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

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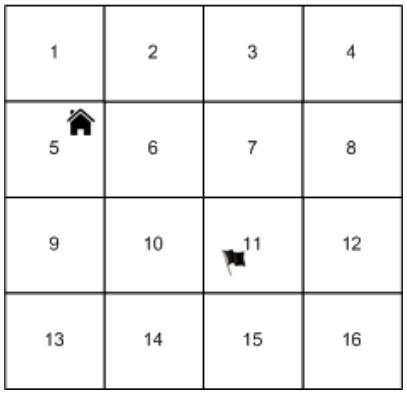
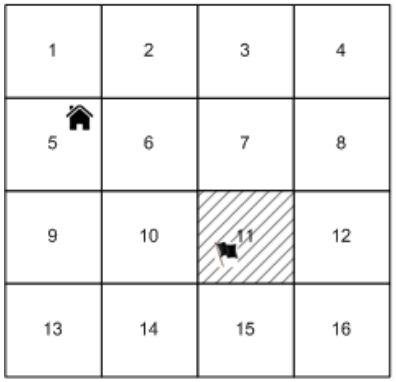
Simulated environment

- 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

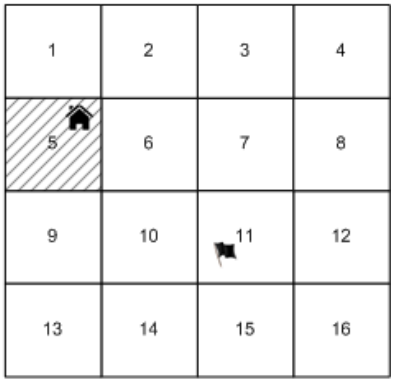
Zero setting



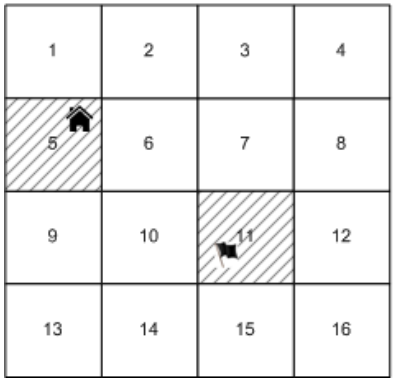
A) district of previous offence



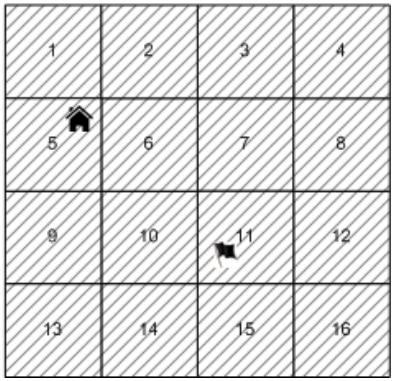
B) home district



C) both districts



D) everywhere



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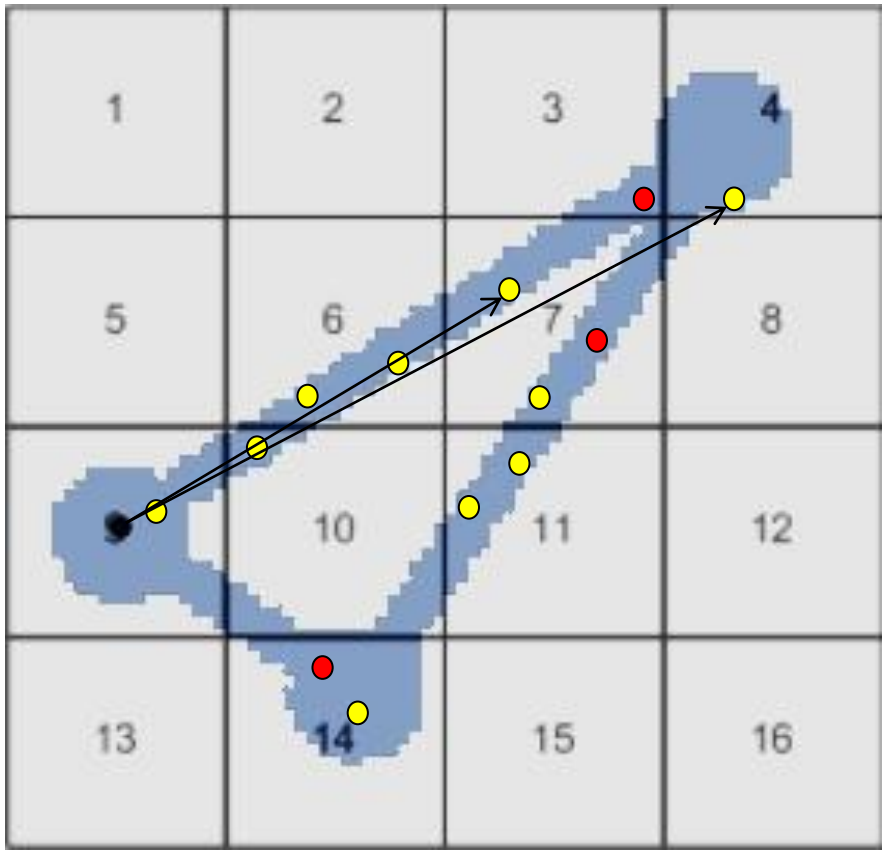
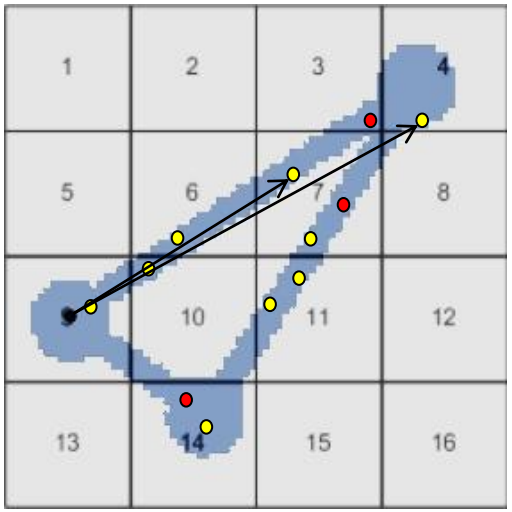
Model: step-by-step

