University of Melbourne

SWEN90004

Modelling Complex Software Systems

Research Project

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1 Background

Wealth is always a trade. Wealth distribution becomes an extremely hot topic for a long time, which contains two directions. The first direction focuses on how to increase the wealth gap between the poor and the rich. The second direction mainly and how to balance the wealth distribution. Wealth distribution is a giant and complex system in real world as there are uncountable factors to contribute variations. In our project, we aim to simulate a simplified wealth distribution system comparing to real world.

There are multiple reasons and motivations for us to analyze this topic. Firstly, it relates to our daily life. The more we know about the wealth, the better we could manipulate it such as daily usage or investment. In our model, people are divided into three classes, the poor, the middle and the rich. If we can summarized something helpful. It may contribute to others for further decision in the future, which is our motivation as well.

In our project, we aim to accomplish two part. The first part concentrates on replicating the original model provided by NetLogo. The basic attributes we applied to contribute to wealth distribution list blow.

- grain growth interval
- number of grain grow
- max vision
- max of metabolism
- percentage of best land

This model is much simpler than real world model but the dialectical law of the development keep the same, which states that gradually a small part of people possess majority of wealth and the whole system tends to be stable. However, it's still a complex system as a set of things work together as parts of a mechanism or an interconnecting network. The whole system consists of grain and people. People collect grains and compete with others.

The second part focuses on extensions. We add multiple variables and try to make some differences of

the wealth distribution.

- Heritage inheritance

- Season

- Reclamation

Further more, we are interested in finding a solution to reduce the wealth distribution.

2 Design

2.1 Original Model

The first task to rebuild original model is the whole world initialization, which contains grain and people initialization based on specific configuration. We assume that the whole world is a 2-dimension matrix. There are several properties for every single person, which are the same as model in NetLogo.

- ID: identification of person.

- Age: the age of person.

- Vision: determines how far a person could see.

- Metabolism: how much a person cost in every global clock.

- Life expectancy: how long a person stay alive

- Position: current position of person.

There are two behaviors for a person in every clock. Firstly, everyone tries to find a best land within vision. Then they cost some money which related to their predefined metabolism value with age increased by 1. When someone's age is larger than expected life expectancy, he will die and reborn with random values of properties.

2.2 Extensions

Based on original model, we are going to improve its complexity by adding multiple extensions. Here we list the extensions we added in this project.

1. Heritage inheritance

    In original model, people will discard all the money belonging to them when they are dead and generate money randomly when they reborn. In our extension, we introduce inheritance function for collecting their money when they reborn. Based on our assumption, it should be a way to speed up model development.

2. Season

    The richness of land is fixed when the world is initialized in original model. We think that the circumstance could be more interesting if this factor varies. Therefore, the season function is come up. In our extended model, the richness of land varies based on different clock. We assume there are two seasons, land generates the same amount of grain as before in summer. In winter, land only generates half grain. We will find out the relationship between seasons and wealth distribution.

3. Reclamation

    Based on previous extension, we change the richness of land in different season. However, there should be lots of factors to impact a small part of land's richness. In order to simulate this situation, we introduce the reclamation function, which aims to improve or reduce a small part of land's richness suddenly in a time interval. We want to figure out if sudden incident will impact final wealth distribution.

3 Results & Discussion

3.1 Evaluation Tools

- Class distribution

    Some direct population proportion diagrams are simplest way to figure out the wealth distribution. Within a single time of wealth evolution, class distribution diagram is a critical tool to evaluate the evolution speed.

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- Gini-index

  Gini coefficient is a single mathematical index to measure the inequity of wealth distribution. It is one of most important methods to evaluate how severe the actual wealth distribution deviates from equal distribution.

3.2   Results of Original Model

In replicated model, we will evaluate how wealth distributes with varied five factors mentioned before.

3.3   Results of Extended Model

We find that our three extensions don't impact the final wealth distribution. However, there is a huge difference during the evolution such as evolution speed and evolution fluctuation. Here we will discuss the results from extensions to answer the questions addressed above.

3.3.1   Heritage Inheritance

The result of extension prove our assumption that the heritage inheritance will speed up evolution of wealth distribution.

3.3.2   Season

After our analysis, we find that season is a complex factor to impact the wealth distribution.

I rich circumstance: People have enough remaining grain to deal with season change in this situation. There is little difference between this and original model.

II middle circumstance: Part of poor people could not survive from winter in current situation. From the diagram, we could find that small fluctuation appears after a while winter came.

III poor circumstance: Large number of poor people could not survive from winter if original land is already too poor.

Finally, we get the conclusion of relationship between season and wealth distribution, which is that season may put pressure on everyone's life. However, the rich can get over it with bench of savings while the poor may not be able to survive if the situation is too severe.

3.3.3 Reclamation

We simply implement reclamation function by replacing grains of two random lands. Based on result we get from simulator, we find that there is redistribution process every time reclamation happens. It relatively slows down the evolution speed.

4 Further Improvement

- Firstly, we actually didn't find out a possible way to prevent or mitigate the wealth distribution gap between the poor and the rich.

- Secondly, we would have wanted to implement the loan system as extension. However, we find that it's also a very complex system as we can't track every single person in our system.