

Testing for Network Effects in Field Experiments

Examples from Legislative Studies

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Overview

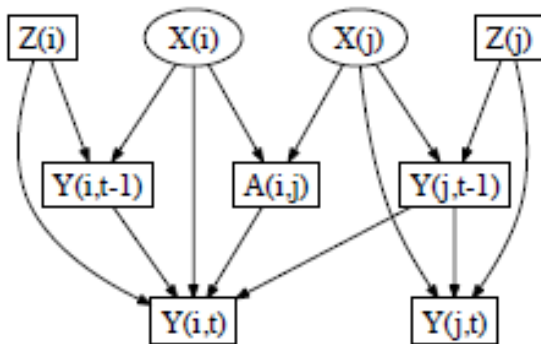
- 1 Motivation
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- 3 Applications
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Motivation: Bergan and Cole (Political Behavior, 2015)

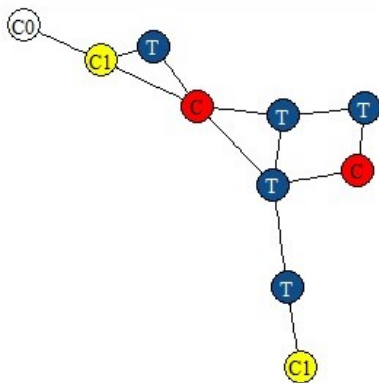
- Field experiment on 148 Michigan legislators
- Calls from constituents to influence vote on anti-bullying bill
- Analysis concluded significant treatment effect
- Could treatment effects have spilled over to untreated legislators?

Motivation: Identification of causal effect

Shalizi and Thomas (Sociological methods and research, 2011)



Motivation: Network plot



Stable Unit Treatment Value Assumption (SUTVA)

Assumption that the treatment status of unit does not affect the outcome of another.

Research objectives

- Model spillover of treatment effect via network structures.
- Examine how inferences depend upon network specification and spillover structure.
- Evaluate models using data from field experiments on US State legislatures.

Methodology: Intuition

- Network and model for spillover specified by researcher
- How do we compare outcomes across groups?
- How do we test for effect of treatment?

Causal model (Bowers et al., Political Analysis, 2012)

- Sharp null of no hypothesis assumed
- Spillover depends on $\#$ treated neighbors
- Magnitude of spillover modeled as a nonlinear growth curve
- Separate direct and indirect effect parameters

Testing (Bowers et al., Political Analysis, 2012)

- Kolmogorov-Smirnov (KS) test used to compare treatment-control outcomes
- Compared under large number of permutations
- p-value is proportion of permutation statistics smaller than observed statistics

Salient dimensions: Network selection

Network selection identifies ties through which units interact

- Ideological network
- Committee network
- Co-sponsorship network
- Geographical network

Salient dimensions: Neighborhood specification

Neighborhood specification determines how far the treatment spreads

- Effect from all units
- Effect from k-nearest neighbors

Salient dimensions: Diffusion model specification

Diffusion model specifies how the treatment spreads

- Distance from the nearest treated node
- Number/proportion of treated neighbors
- Form of spread (linear or non-linear)

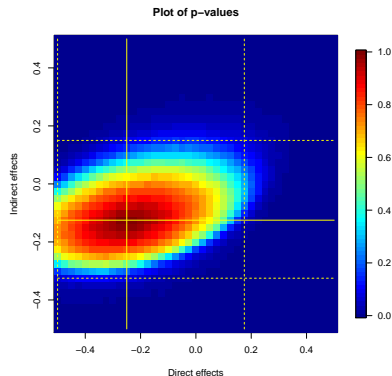
Application: Butler, Nickerson et al. (2012) experiment

- Field experiment on 70 New Mexico legislators
- Letters indicating constituent opinion about a spending bill
- Analysis concluded significant treatment effect
- Coppock (2014) extended analysis to model spillovers

Application: Replication of Coppock (2014)

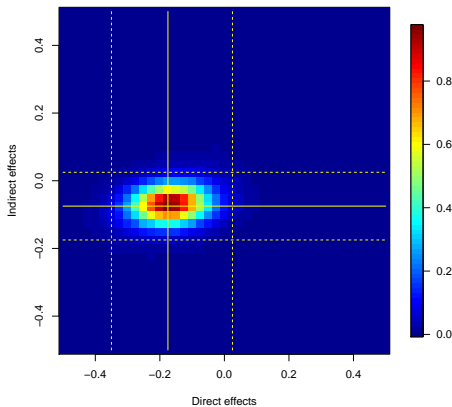
$$y_{i,z} = y_{i,0} + \beta_1 * z_i + \beta_2 * g(\Gamma_z)$$

- β_1 on X axis
- β_2 on X axis
- Higher p-value indicates evidence for spillover

