Mathematics Laboratory Final Project

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Introduction

A computational model to solve the outcome of strategic games

- reviewing a paper and do the codes
- my own idea to model a real world problem

Theory

- Game Theoretic Decision Making
  - Strategic game
  - Decision making
  - Best Response
  - Nash Equilibrium

Theory

- Bidirectional Associative Memory
  - Neural Network
  - Binary Neural Networks
  - Activation Function
  - The nodes and edges
  - What they show

Model Results

- Unique Nash Equilibrium
  - network reaches a stable state
  - traveler's dilemma
- No Nash Equilibrium
  - network does not converge to a stable state
  - rock-paper-scissors
- Multiple Nash Equilibrium
  - network reaches a stable state with multiple nodes
  - military dilemma

The Code

- Game Creator
- Main
  - Stage Update
  - Loop Check
  - Stage Plot

Results

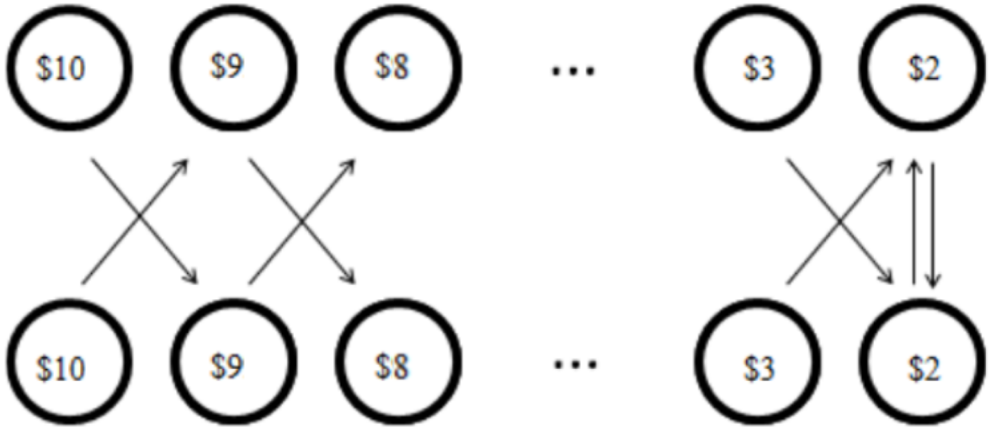


Figure 1: Traveler's dilemma result

Results

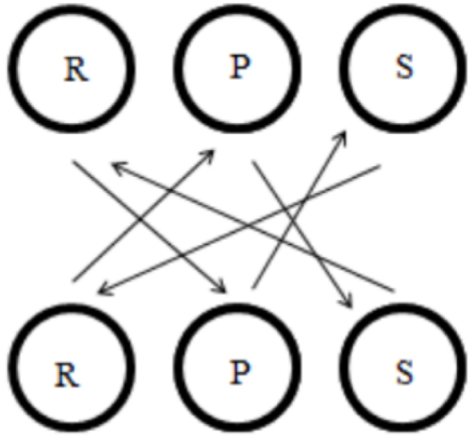


Figure 2: Rock Raper Scissors result

Results

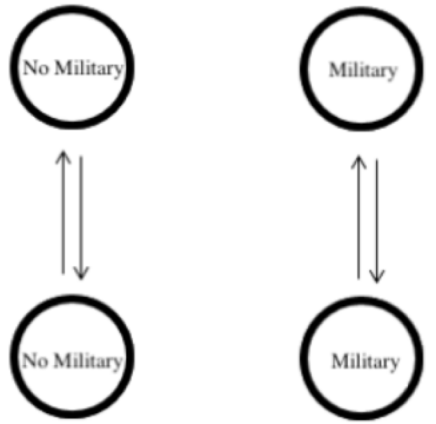


Figure 3: Military dillema result

My Extension; Market Simulator

- The problem
- The simplifications
- The process
- Results

My Extension; Market Simulator

- Parameters
  - Number of rounds
  - Number of players
  - Average money
  - Average asset
  - Initial price
  - Sentiment effect