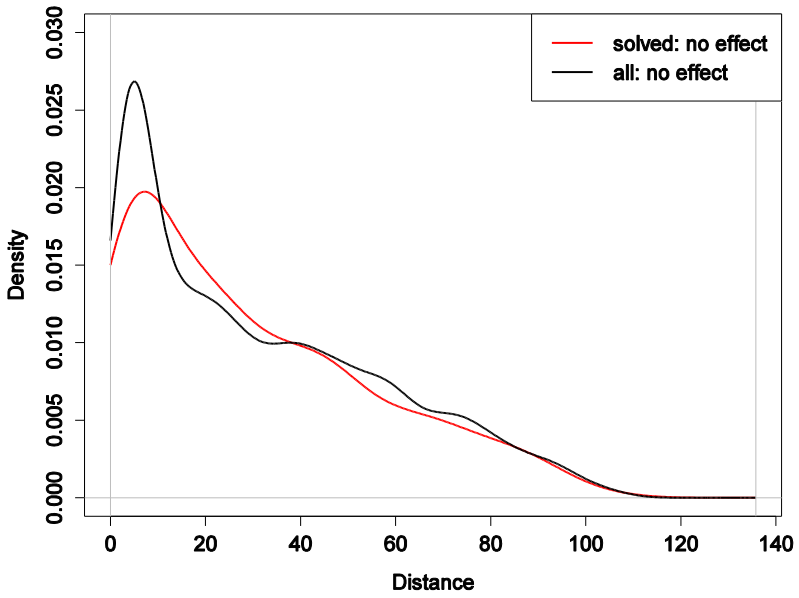


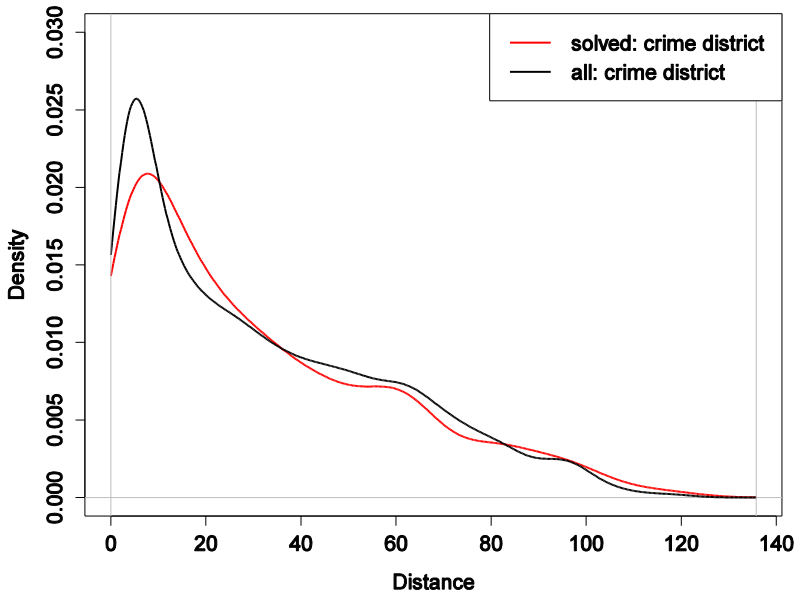
Measures

- 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



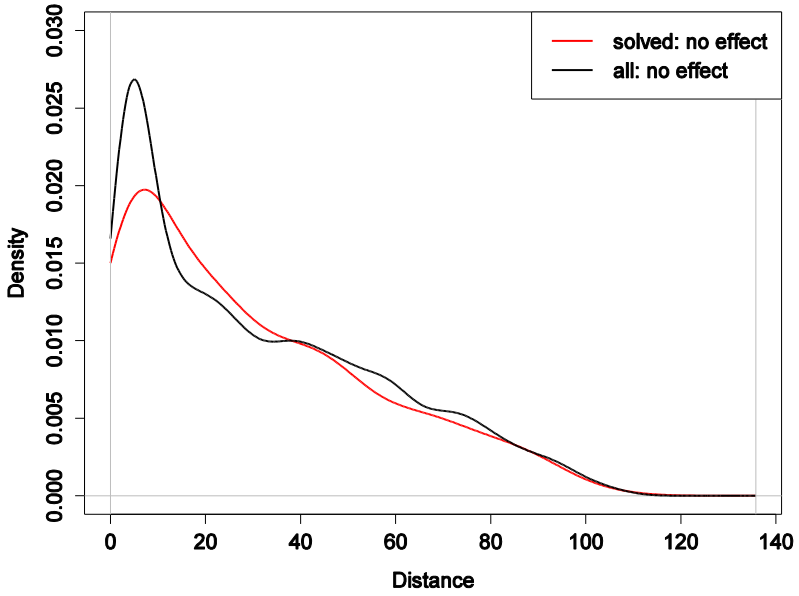
