

Interaction and Telemarketers

EES 4760/5760

Agent-Based and Individual-Based Computational Modeling

Jonathan Gilligan

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Getting Started

- Download files for from the download page for “Interaction Models” on the course web site: ees4760.jgilligan.org/downloads/interaction_class_14.

Cooperation and Coordination

Game Theory

- Modern Formal Game Theory originated in the 1940s
 - John von Neumann, *On the Theory of Games of Strategy* (1944)
 - John F. Nash, Jr. “Nash equilibrium”
 - “Equilibrium points in n -person games,” Proc. Nat’l. Acad. Sci. **36**, 48 (1950). doi: [10.1073/pnas.36.1.48](https://doi.org/10.1073/pnas.36.1.48)
 - 1994 Nobel Prize
- Older history (informal)
 - Many centuries of writings on war and gambling
 - Sun Tzu, *The Art of War* (5th century BCE)

Knowing the other and knowing oneself: In one hundred battles, no danger.

Not knowing the other and knowing oneself: One victory for one loss.

Not knowing the other and not knowing oneself: In every battle, certain defeat.

- Girolamo Cardano, *Liber de Ludo Alea* (Book on Games of Chance) (1564)
- Big question:
 - If you are playing a game with another person, what is the best strategy?



John von Neumann (Photo: Los Alamos National Laboratory)



John Nash (Photo: MIT Museum)

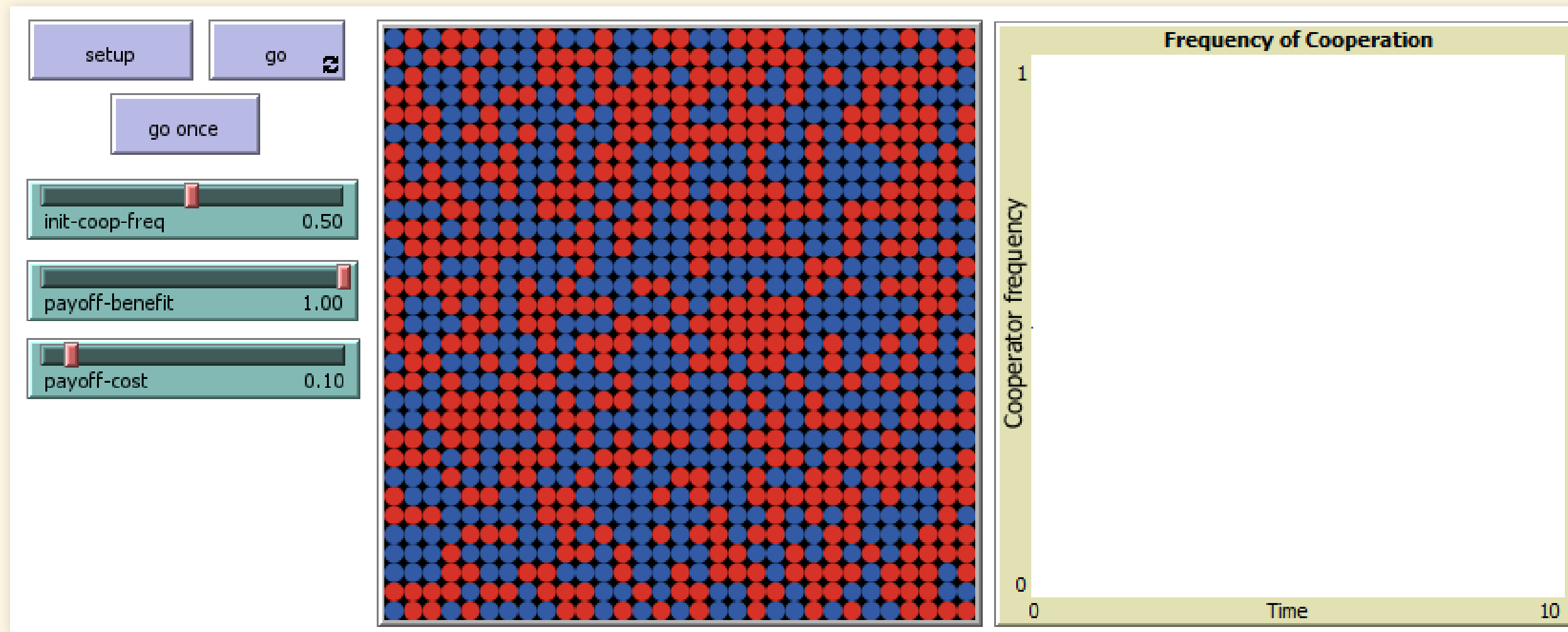
Cooperation vs. Defection (The Prisoner's Dilemma)

