Seed Selection Strategies for Information Diffusion in Social Networks: An Agent-based Model Applied to Rural Zambia

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Introduction

- Lack of access to formal information sources in rural areas of developing countries[1]
- Spread of information through social networks[2,3]
- Information important for innovation adoption[4,5,3]
- Policy-makers only inform subset of population initially and rely on them to disseminate information[6,7]
- Seeds: individuals who obtain information first

Research question: Which is the optimal set of seeds to improve information spread in a social network?

Data

Project: Food Security in Rural Zambia (FoSeZa)

- Use of social networks to promote innovations such as diversified food systems

Data set

- FoSeZa household census 2018: socio-economic survey of 264 households in eight villages

Methodology

ABM: computational model for simulating (inter)actions of autonomous agents to assess effects on micro- and macro-level

Household actions during each time step.

Households with status „informed" pick one of the households they are connected with

↓

If such household exists, check if other household is „informed"

↓

If not, acting household informs other household with certain probability

↓

If information is transmitted successfully, other household sets status to „informed"

Agent-based model (ABM)

- Purpose: simulation of information diffusion by word-of-mouth communication to predict impact of varying seed sets on diffusion
- Entities: households represented by household heads, connected via links
- Household variables: state of information, administrative affiliation
- Link variables: occurrence and frequency of agricultural discussion
- Scale: one simulation run = 52 weeks
- Output: number of informed households after each month
- Input: household survey data

➢ Replication of observed patterns

Systematic evaluation of strategies.

Scenario 1: **seed selection criteria**
- Random
- Degree centrality
- Betweenness centrality
- Eigenvector centrality
- Closeness centrality
- Hierarchy (Village heads)

Scenario 2: **number of seeds**
- From 1 to 10% of whole population
- Randomly chosen

Scenario 3: **interaction effects between seed selection criteria and number of seeds**

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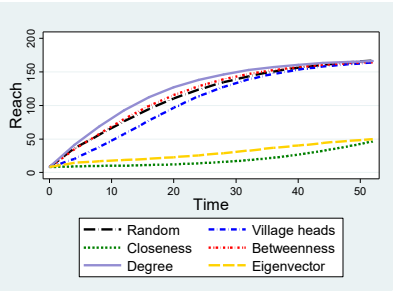
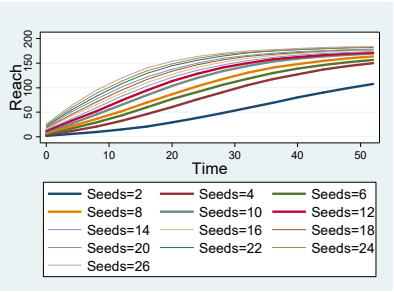
Results & Discussion

Scenario 1



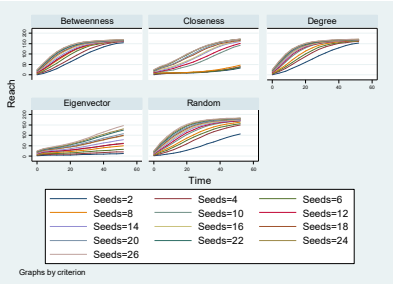
- Degree: direct influence improves spread
- Betweenness: bridging function in sparse network
- Random: seeds can be in several components
- Village heads: well connected
- Eigenvector and closeness: indirect influence hinders spread

Scenario 2



- Higher number of seeds leads to faster and more widespread reach due to greater transmission in the early stages
- Decreasing marginal effects of additional seeds

Scenario 3



- Interaction effects significant
- Results robust for betweenness-, degree-, and random-based seeds
- Performance of closeness- and eigenvector-based seeds depend on seed size

Note: Village heads excluded from graphic because number is fixed.

Conclusions

- Seeding strategies have high potential to improve information diffusion
- Best results under degree-based seed selection, followed by betweenness-, random-, and hierarchy-based seed selection
- Higher number of seeds has positive effect with declining marginal effects
- Effect of number of seeds robust for random-, betweenness-, and degree-based selection, but performances of closeness- and eigenvector-based selection depend on number of seeds

Further research

- Assessment of social constraints, rivalry of information consumption, and decreasing information values
- Evaluation of options to improve transmission process

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