Agent based modelling

Civil Violence

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Content

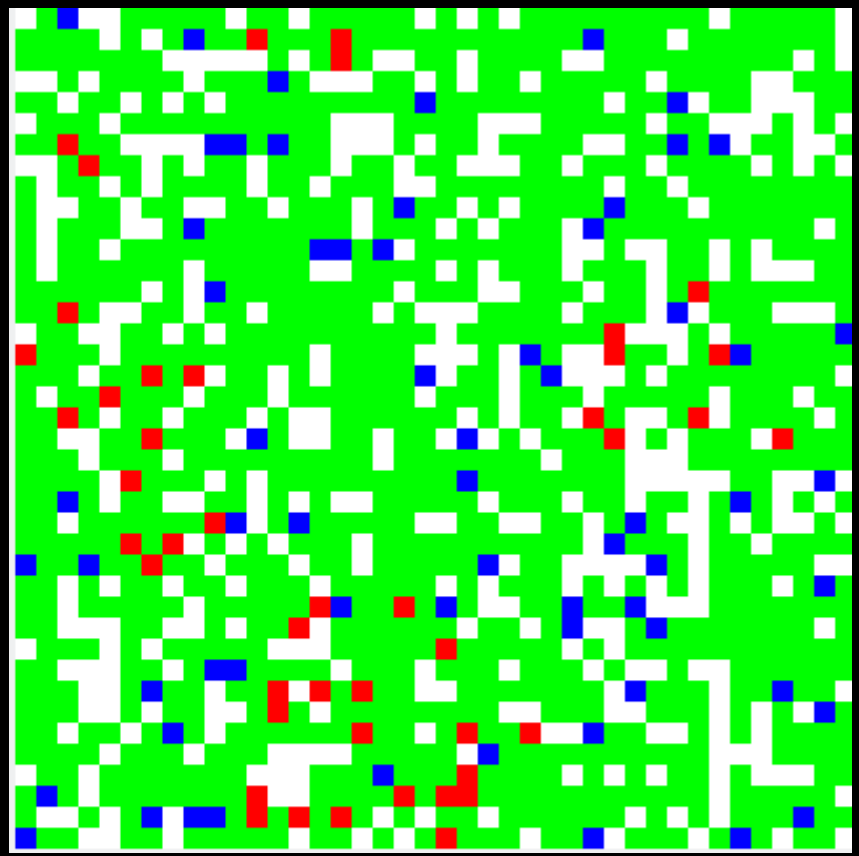
Civil violence: a broad issue

- Many forms
- Complex dynamics
- Multitude of actors
- Studied here: rebels vs. central authority

Model by Epstein: Generalised rebellion against central authority

Set-up

The model is situated on a square lattice. Agents and cops move around on the lattice and only have information about the lattice points in their proximity.



Model by Epstein: Generalised rebellion against central authority

Agents

- Hardship $H_i \in U(0,1)$
- Risk aversion $R_i \in U(0,1)$

Global

- Legitimacy $L \in [0,1]$
- Vision v
- Threshold T

Model by Epstein: Generalised rebellion against central authority

Agents

- Hardship $H_i \in U(0,1)$
- Risk aversion $R_i \in U(0,1)$
- Arrest probability P_i
- $P_i = 1 - e^{-k\left(\frac{C}{A}\right)_v}$

Global

- Legitimacy $L \in [0,1]$
- Vision v
- Threshold T

Model by Epstein: Generalised rebellion against central authority

Agent Rule

We define a personal *grievance* G_i and a net-risk N_i:

$$\begin{aligned} G_i &= H_i(1 - L) \\ N_i &= R_i \cdot P_i \end{aligned}$$

If $G_i - N_i > T$, be active. Otherwise, be quiet.