My Extension; Market Simulator

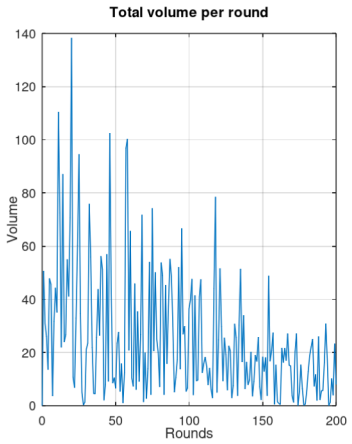
- Outputs plots and details
  - Price History
  - Rounds details
  - More statistics about trades
  - People statistics in money and assets
  - Changes in wealth of people

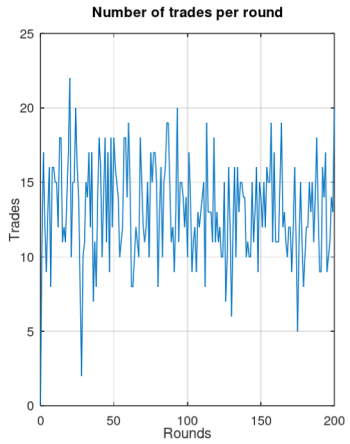
Price History

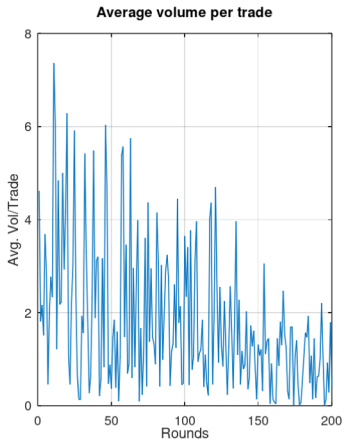
Rounds details

```
[1,190] = Round 190; change in price = -0.283664, number of trades = 9, total volume of trades 5.62381 dollars
[1,191] = Round 191; change in price = 2.68092, number of trades = 9, total volume of trades 5.73307 dollars
[1,192] = Round 192; change in price = 1.39623, number of trades = 16, total volume of trades 16.2369 dollars
[1,193] = Round 193; change in price = 1.63137, number of trades = 14, total volume of trades 30.8272 dollars
[1,194] = Round 194; change in price = -0.00881295, number of trades = 17, total volume of trades 17.3897 dollars
[1,195] = Round 195; change in price = -1.06541, number of trades = 9, total volume of trades 0.0309609 dollars
[1,196] = Round 196; change in price = -0.969584, number of trades = 10, total volume of trades 1.31419 dollars
[1,197] = Round 197; change in price = -1.36351, number of trades = 11, total volume of trades 10.1885 dollars
[1,198] = Round 198; change in price = -1.21813, number of trades = 14, total volume of trades 4.01641 dollars
[1,199] = Round 199; change in price = 1.19142, number of trades = 13, total volume of trades 23.2847 dollars
[1,200] = Round 200; change in price = 0.256789, number of trades = 20, total volume of trades 7.99262 dollars
```

