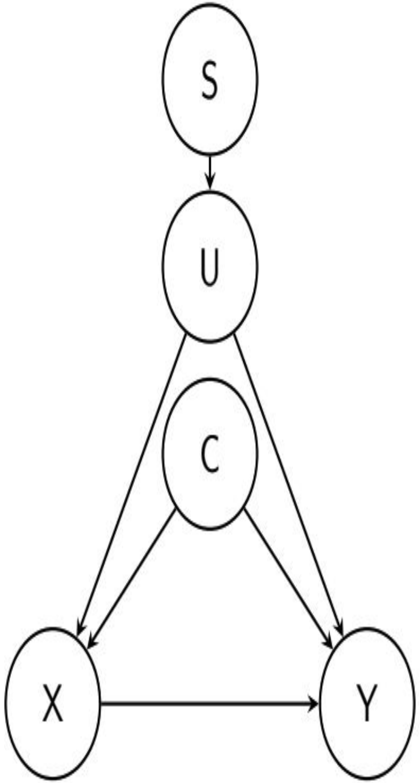


Introduction to Causal Inference for Spatial confounding

Exploring the complexities of causal inference when spatial factors influence the relationship between variables. A presentation for the statistics DRP

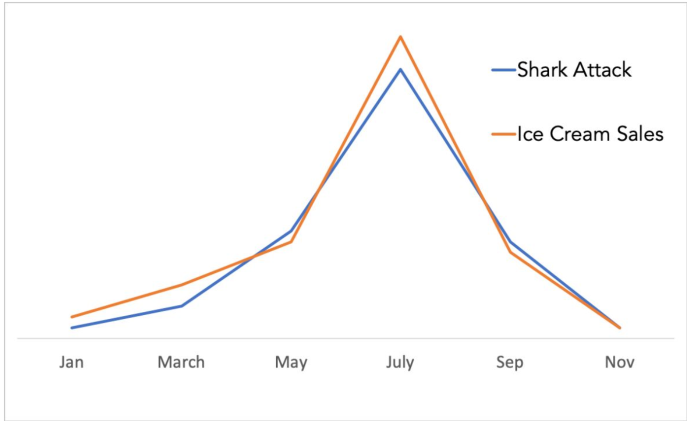
Carson Lindholm & Sam Zinbarg

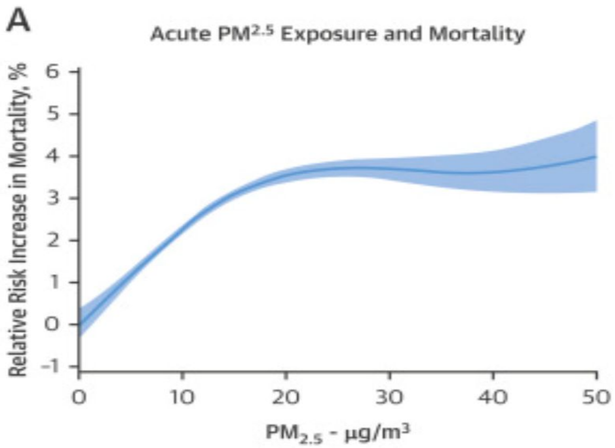
What is Causal Inference?

Distinguishing between Correlation and Causation

Causal inference aims to establish whether a change in one variable directly causes a change in another, holding all over variables constant.

- Calculating an average treatment effect when we cannot see how an individual would react to two different treatments (counterfactual)





Assumptions for Spatial Causal Inference

To sufficiently argue and trust a causal inference relationship with spatial confounding we need the following assumptions to be met

Spatial information

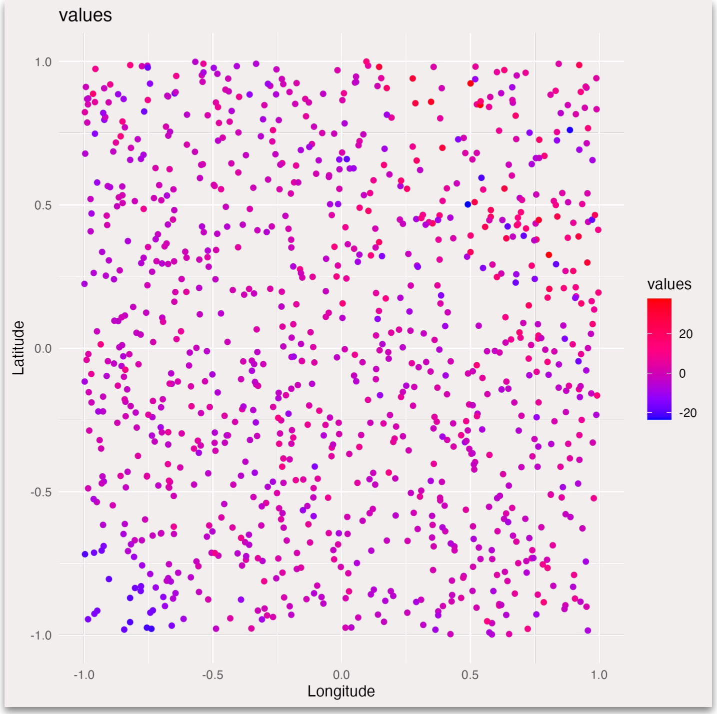
We assume that the unknown cofounders are a function of space. We assume U = g(S) and g(S) is smooth.