Model by Epstein: Generalised rebellion against central authority

Cops

Vision v^*

Model by Epstein: Generalised rebellion against central authority

Cops

Vision v^*

Cop Rule C

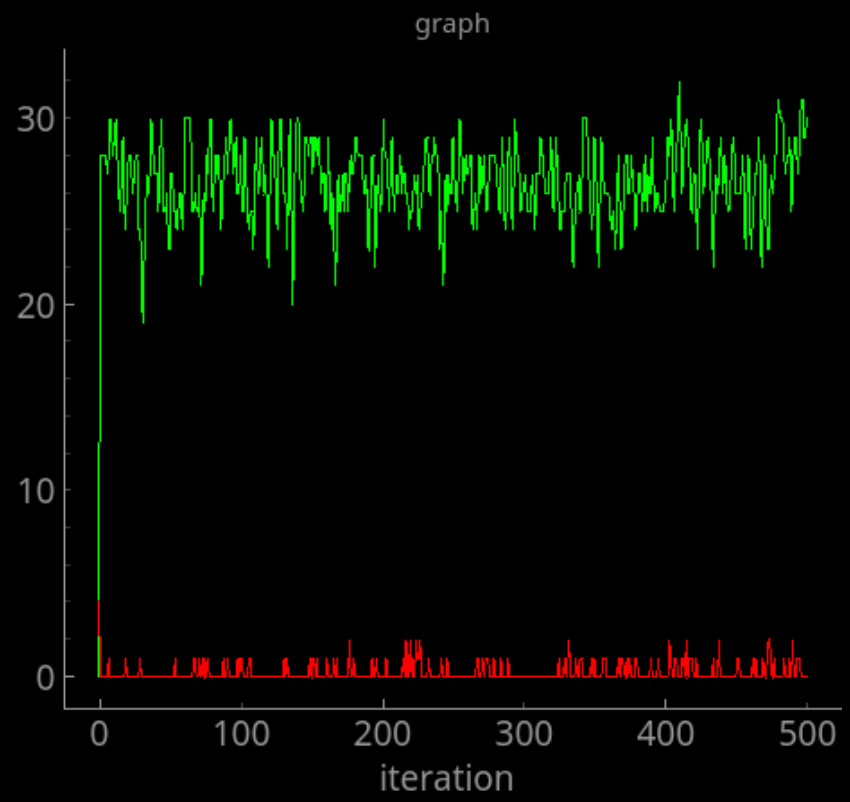
Inspect all sites within v^* and arrest a random active agent.

