An ABM using awareness space to study possible police effects on distance decay

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Overview

- Research question
- Agent-based modelling (ABM)
- Our present model
- Results
- Conclusions and future work
Research question

• Distance decay curve (DD) of offending behaviour
  • One of the stylized facts in environmental criminology
• Based on a limited sample: police data -> caught offenders
• It may be that local criminals get caught more easily
  • **DD may be a result of non-random sampling** (McIver, 1981; Eck & Weisburd, 1995)
  • Measuring police activity instead of offender behaviour?
Method

• Difference between caught and successful offenders?
  • police data useless

• We explore the likelihood of the hypothesis…
• … and simulate various settings in an agent-based model (ABM)
  • Simulated environment: represents simplified ‘world’
  • Complex patterns can be result of simple rules
  • ABM implements such rules to better understand real-life behaviour
  • Bottom-up approach: rules determine how agents (i.e. smallest units) behave and interact in the ‘world’; no ‘higher power’
    • Interactions evolve, based on past -> time dynamics

• Netlogo (Wilensky, 1999)
Model

- **Research question**: can observed DD be an artifact of police attention only?
  - ‘usual suspect’ approach
  - ABM rules: people that have been caught before, may be more likely to get caught again...
    - A) In the district where they have already been caught (police forces know active offenders in their district)
    - B) In the district where they live (police forces know the criminals living in their area)
    - C) In both these districts
    - D) Everywhere (police forces know all previously caught offenders)

- Does this generate (stronger) DD?
  - Compare with a ‘zero’ setting (no usual suspects)
Simulated offending patterns

- Basic notion of **awareness space** (Brantingham & Brantingham)
- 2-5 nodes
- 1 home node for distance calculation (is connected to all other nodes)
- Equal chance of offending within awareness space
- 100 crimes, partly solved
- 50 repetitions
  
  -> 5000 crimes per setting
Simulated environment

- 96 x 96 grid
- 16 police districts
- Chance to get arrested increases in case of being a usual suspect
  - 5% -> 20%
  - Cfr. 8-15% solved burglaries

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A) district of previous offence

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B) home district

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C) both districts

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D) everywhere

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Model: step-by-step
Measures

- Calculate Euclidian distances
  - ≠ travelled distance

- Plot all crime trips of all offenders
  - 2 data sets
    - Solved crimes (red)
    - All crimes (yellow + red)

- Kernel density estimations
Comparison: no effect vs. crime district (2 nodes)

- If no usual suspects: DD is **weaker** for solved crimes (left)
- Same for usual suspects in previous crime district (right)
Comparison: no effect vs. home district (2 nodes)

- Usual suspects in home district (right): stronger DD for solved crimes
Comparison: no effect vs. both districts (2 nodes)

- If usual suspects in home district AND previous crime district: similar DD patterns
Comparison: no effect vs. all district (2 nodes)

- If usual suspect in all districts: similar to ‘zero’ setting
Results: 2 nodes

- DD is overestimated if offenders are usual suspects in their home district
- Otherwise the effect is marginal

-> focus on home district
Comparison of settings (3 nodes)

- DD curve gets ‘bumpy’, but conclusions remain the same
Comparison of settings (4 nodes)

- Little DD remains, except in right graph
Comparison of settings (5 nodes)

• Trend continues
Conclusions

• DD is enhanced by usual suspect enforcement only if police focus solely on offenders who live within their district
  • When offenders choose locations according to AS principle

• In other cases of offending within AS, ‘usual suspect’ thinking by police only marginally affects DD

• Traditional DD studies probably measure offending patterns indeed (not just police behaviour)

• Awareness Space -> DD
  • Only in case of limited nodes
Future work

• With 2 nodes (except for ‘home district usual suspects’) we observe a weaker distance decay for solved crimes than in general
  • Even for the zero setting !?
  • More repetitions needed?

• How about using another framework than ‘awareness space’ for offender mobility?
  • AS contains no distance constraint -> no tautology

• How about other effects than ‘usual suspects’ that may influence distance decay patterns?
  • E.g. more careless offenders take less effort to travel and to avoid getting caught