Comparison: no effect vs. crime district (2 nodes)

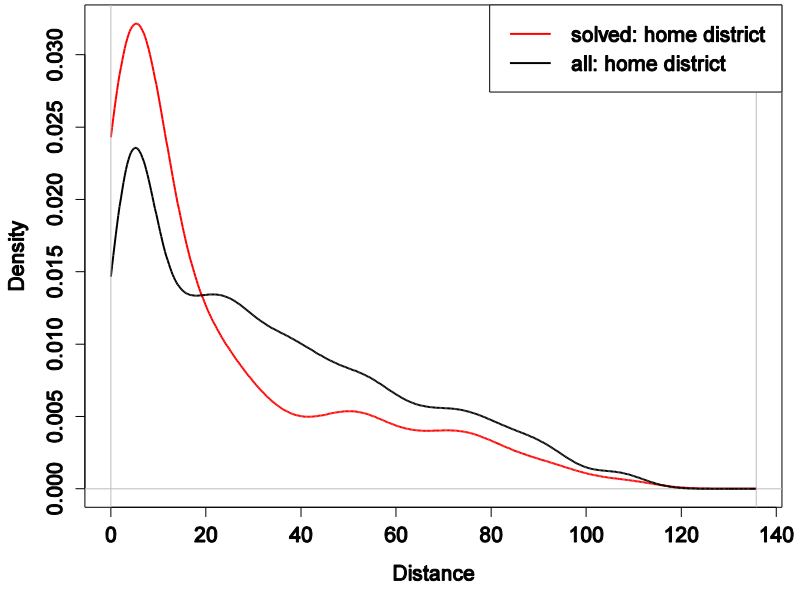




- If no usual suspects: DD is **weaker** for solved crimes (left)
- Same for usual suspects in previous crime district (right)