Model by Epstein

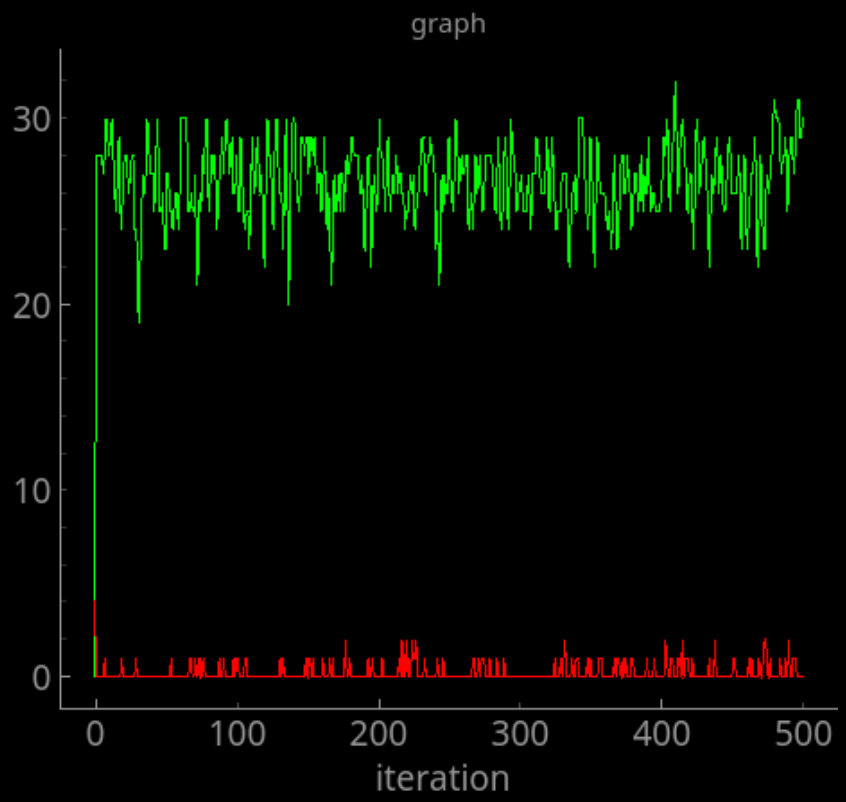
Movement rule

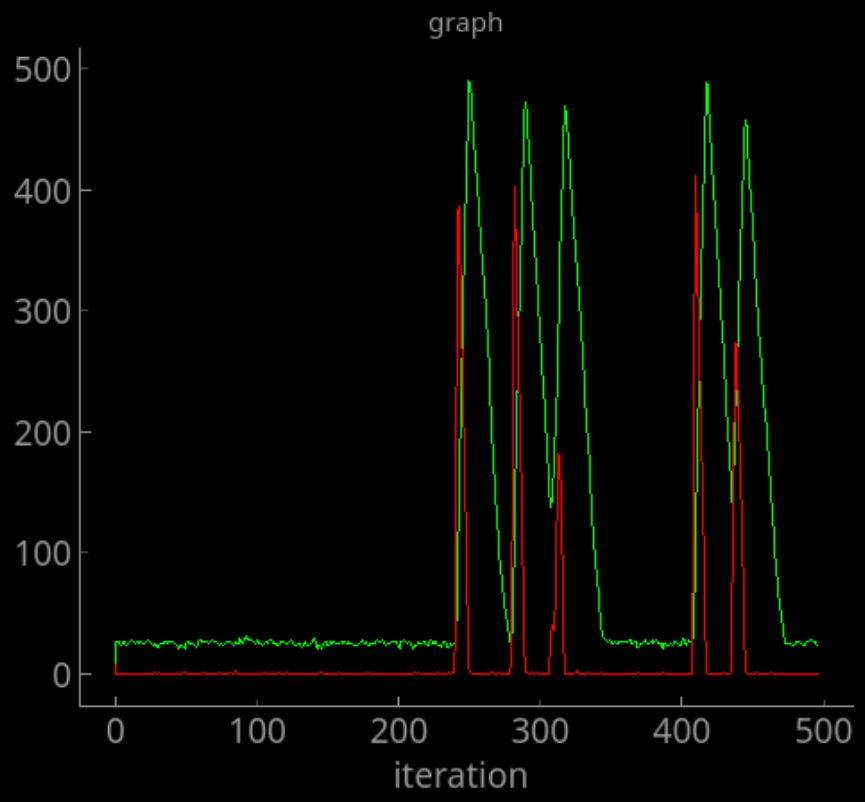
Move to a random site within your vision

Expected behaviour



Expected behaviour





Issue with the model

Why?

floor() function

Issue with the model

Why?

floor() function

Where?

$P = 1 - \exp(-k \cdot \frac{C}{A})$

Issue with the model

Why?

floor() function

Where?

$$P = 1 - \exp(-k \cdot \frac{C}{A})$$

How?

- Situation: strike

Issue with the model

Why?

floor() function

Where?