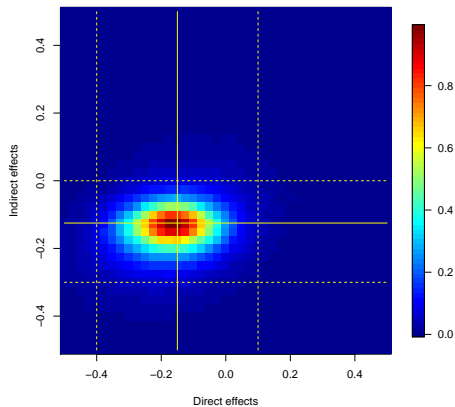


Extension: K-nearest ideological neighbors

Plot of p-values: k=3

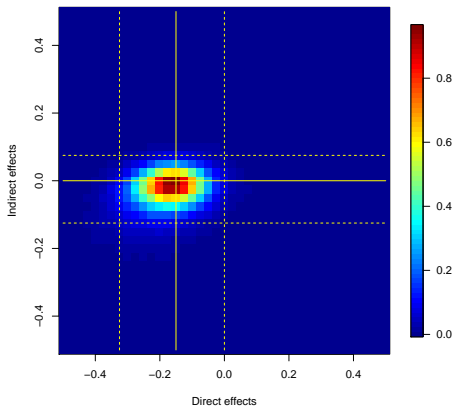


Plot of p-values: k=12

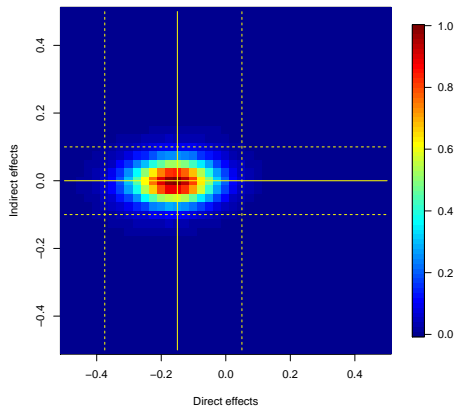


Extension: Committee network

Plot of p-values: Committees>0

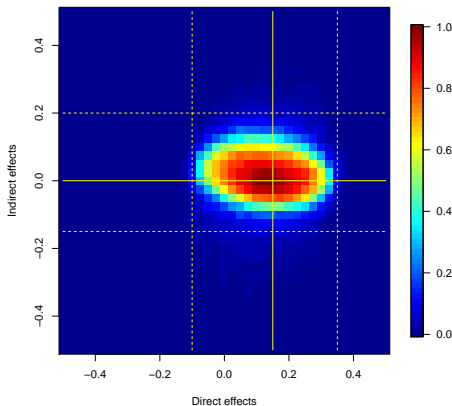


Plot of p-values: Committees>1

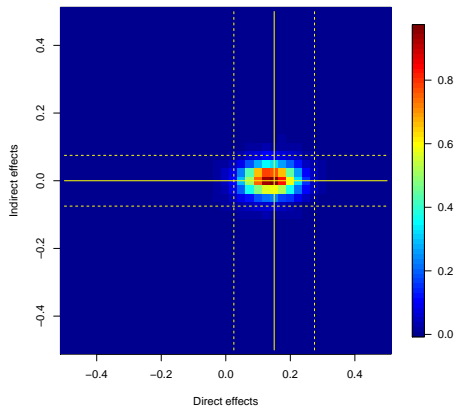


Application: Bergan and Cole (2015)

Plot of p-values



Plot of p-values: k=5



Findings

- Treatment spreads among New Mexico legislators via ideological network
- Spending is a fairly partisan issue
- Spillover not observed among Michigan legislators

Summary

- Interference exists in experiments on interactive social groups
- Several dimensions important to models for interference
- Analysis useful for power calculations and optimizing experimental design

Next steps

- Replicate Broockman (2013) that studies legislators from multiple states
- Consider other networks
- Model a mixture of networks
- Model proportion of treated neighbors

Thank you

Questions?

Network plots

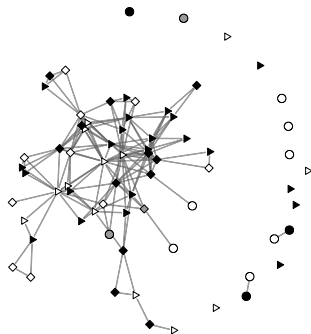
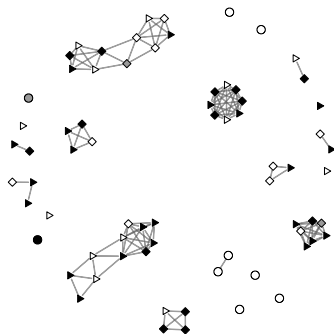


Figure: Ideological network: New Mexico

Figure: Committee network: New Mexico