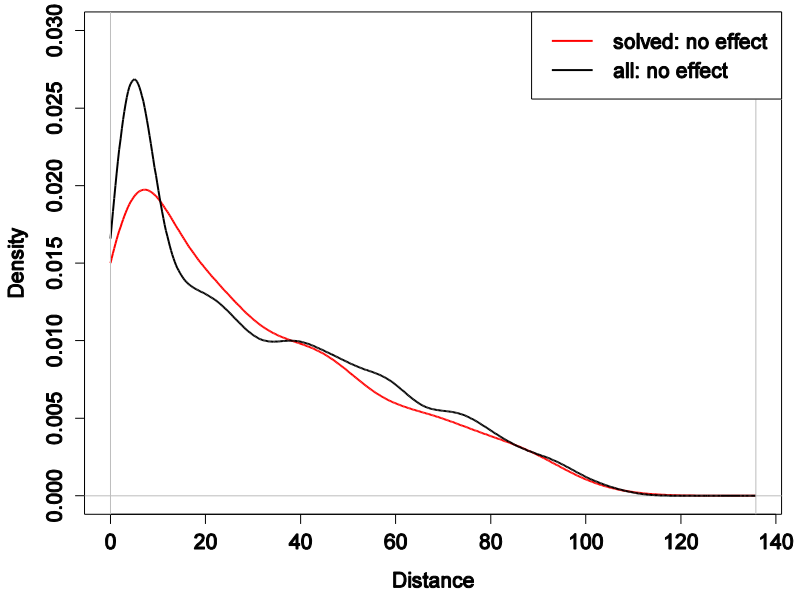
Comparison: no effect vs. home district (2 nodes)

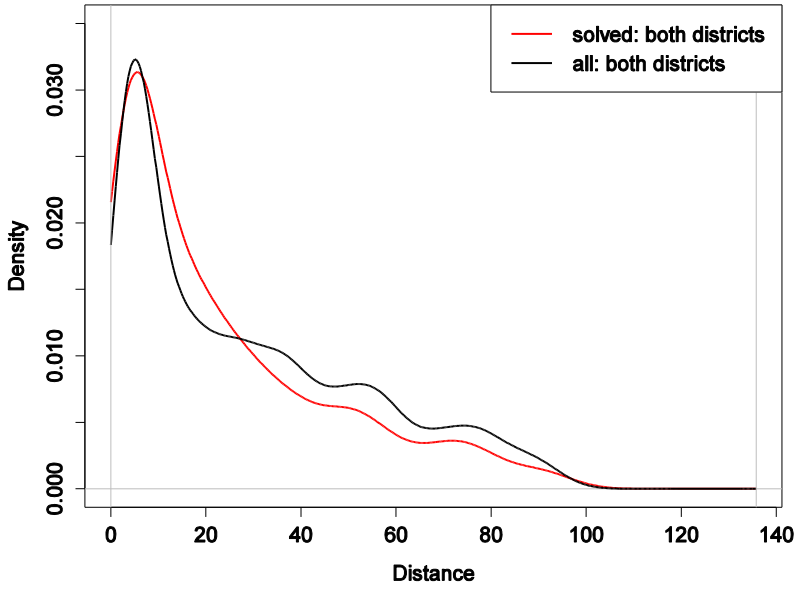




- Usual suspects in home district (right): stronger DD for solved crimes

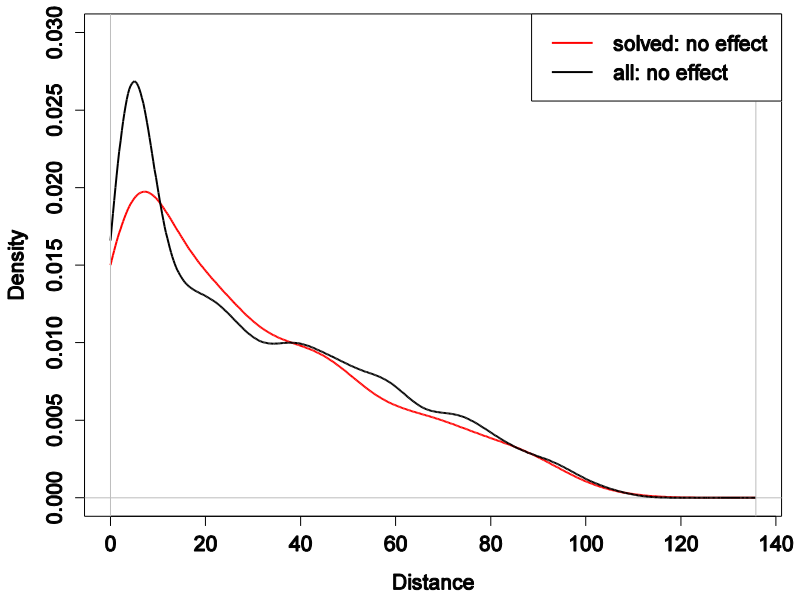
Comparison: no effect vs. both districts (2 nodes)