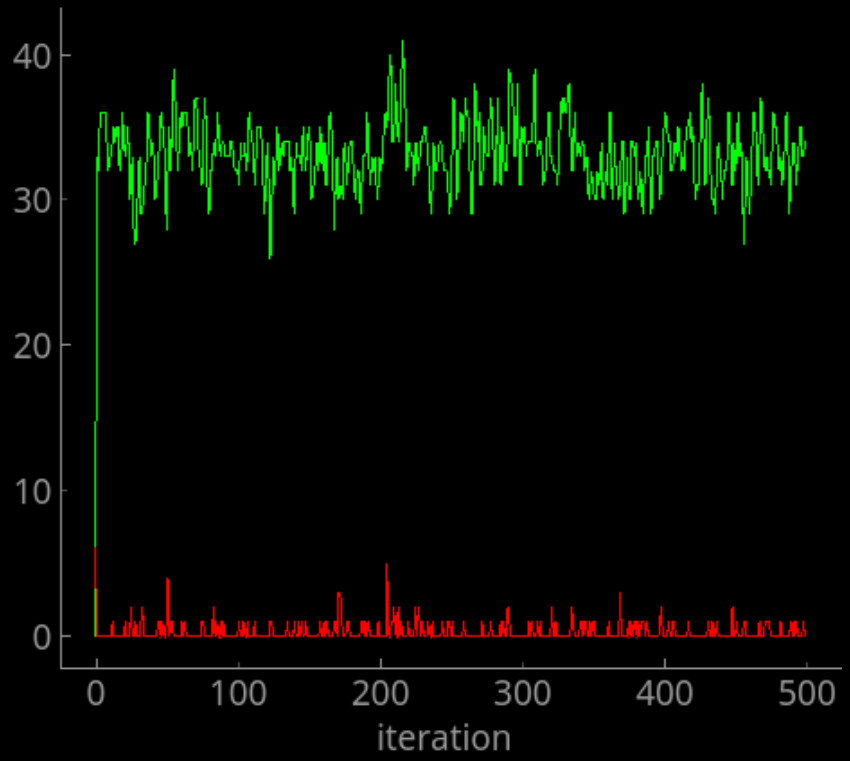
$P = 1 - \exp(-k \cdot \frac{C}{A})$

How?

- Situation: strike
- Model: legitimacy (L) fluctuations

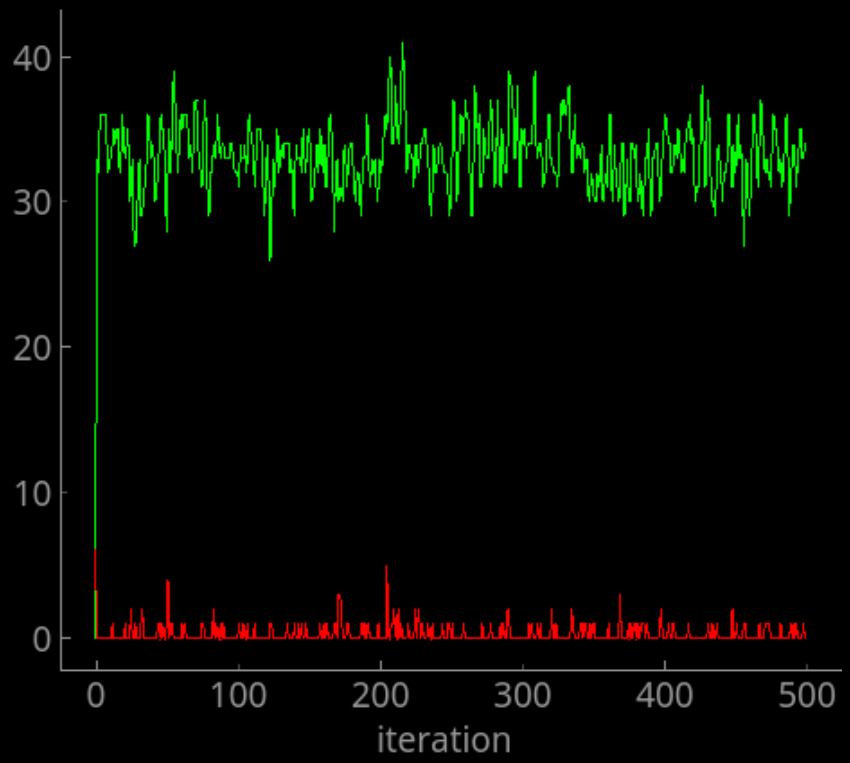
Corrections

High frequency fluctuations:

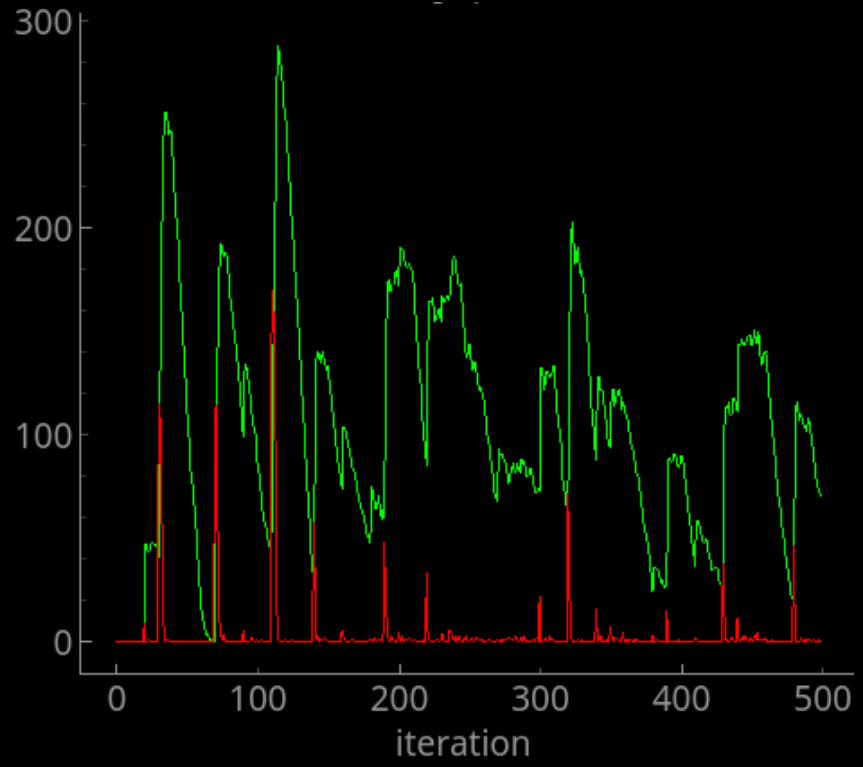


Corrections

High frequency fluctuations:



Periodic fluctuations:



Extension : Cop Motion Improvement

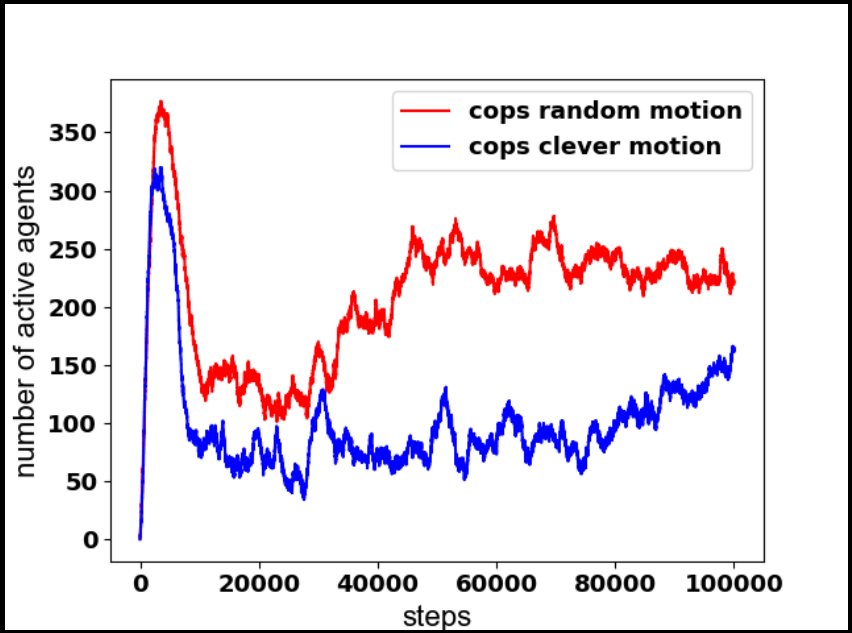
Previous movement rule

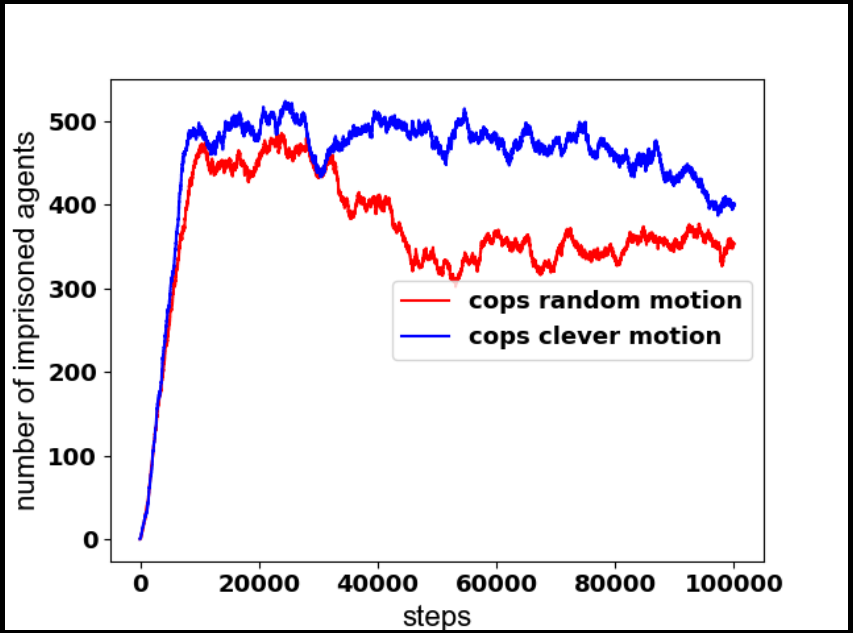
Move to a random site within your vision

New cop movement rule

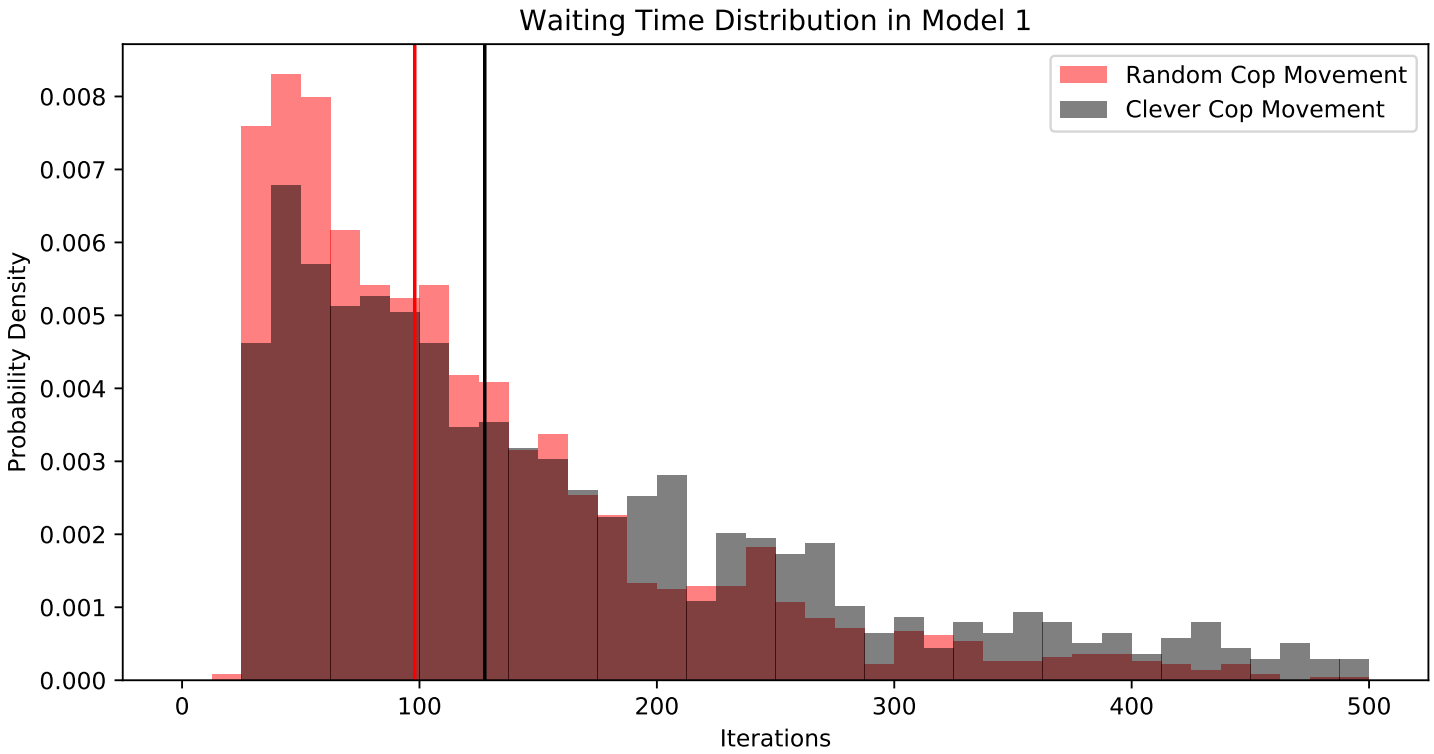
Move towards the sub-box that contains the greatest number of active agents

