Modified El Farol: Simulating Repeated Games

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Overview

- Motivation
- Structure of Simulation
- while not bored:
  - Demo
  - Graphs
- Q&A

Basic El Farol (recap)

A fixed number of players have two choices:

Go to the El Farol Bar

Stay home

If the population of the bar is less than 60% of the population, the patrons are happy

Otherwise, the patrons are unhappy

We assume positive utility in <60% bar, negative in >60% bar, and no change at home

Motivation

A deterministic, pure strategy nash equilibrium does not exist for the El Farol framework:

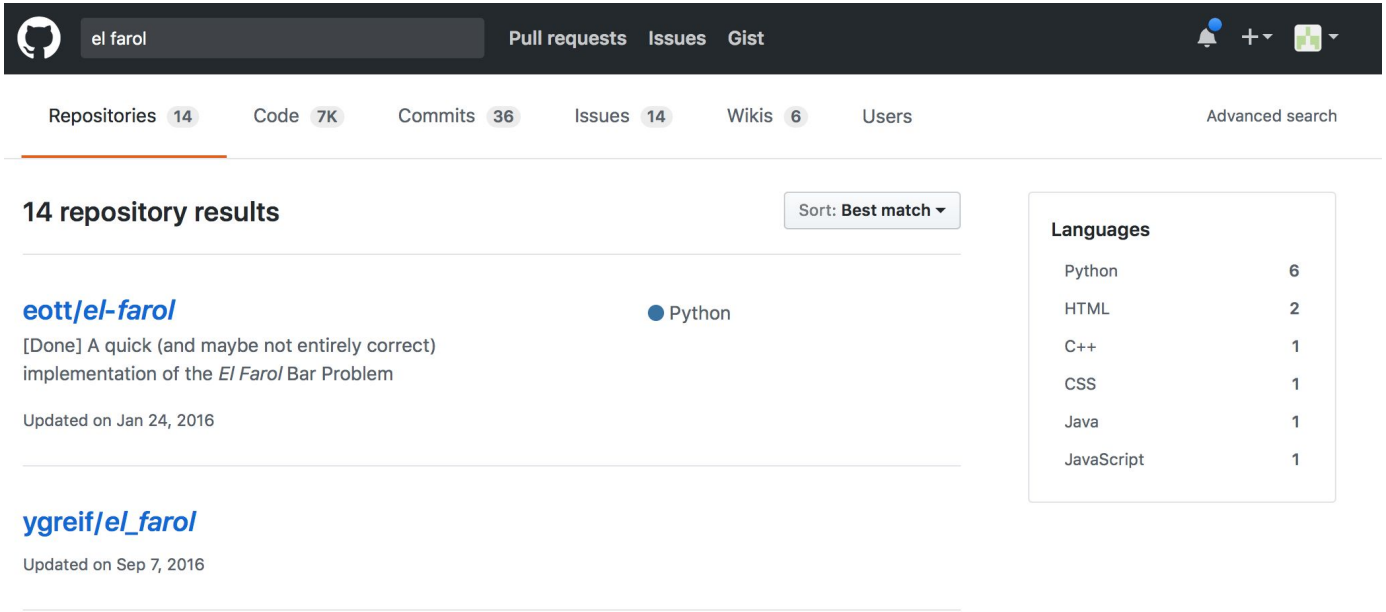
If all players attend the bar, they will all have a bad time

Conversely, an empty bar means players could be happier than they are

Furthermore, everybody attending the bar 60% of the time is not an equilibrium point either! This would mean that half of the time the bar population is over 60% (and therefore everybody is unhappy more than half the time).

Motivation

There are a number of simulations for finding mixed strategy El Farol Equilibrium



Motivation

Pavlovian Agents (Szilagyi)

Positive outcomes reinforce behavior, and the opposite is true for negative outcomes

Models with a substantial number of actors will rapidly converge on the “capacity” of the bar