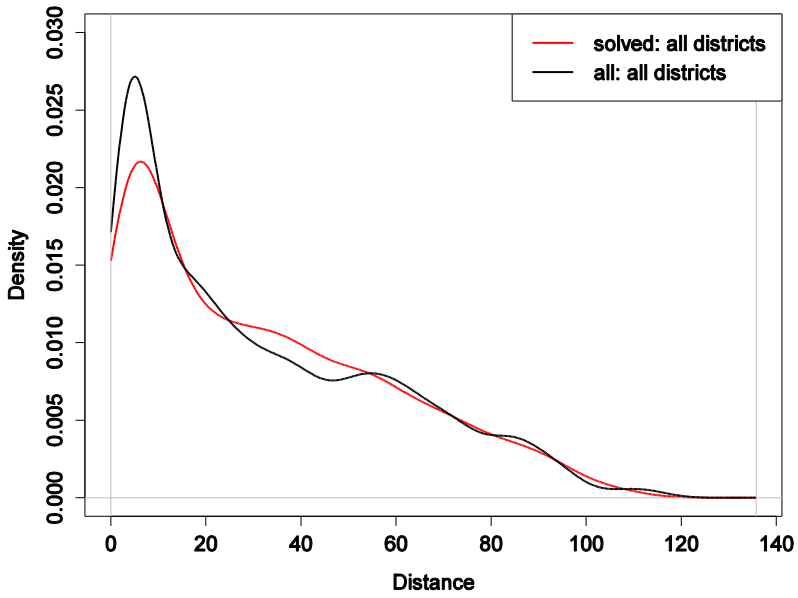




- If usual suspects in home district AND previous crime district: similar DD patterns

Comparison: no effect vs. all district (2 nodes)





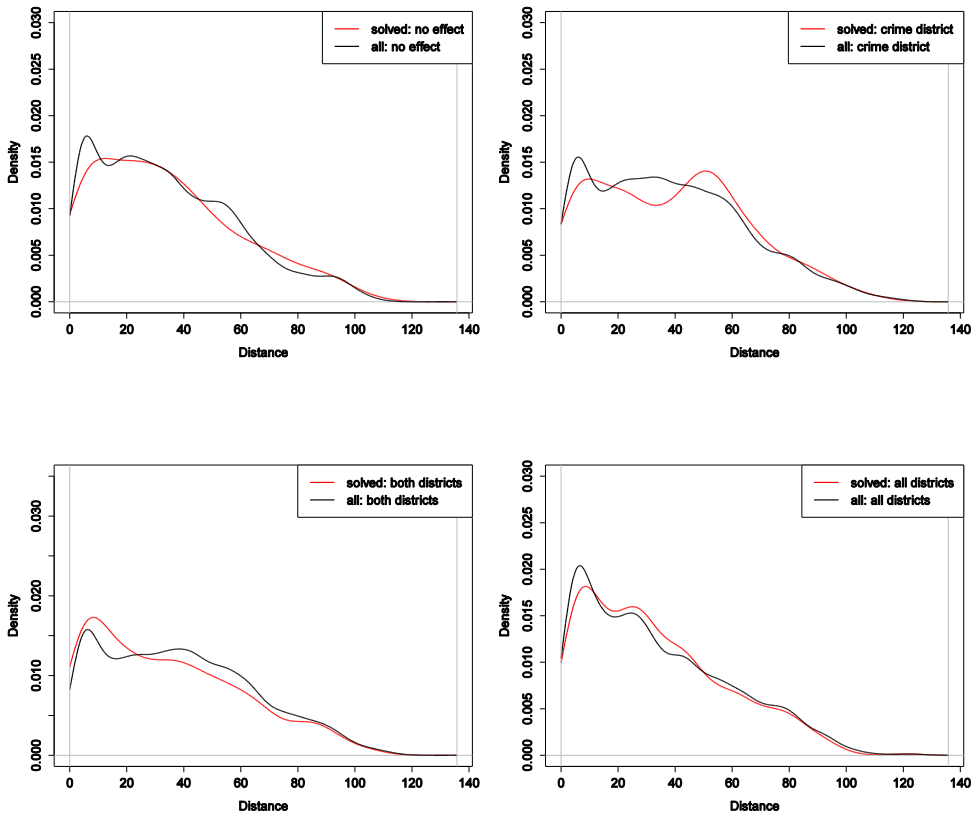
- If usual suspect in all districts: similar to ‘zero’ setting