Extension : Cop Motion Improvement

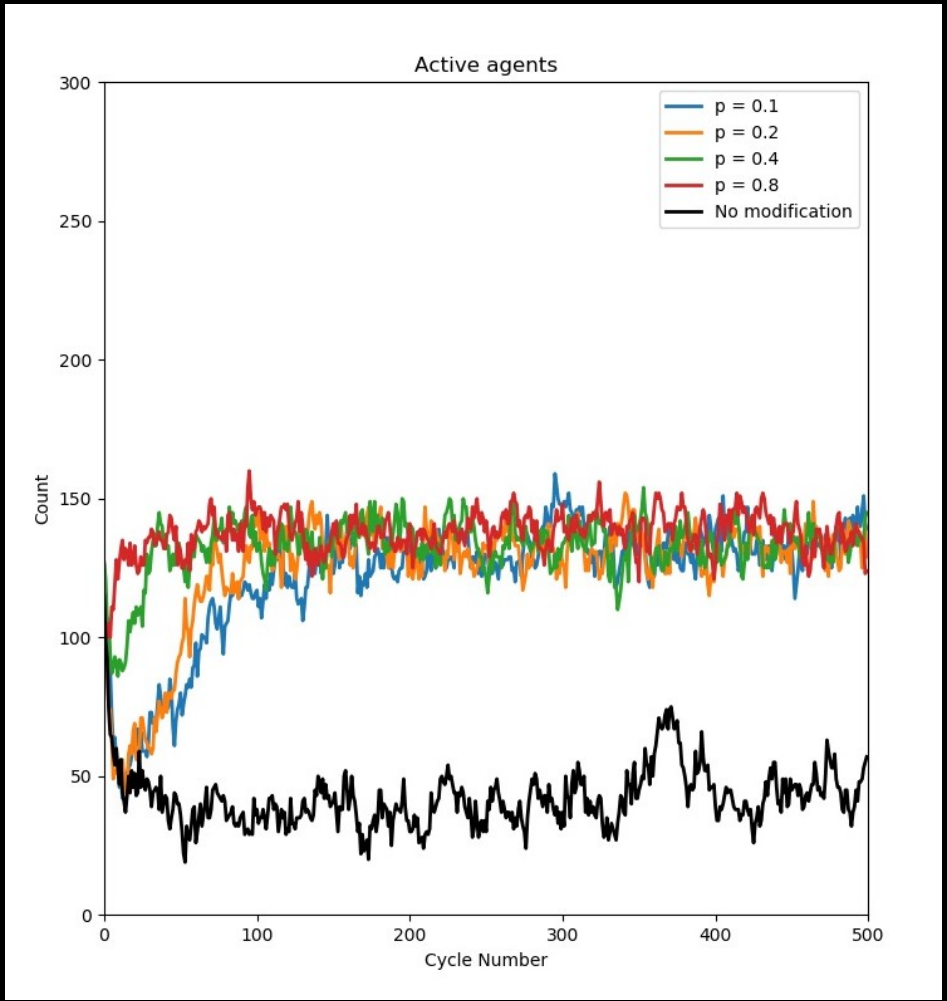




Extension : Cop Motion Improvement



Extension: Agent Reactions



- Jailing of agent raises grievance and renders active a nearby neighbor with probability p
- p-independent saturation
- initial growth corrrelates with p

Conclusion

- Main results replicated (peaked active agent distribution, effect of perceived legitimacy drop)
- 3 extensions (global information access, intelligent cop movement, agents' reactions)
- Potential flaw identified and resolved (cop/agent ratio implementation)

Sources I

Epstein, J. M. (2002). Modeling civil violence: An agent-based computational approach. Proceedings of the National Academy of Sciences, 99(suppl 3), 7243-7250.