- Two people play, and they cannot communicate to discuss their moves.
 - Model:
 - Two people are arrested and accused of a crime
 - If both **cooperate** and remain silent, both are convicted of a minor crime
 - If one **defects** and testifies against the other, they are given a lighter sentence, and the other is convicted of a more serious crime and receives a harsh sentence
 - If **both defect**, they are both convicted of the serious crime, but receive some time off their sentence as a reward for defecting.
 - Mathematical representation:
 - Value for (A, B) of each choice
 - *b* = benefit of the other person cooperating (lesser crime)
 - *c* = cost of not defecting (don't get time off the sentence)

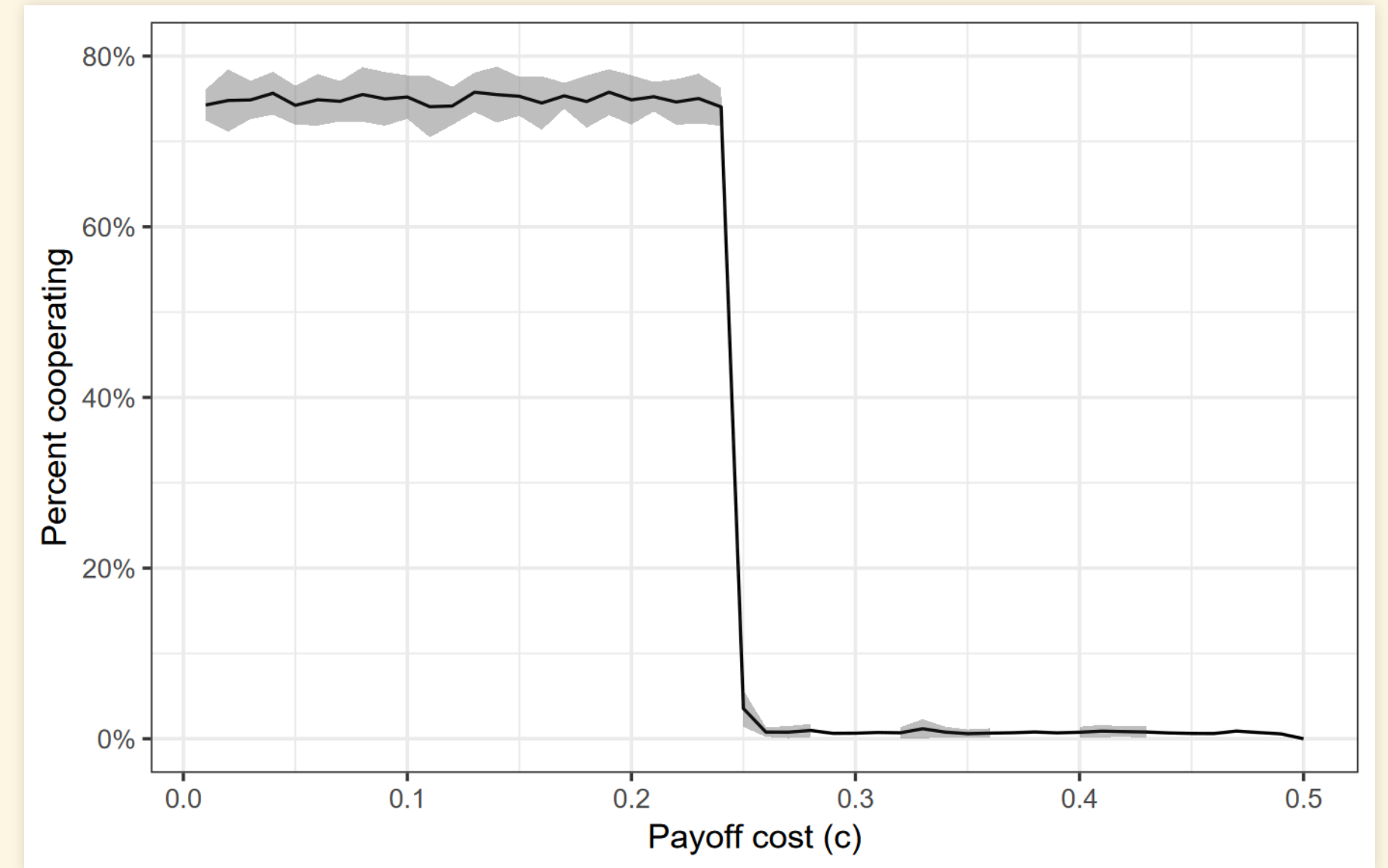
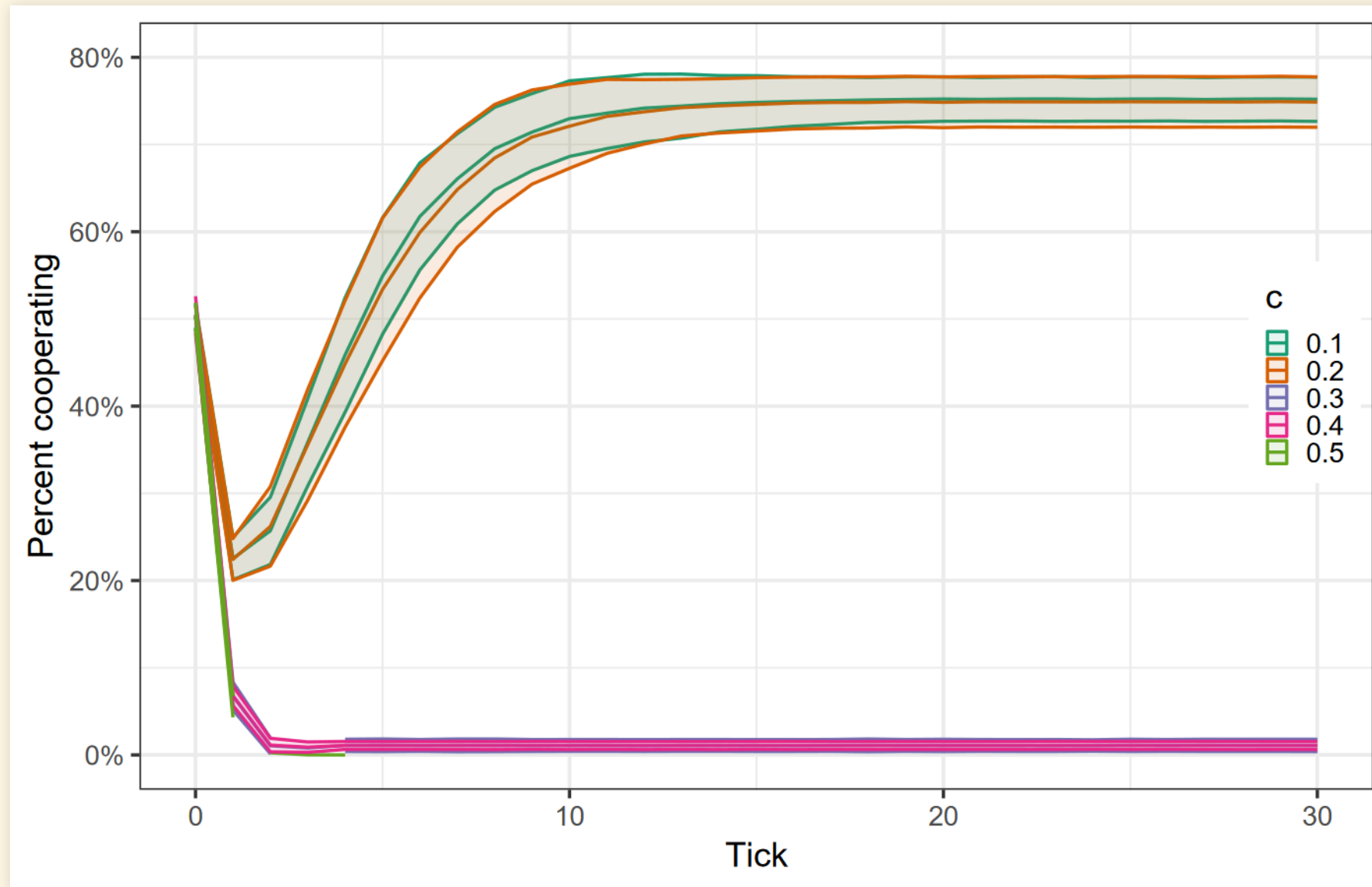
	B cooperates	B defects
A cooperates	$b - c, b - c$	$-c, b$
A defects	$b, -c$	0