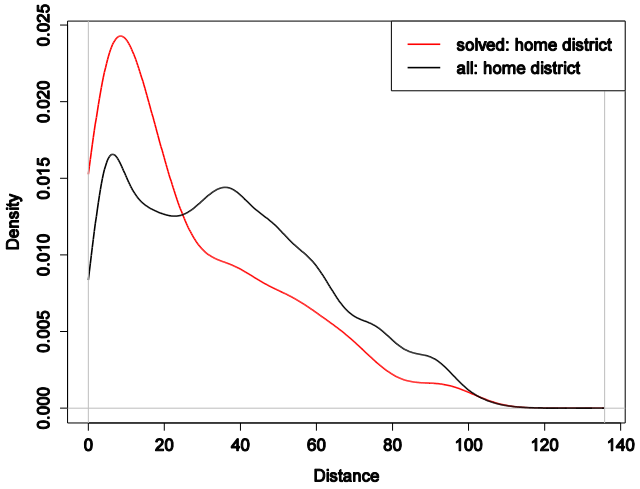
Results: 2 nodes

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

-> focus on home district

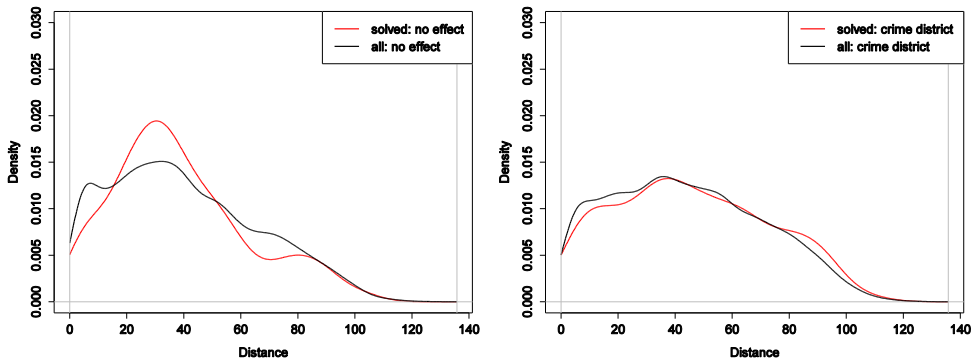
Comparison of settings (3 nodes)