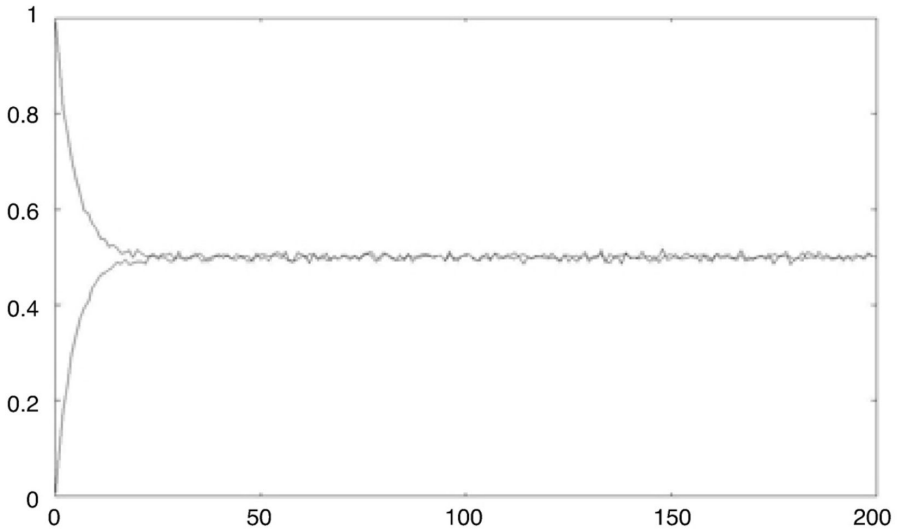


Figure 5. The El Farol Bar problem for 10 000 agents and $L = 0.5$. The initial ratio of bar-goers is 0 or 1.

Motivation

Additionally, modifications have been proposed for increased simulation “realism”:

- Give players distinct “personalities”
- Introduce communication elements (like the Minority Game)
- Introduce asynchronous decision making
- Add additional sub-choices necessary to enter bar

Simulation Overview

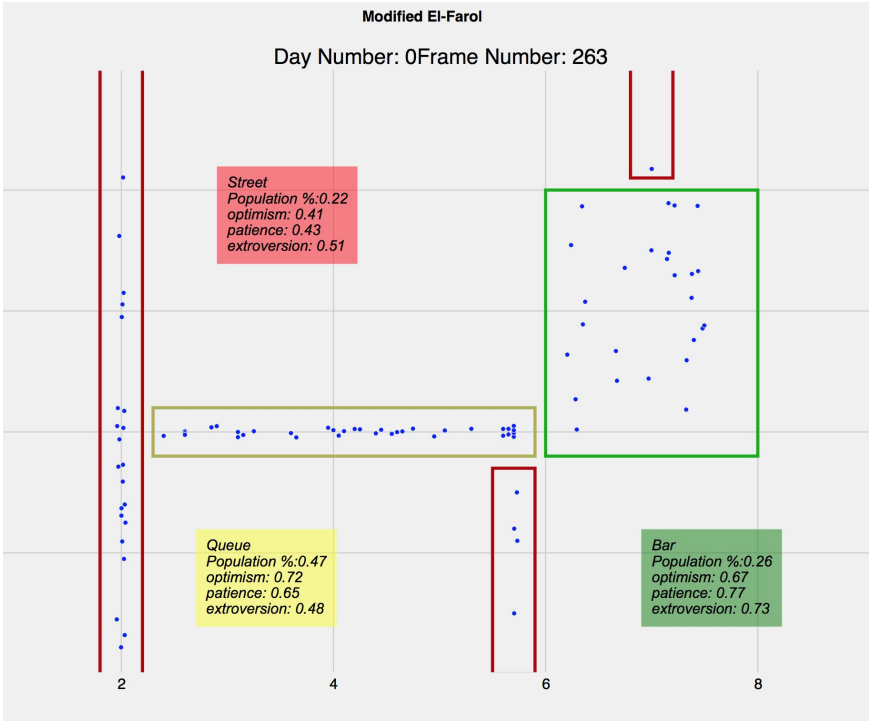
Layout

Three Locations:

- Street: Zero Payoff
- Queue: Negative Payoff
- Bar: Positive Payoff

Three Sub-Games:

- Enter Queue from Street? Y/N
- Exit Queue? Y/N
- Exit Bar? Y/N



Players (or Patrons)

Three attributes (spanning 0 - 100):

- Optimism - Will enter line of x% population length
- Patience - Will remain in line of y% population length (and bar is not at capacity)
- Extroversion - Will remain in bar with z% of population

Happiness (payoff) decreases in Queue proportionally to Patience attribute

Happiness increases in Bar proportionally to Extroversion attribute

Player Network

Players are assigned an initial number of randomly selected “friends”

Each time a player’s attribute results in an exit choice, either:

- The player copies the specific attribute of it’s friend with highest happiness *for that day*
- The player updates trait to that of the highest *cumulative* happiness player

Basically this is a Q-Learning Model, without full communication between simulated nodes

Expectations

In a bar with 100% capacity, we will expect players to converge on maximal attributes

We might expect optimism to be less critical as the bar becomes full

We might expect patience to be less critical if optimism is low

Demo Time

Future Improvement

Improvement

Meta-strategies:

Stubborn: players that increase/decrease traits in the direction of their network leader, instead of directly copying

Reckless: players that chose in a distribution around their trait

Dishonest: players that advertise false trait values (Minority Game)

Linked days with accurate chronology (opening/closing times for bar, player tiredness)

Multi-Bar model (Kolkata Paise)

References

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Questions?