Agent-Based Model: PD_simple.nlogo

- Each turtle either **always cooperates (blue)** or **always defects (red)**
- Each turtle plays against the four neighbors with which it shares a side
- After each turn the turtle “evolves” by comparing its payoff to its four neighbors and copying the most successful strategy
- What happens when you vary the cost of not defecting (c)?

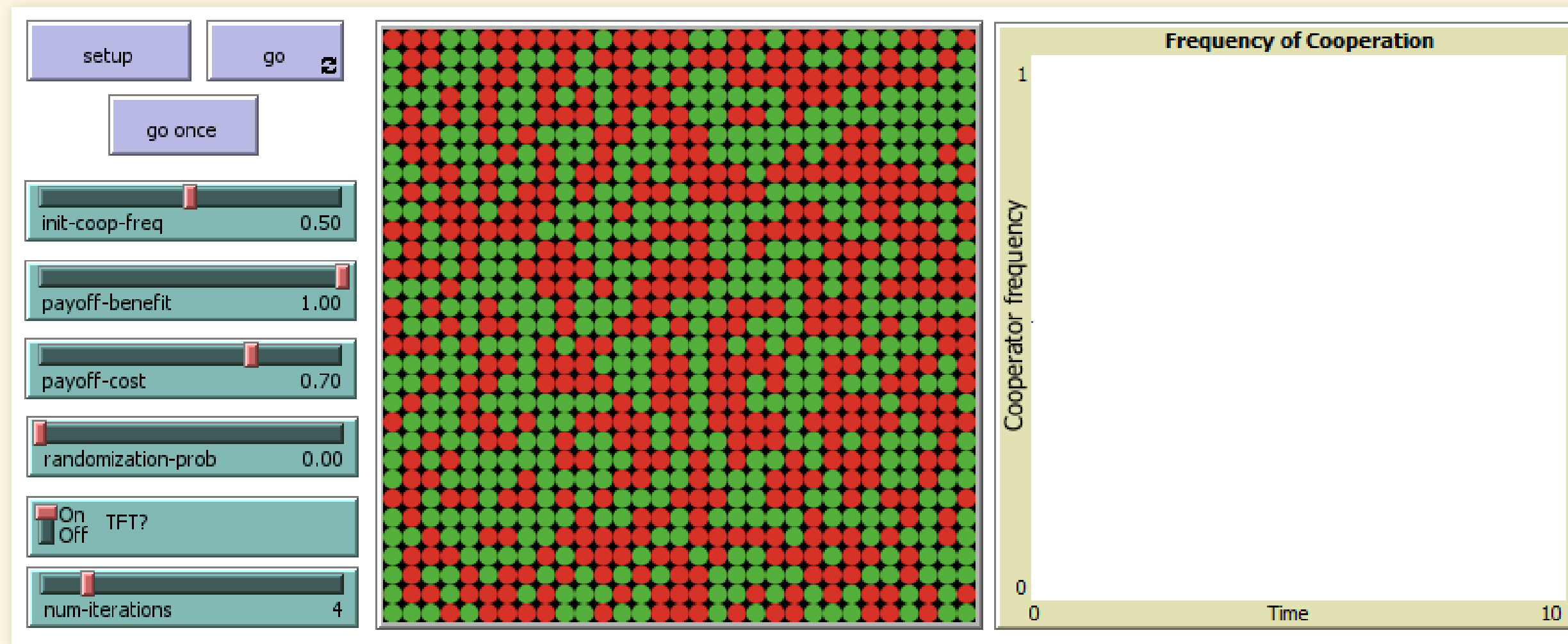


Vary cost of not defecting (c)

