

Causal Inference

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Motivation

- Causal inference: Does a relation from cause to effect exist?
- Many of the critical policy questions are causal in nature: Identifying and implementing effective interventions to affect outcomes

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Theory → Practice

- Thinking through a causal chain:
 - Use of improved inputs and technology increases yields- How do we get farmers to use improved seeds, fertilizers, and adopt new technologies? What effect does adoption have on yields in a real setting?
 - Accountability improves the delivery of goods and services of local governments- What mechanisms improve accountability? What is the effect on improved accountability in our context?

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Attributing causality

Policy perspective:

- What works? Identifying effective interventions
- What are the benefits per unit costs of alternative interventions? Comparing alternatives

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Causally linking interventions to outcomes: EFFECTIVENESS

- Especially challenging

Interventions → Behavioral outcomes:

- Do subsidies increase input use? Are matching grants effective as a tool for technology adoption?
- If communities must compete for grants from the state government, will this lead to greater community participation in decision-making?



Comparing alternatives: COST-EFFECTIVENESS AND INFORMING SCALE-UP

Comparing interventions in terms of final outcomes:

- Subsidies versus matching grants: Which is the most effective intervention in terms of increasing crop yields?
- Competitive community grants versus guaranteed budget support – Which leads to better targeting and greater responsiveness to the interests of vulnerable groups?



Identifying causal impact

- Evaluate the impact/effect of a program or an intervention on some outcomes of interest
 - By how much did X (intervention) change Y (outcome)?
- Not the same as correlation!
 - X and Y are related, move together in some way
 - Fertilizer subsidy program & bad harvest
 - Does the subsidy lower yields? Drought? Pest attack?



Evaluation Question

- What is the effect of an intervention/treatment P on outcome Y ?
- Example: What is the effect of an input subsidy program (P) on maize yields (Y)?

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Evaluation Question

Impact of P =

Maize yield (Y) for a farmer participating in the input subsidy program

–

Maize yield (Y) for the same farmer in the absence of the input subsidy program

(at the same point in time)

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Attributing Causality: Problems

We observe maize yields (Y) for the farmer participating in the subsidy program

But we do not observe maize yields (Y) for the same farmer in the absence of the subsidy program

Fundamental problem: We never observe the same individual with and without program at the same point in time



Attributing Causality: Solution

Estimate/ mimic/find a good proxy for what would have happened to outcome Y in the absence of program P

- Compare the farmer with someone who 'looks' exactly like him/her who was not exposed to the intervention P at the same point of time
- In other words, we must find a valid Counterfactual: Comparison or Control group- comparing average effects



Finding a Valid Counterfactual

- Understand the process by which program participation (treatment) is determined:
 - How are benefits assigned? What are the eligibility rules?
 - The counterfactual must be similar in terms of the likelihood of treatment/program participation



Finding a Valid Counterfactual

- The treated group and the counterfactual group should have identical characteristics on average, except for benefiting from the intervention
- **only reason** for different outcomes between treatment and counterfactual is the **intervention**



“Counterfeit” Counterfactual #1

Before and After

- Same group of farmers before and after treatment/subsidy program
- Compare yields before and after
- Findings: Yield after program is lower than yields before the program
- Did the program fail?



“Counterfeit” Counterfactual #1

Before and After

What else is happening over time?

- Poor and irregular rainfall?
- **Effect of treatment and time-varying variables on outcome cannot be separated**

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“Counterfeit” Counterfactual #2

Compare participants to non-participants at the same time

— Non-participants:

- Those who choose not to enroll in program:
Communities who do not apply for grants- poor capacity, high need (other interventions?)

or

- Those who were not offered the program, ineligible:
Richer communities



“Counterfeit” Counterfactual #2

Compare participants to non-participants at the same time

Problem:

- We cannot determine **why some participate** in the program and **others do not**, existing differences in behavior could affect outcomes (compare more cohesive communities with low capacity communities)
- Cannot compare eligible to ineligible, differ in **characteristics that also affect outcomes** (compare rich communities to poor communities)

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Why might participants and non-participants differ?

Government offers input vouchers for fertilizers to farmers through extension workers:

What is the effect of this intervention on yields?

Who participates? Which farmers go to the extension workers to get the voucher?

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Who participates?

- Farmers who are more enterprising, less risk-averse, have higher income to contribute their share of the subsidy – may have higher yields irrespective of fertilizer use
- Participants have differing (pre-existing) characteristics relative to non-participating communities and individuals that also affect outcomes of interest
- **Non-participants → a poor counterfactual for treatment group**



Possible Solutions...

- Guarantee comparability of treatment and counterfactual groups
- ONLY remaining difference is intervention
- How?
 - Experimental design
 - Non-experimental/ Quasi-experimental design

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These solutions all involve...

- EITHER Randomization
 - Give everyone an equal chance of being in control or treatment groups (or a lottery)
 - Ensures that participants and non-participants will be similar on most characteristics
 - Only difference is the intervention
- OR Transparent & observable (quantifiable) criteria for assignment into the program
 - Separate effects of intervention from “other things”

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Conclusions

- To identify effective interventions and compare alternatives, we need to be able to attribute causality
- Need a valid counterfactual: a group that would behave the same as the treated group in the absence of the intervention
- Invalid counterfactuals:
 - Before and after: time-varying variables
 - Participants vs. non-participants: characteristics
- Options: Choice of method depends on program design, operational considerations, and the question



Thank You

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