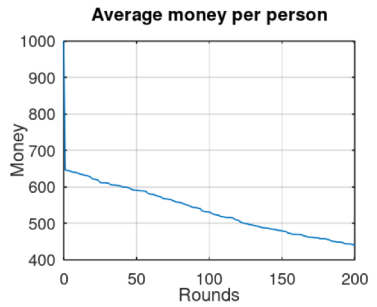
More statistics about trades

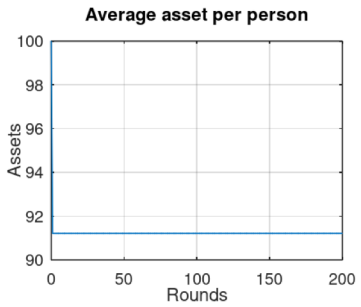


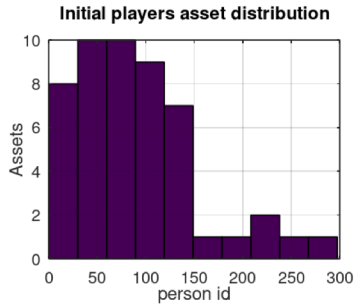


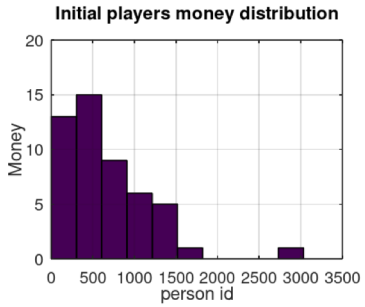


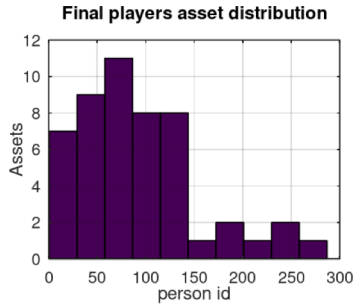
People statistics in money and assets

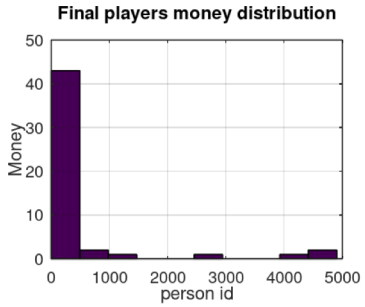




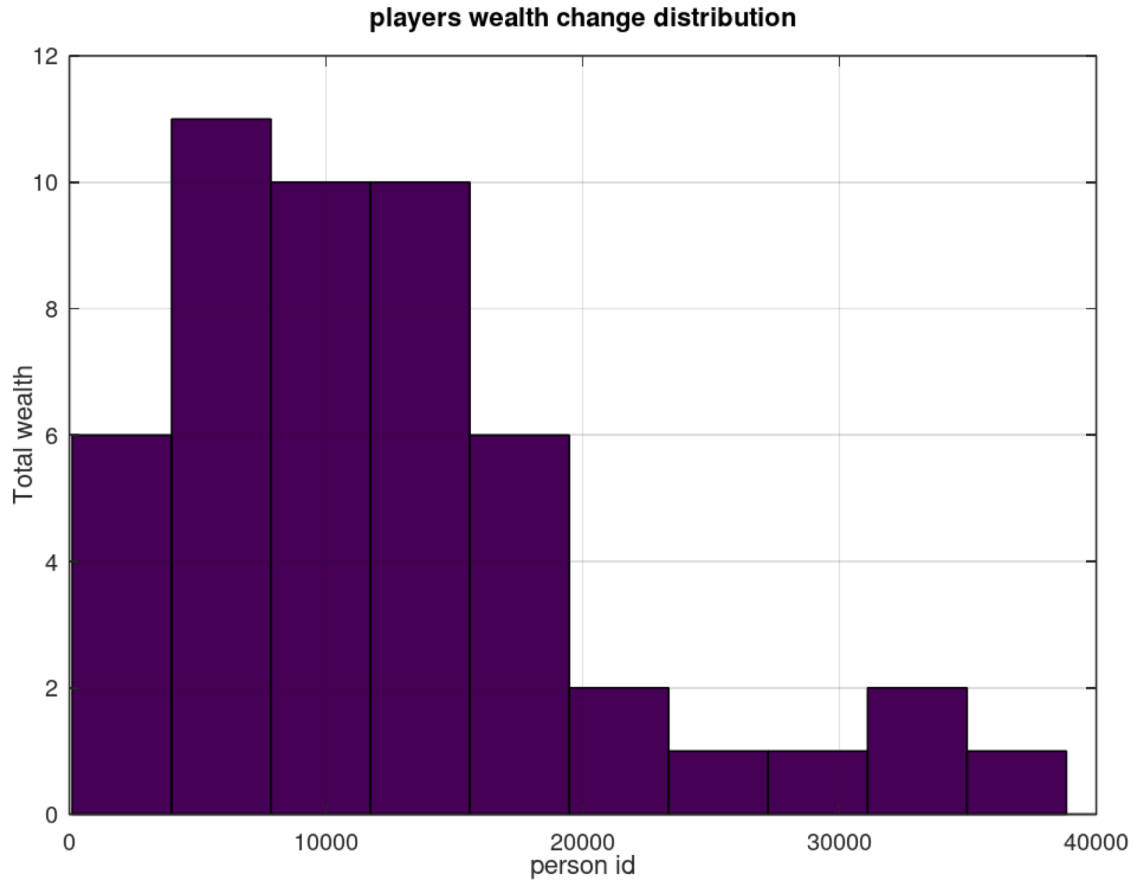








Changes in people's wealth



My Extension; Market Simulator

- Outputs values
  - Brooker profit
  - Greatest winner
  - Greatest loser
  - Average change of wealth

References

- [1] A Recurrent Neural Network for Game Theoretic Decision Making, Sudeep Bhatia and Russell Golman. Carnegie Mellon University, 2014

Thank you for your attention

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