Shift Ignorability

We assume (can argue) that with the inclusion of U, there is no unmeasured confounding.

Shift Positivity

Exposure varies at a finer spatial scale than U. The exposure, X has non-spatial variation.



Modeling Air Pollution effects on Cardiovascular Disease

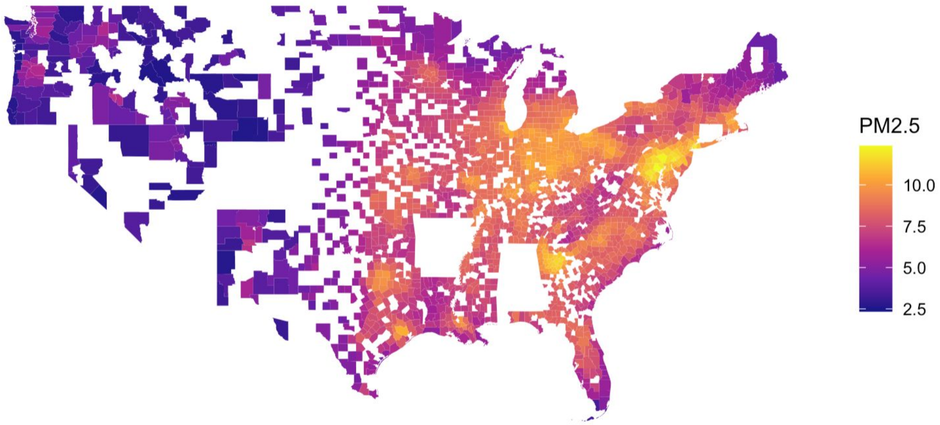
- In *A Causal Inference Framework for Spatial Confounding*, the research focuses on using census data to model the relationship between pollution and cardiovascular disease

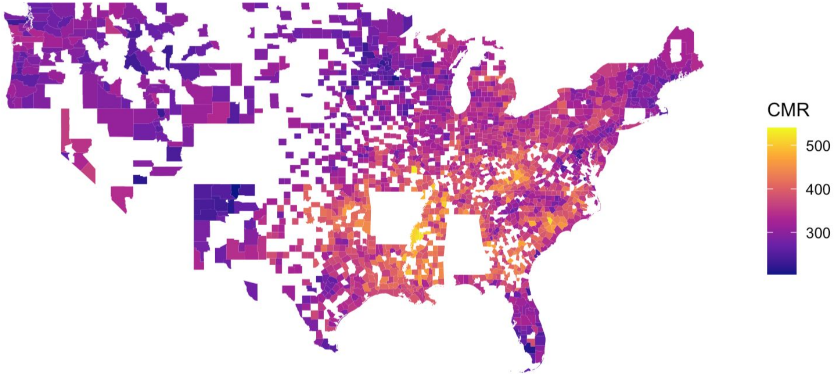
- Specifically modeling the effect of increasing PM2.5 and seeing the change in CMR, $E[Y(x + \delta) - Y(x)]$

  - PM2.5 is measure of micrograms of pollutant per cubic meter in the observed county

  - CMR is the cardiovascular mortality rate of the county observed

Visualization of treatment and outcome





Potential Sources of Confounding Variables

1 Green vs. Industrial Space

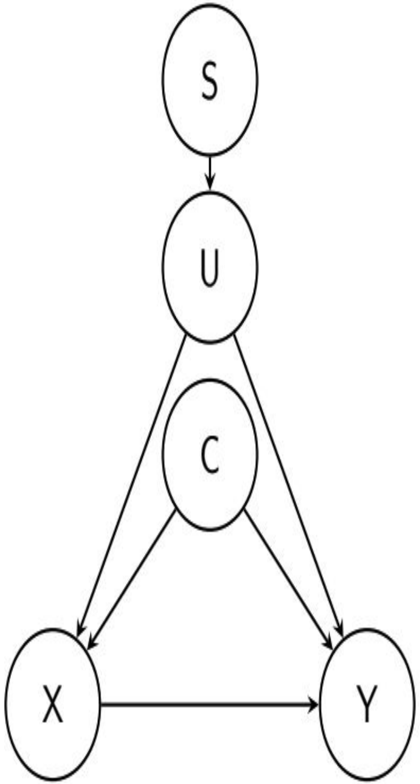
We believed this to be a potential source of confoundedness as the amount of green space vs. industrial zoning in a county could contribute to the outcome

- If say one county is more urban and has more industry, could cause more pollution with more adverse effects to one's cardiovascular health than on that of a country with more green space

2 Vehicle Usage

Building off our first potential source is vehicle usage as this could vary amongst county's close to each other

- If a county is more vehicle oriented, than the population is more likely to use that method of transportation as opposed to walking or taking a bicycle, more green and health conscious modes of transportation



Visualization of shift estimand