

Dynamics of Epidemic in Cities

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Table of Contents

What's on?

Research Highlights

My Works

References

Backgrounds

- The effect of scales has made cities active and creative.
- Meanwhile, the dense structure of cities makes them more vulnerable during emergencies such as pandemics and wars.
- How to maintain cities' resilience?

Example: COVID-19

- Jan 23, China banned travel to and from Wuhan city



The tragedy of the commons

A tragedy of the commons (TOC) occurs when individuals acting in their own self-interest deplete commonly held resources, leading to a worse outcome than had they cooperated.

Research Highlights

- Intuitions on the emergent dynamics of social context and resources:
 1. to assess the influence of noise
 2. spatially explicit interactions
- Schemes:

Individual-based coevolutionary game

- Results
 - Transition rate for #C and #D. Furthermore, the limiting frequency of cooperaters $\lim_{N, n_c \rightarrow \infty} \frac{n_c}{N}$
- Problems: is such frequency convergent or divergent?
 - Recalling a Cauchy distribution, or a Lorenz oscillator.
 - In other words, is the society ending up in tragedy?

Individual-based coevolutionary game

Demongraphic noise and spatial structure

My Works

- Commut

Establishing models

- Task: Predicting the emergence of new firms over a city's space.
0. Collect financial statements of companies and the decay of communication distances, establish the IOs of every trade and the current cross matrix;
 1. Vectorize the factors of different firms by reliance on different trades;
 2. Establish a dynamical matrix of size $kN \times kN$, new companies may emerge at some optimal location to take charge for urban development;
 3. simulate until it ends or a sufficiently long time;
 4. Evaluate the diversity of trades and the fitness of industrial structures.

Expecting

- Some cities' industrial structures may lead to TOC: companies harm their city when pursuing their own benefits.
- Diversity of cities diverges according to the initial conditions since both the specialization and diversification exist.
- Emergence of new companies' spatial and size distribution.

References

- Spatial Interactions and Oscillatory Tragedies of the Commons
Yu-Hui Lin and Joshua S. Weitz Phys. Rev. Lett. 122,
148102 – Published 12 April 2019
- Evolution of cooperation in stochastic games, Christian Hilbe,
Štěpán Šimsa, Krishnendu Chatterjee & Martin A. Nowak
Nature - Published: 04 July 2018
- Reputation helps solve the 'tragedy of the commons' Manfred
Milinski, Dirk Semmann & Hans-Jürgen Krambeck Nature -
Published: 24 January 2002
- Cooperating with the future Oliver P. Hauser, David G. Rand,
Alexander Peysakhovich & Martin A. Nowak Nature
Published: 25 June 2014
- Evolutionary games and spatial chaos Martin A. Nowak &
Robert M. May Published: 29 October 1992