Agent-Based Modeling: New Methodologies in Impact Analysis

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Outline

- Understanding Impact Analysis
- Agent Based Modeling
- ABM: How can it help you
- Methods for Impact Evaluation
- Conclusions: Future Directions
What is Impact Analysis?

- The design, implementation, and evaluation of a social or technological innovation in a real-world setting that improves the well-being of individuals or communities.

- **Examples:**
  - Introduction of a regulation
  - Creation of a new social program
  - Dissemination of a new technology
  - **Outcomes of Interest:**
    - Health indicators (life expectancy, nutritional status)
    - Economic indicators (GDP, household income)
Stages of Impact Analysis

- Part 1: Before Roll Out
- Designing Roll-out Process
- Modeling Potential Impact
- Part 2: During/After Roll-Out
- Piloting
- Evaluation
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Designing Roll-Out

• How can we disseminate the innovation so as maximize the potential benefits?

• Considerations:
  » Decision makers/ Decision Process
  » Education
  » Community Leaders/ Politicization
  » Dissemination Channels
Modeling Potential Impact

- Given the options of how to roll-out or disseminate the innovation, what will the potential impact be on individuals and communities?
  - Will the new innovation be adopted?
  - How fast will it spread?
  - Will the benefits be shared by all?
  - How will it interact with other programs?
Agent-Based Modeling (ABM)

- A general tool to allow researchers and policy makers to simulate social or scientific phenomena in a computerized laboratory setting, in order to better understand how these phenomena will unfold in real-world settings.
ABM: Building Blocks

- Components
- Agents
- Behaviors
- Landscape
- Key Concepts
- Bounded Rationality
- Heterogeneity
- Emergence/Bottom-Up Approach
What is ABM Used For?

- Diffusion/ Contagion processes
- Social Networking applications
- Population Dynamics
- Spatial Analysis

Most useful for understanding large-scale (macro) implications of individual-level (micro) processes
How to Build an Agent-Based Model

- Domain Experts and Modelers Meet
- Story-Boarding
- First-pass model with basic behaviors
- Iterations to add more complexity
ABM: Examples

- Technology Diffusion
- Agricultural Practices
- Teenage Smoking
- Kayenta Anasazi
- Epidemics
ABM: Examples (2)
ABM: Examples (3)
ABM: How it can Help YOU

• Delivery and Dissemination of Bio-Fortified Staple Crop Species
• How are new crop species adopted, marketed, and consumed?
• How are the benefits of new crop species distributed across society?
• How will the dissemination unfold under different scenarios?
ABM: How Can it Help You To... Design Roll-Out

• What are the best dissemination channels?
• Who should provide extension?
• When should the new varieties be introduced?
• To whom should the new foods be piloted?
ABM: How Can it Help You To... Model Potential Impact

- How will farmers and consumers benefit from new crop species?
- How will markets be affected by these new foods?
- Heterogeneous effects
- Static vs. Dynamic impacts
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Impact Evaluation

**Impact**

- Effect on living standards
  - infant and child mortality,
  - prevalence of specific disease

**Outputs**

- Access, usage and satisfaction of users
  - number of children vaccinated,
  - percentage within 5 km of health center

**Inputs**

- Goods and services generated
  - number of nurses
  - availability of medicine

- Financial and physical resources
  - spending in primary health care
Impact Evaluation

• Experimental Methods
• Quasi-Experimental Methods
• Non-Experimental Methods
• Qualitative Methods
Experimental/Quasi-Experimental Methods

- Need a comparison group that:
  - Is as identical as possible in observable and unobservable dimensions to those receiving the program
  - Will not receive spillover benefits
- How to construct a comparison group (building the counterfactual):
  - Randomized Controlled Trials (RCT)
  - Controlled Trials (Difference-in-Difference)
  - Exploiting spatial and temporal differences in roll-out
Non-Experimental/Qualitative Methods

• Comparing before-and-after measures
• Focus Group Discussions
• Key Informant Interviews
Directions for Future Work

• Using ABM before roll-out to understand process and estimate potential impact

• Using Impact Evaluation after roll-out to identify benefits and beneficiaries
Resources for More Information about ABM

Thank you