Variability of Cooperation in the Spatial Prisoner's Dilemma

TUDelft

Beryl van Gelderen   Supervision by Neil Yorke-Smith   CSE3000 Research Project   June 2020

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The **prisoner's dilemma**:
defection is more profitable individually while cooperation is more profitable for the community.

S is the price of cooperating with a defector.

Spatial prisoner's dilemma: play with neighbour to earn points.
If points > 150 & neighboring free space → clone
If points < **k** → die

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Results:

- Lower values of *k*, combined with a high value of *S* = -0.25, create a low variability environment where cooperation is low.

- For lower values of *S* and the lower value of *N** = 1250, the defectors thrive and the cooperators die out.

- For the lower value of *N** = 1250, there is a sweet spot where, with increasing *k,* the variability increases.

- For the higher value of *N** = 2500, variability does increase with *k*, but not as strongly as for the lower *N** value.

- If *k* is increased for both *N** values to *k* = 2.25, the environment is too harsh and dies out.

- *S* does not seem to have a strong correlation with variability.

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What factors influence the variability between altruistic and egoistic populations?

Factors to explore *k*   *S*   *N** (max no agents)

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Variability is determined over two axes:
1: the variance of the ratio of cooperators
2: the difference of the ratio of cooperators

Harsh environment, none thrive, both cooperators and defectors die out rapidly
N* = 1250, 2500
k = 1.5, 2.25
S = -2.5, -1.75, -1, -0.25

Easy environment, Defector thrives, all cooperators die out rapidly
N* = 1250
k = 0, 0.75
S = -2.5, -1.75, -1

Various patterns of high variability, large shifts in cooperation

N* = 1250
k = 0.75, 1.5
S = -2.5, -1.75, -1, -0.25

Squiggly, but levelling off to steady State, Low cooperation

N* = 2500
k = 0.75
S = -2.5, -1.75, -1, -0.25

N* = 1250
k = 1.5
S = -2.5, -1.75, -1, -0.25

Low variability, high cooperation

# of Blue Agents   # of Red Agents   Coop Ratio * 1000

N* = 2500
k = 0.75, 1.5
S = -2.5, -1.75, -1, -0.25

N* = 2500
k = 0
S = -2.5, -1.75, -1

Low variability from the start, low cooperation

N* = 2500
k = 0
S = -0.25

Low variability from the start, low cooperation

N* = 1250
k = 0
S = -0.25

Low variability, low cooperation

Squiggly, but levelling off to steady State, high cooperation

Average absolute delta in Coop Ratio *1000 every 5000 steps

Average Cooperation Ratio*1000 Variance per 5000 steps