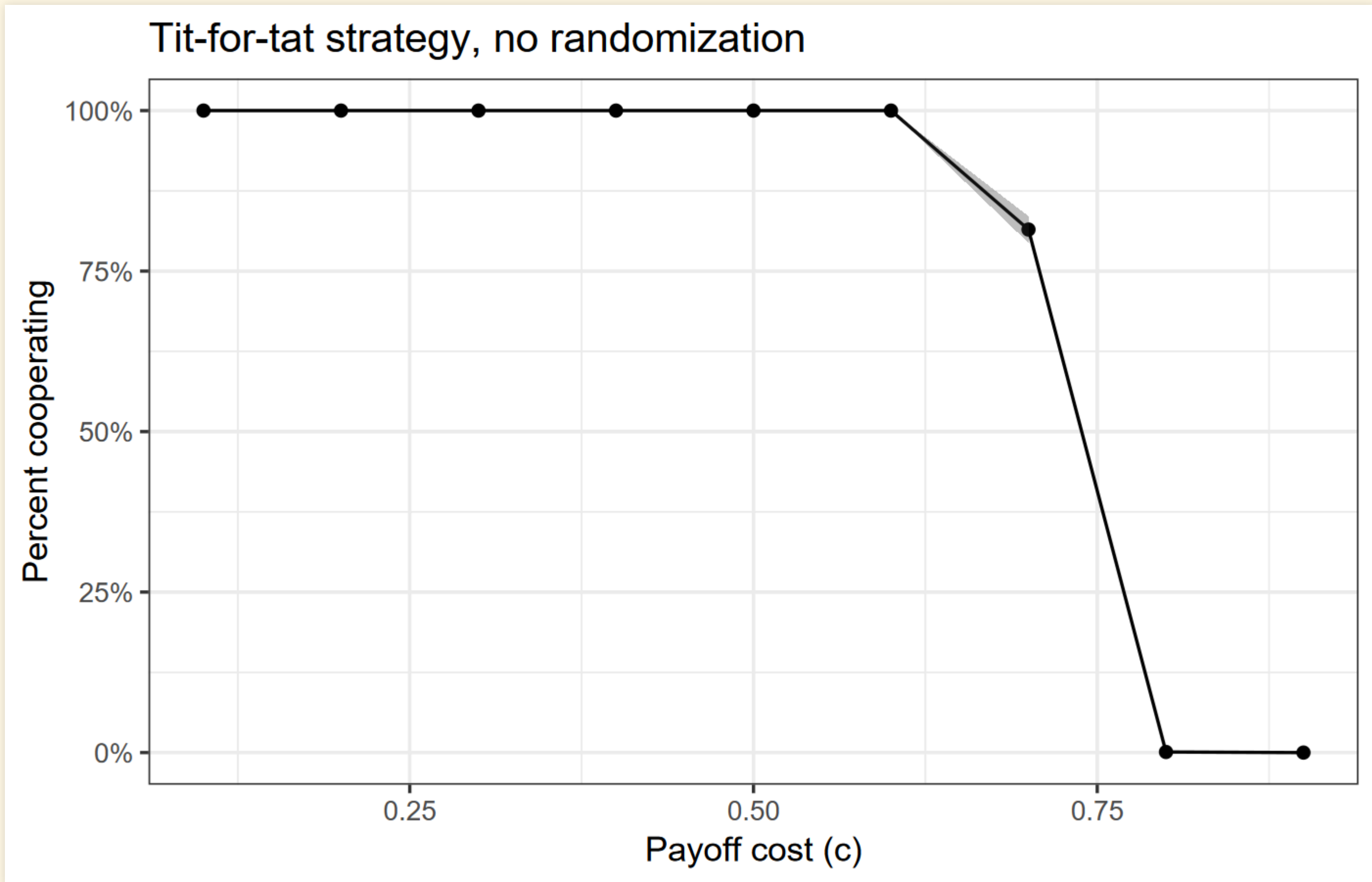


Reciprocity: Tit-for-tat strategy

- `PD_reciprocity.nlogo`
- New strategy: tit-for-tat.
 - Start by cooperating, then copy whatever the opponent did the last time
 - Repeat 4 or more times per tick with each opponent
 - Turtles randomly swap positions each tick, with some probability



Vary cost of not defecting (c)



Interaction between randomization and # iterations