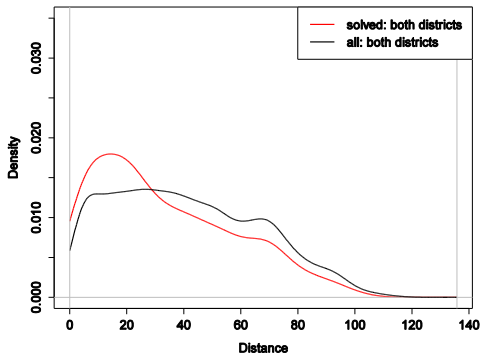


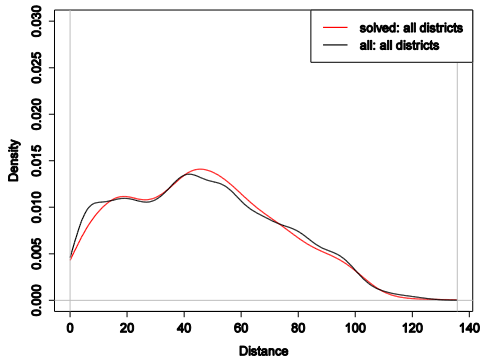


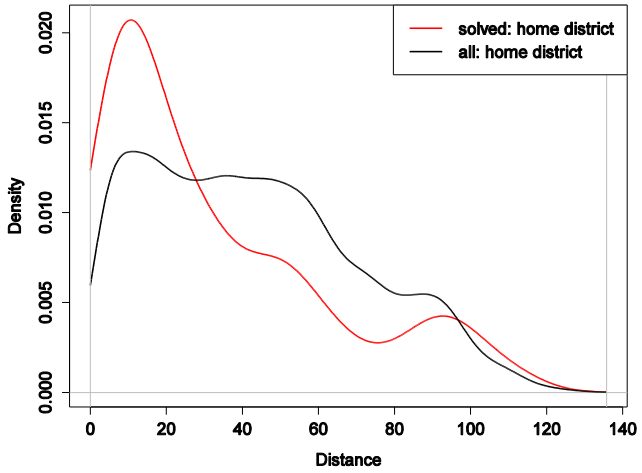
- DD curve gets ‘bumpy’, but conclusions remain the same

Comparison of settings (4 nodes)



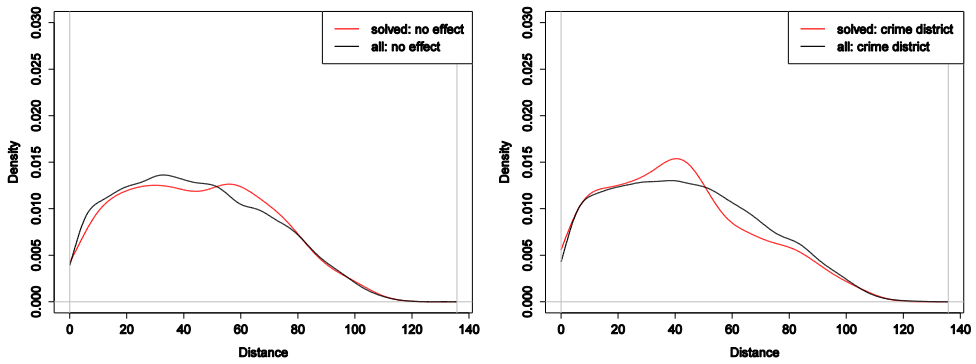


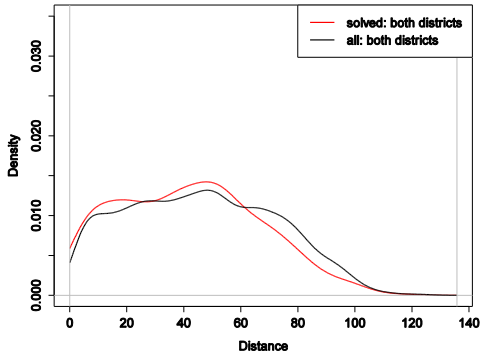


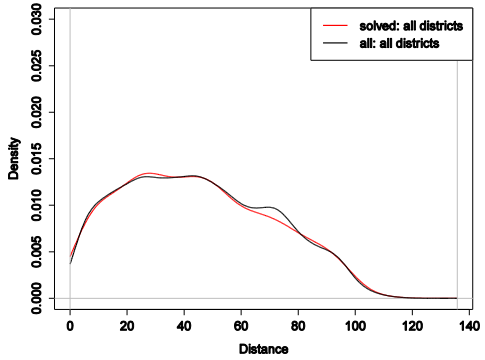


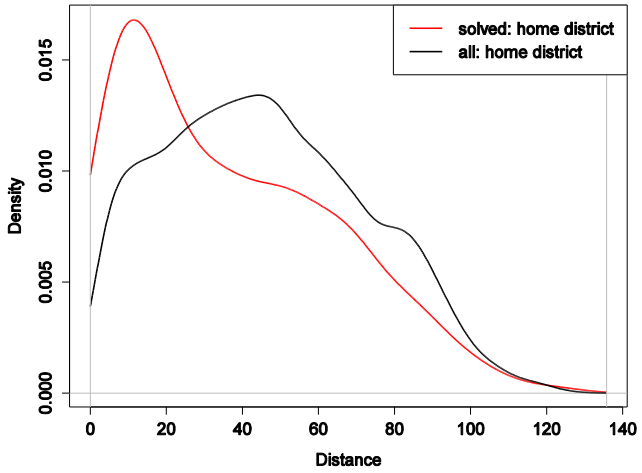
- Little DD remains, except in right graph

Comparison of settings (5 nodes)









- Trend continues

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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