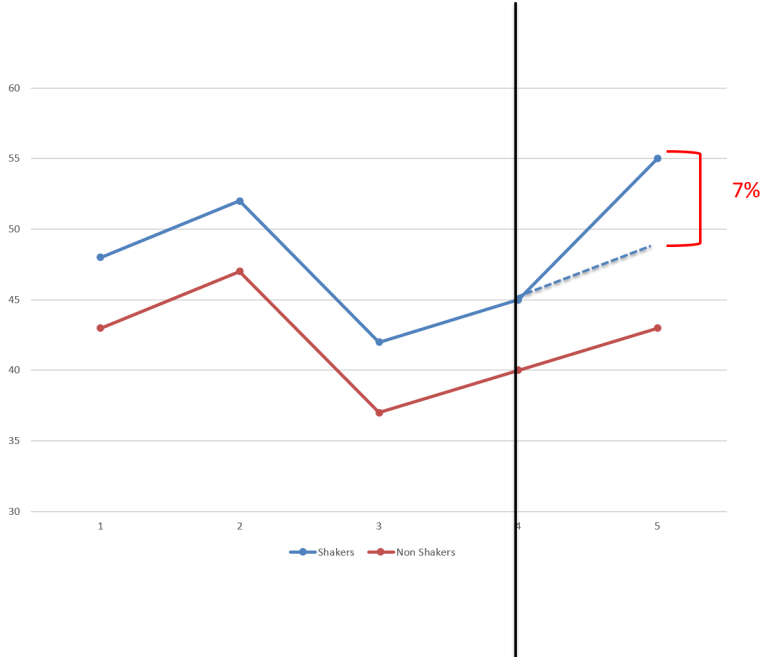
  - However, we should observe parallel trends over time


60
55
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30
1
2
3
4
5
Shakers
Non Shakers
7%