Tree vs. Crop

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What's the game?

Old game

Environment vs.
economy

Research gap

Macroscopic
Outdated vision of people

My game

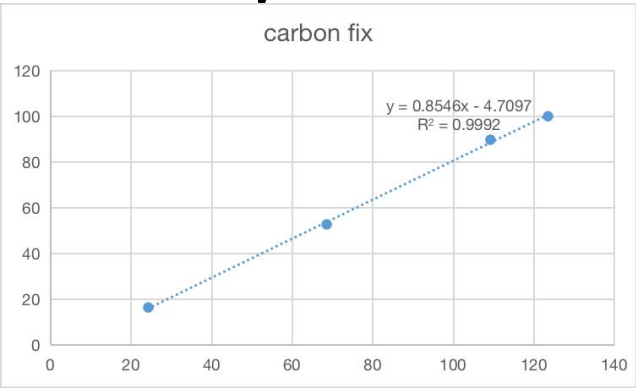
Multi-factor
Multi-players
Cooperatioin

Lee, Chih-Sheng. 2012. "Multi-Objective Game-Theory Models for Conflict Analysis in Reservoir Watershed Management." Chemosphere 87 (6): 608–13. doi:10.1016/j.chemosphere.2012.01.014.

Game Environment

Player	10 players (you can change whatever you want)
Strategies	Choose to plant crop(economy) or tree(environment)
Payoff	Two kinds: environmental--all tree/10 and economic payoff--own crop

Game Payoff Matrix



- Crop economic payoff > Tree economic payoff
- Crop environmental payoff< Tree environmental payoff

	Economic Payoff	Environmental Payoff
Crop	$\frac{104}{365} \times int(t)$	-1.5
Tree	0.5	$0.8546t - 4.7097$

Table 1. Strategies and payoff in the Tree vs. Crop game

Adding factors

Psychological Factors

1 Risk Aversion

2 Environmental Concerns

3 Time Preference

4 Altruism

Social Factors:

Education and Awareness 5

Social Norms 6

Competitive Pressure 7

Collaboration and Cooperation 8

Multi-objective optimization (pulp)

```
RA = np.random.rand(1)
EC = -np.random.rand(1)
TP = np.random.rand(1)
A = np.random.rand(1)
SN = -np.random.rand(1)
CP = np.random.rand(1)
CC = -np.random.rand(1)
EA = -np.random.rand(1)
```

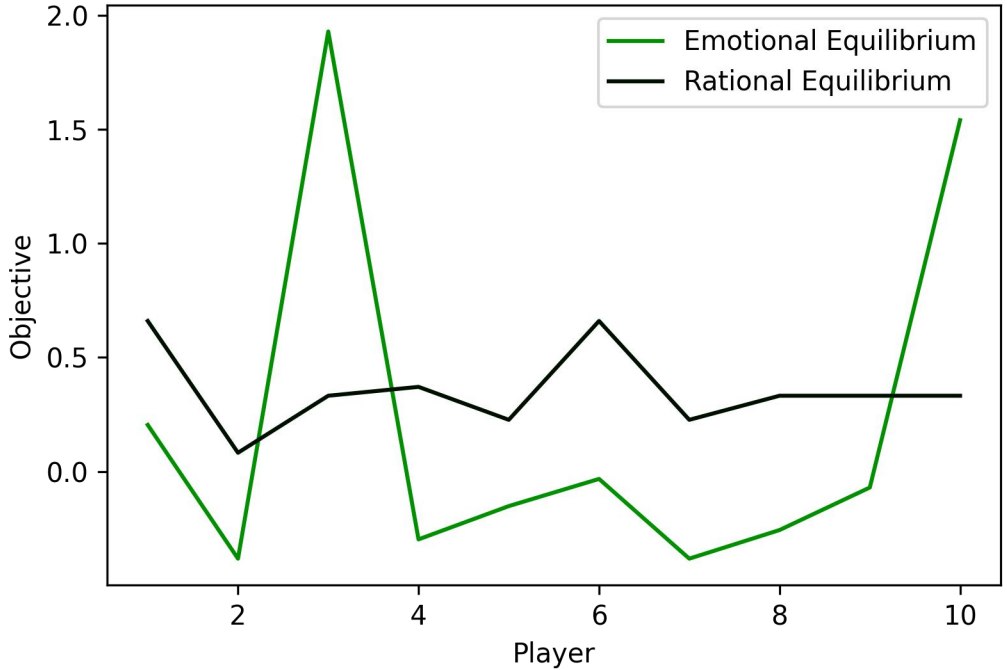
alpha
0.589184
0.587980
0.659693
1.000000
0.714184

```
# Create the LP problem
problem_emotional = LpProblem("Multi-Objective Problem", LpMaximize)

# Decision variables
x = LpVariable.dicts("x", range(N), lowBound=0, upBound=1, cat=LpInteger)

# # Objective functions
objective = LpAffineExpression()
```

```
Optimal Solution:
x_0 = 0.0
x_1 = 1.0
x_2 = 1.0
x_3 = 0.0
x_4 = 1.0
x_5 = 1.0
x_6 = 1.0
x_7 = 0.0
x_8 = 0.0
x_9 = 0.0
```

objective for each player = maximum (alpha*own_economic_profit + (1-alpha)*all_environment_profit/10)

Results and Limitations



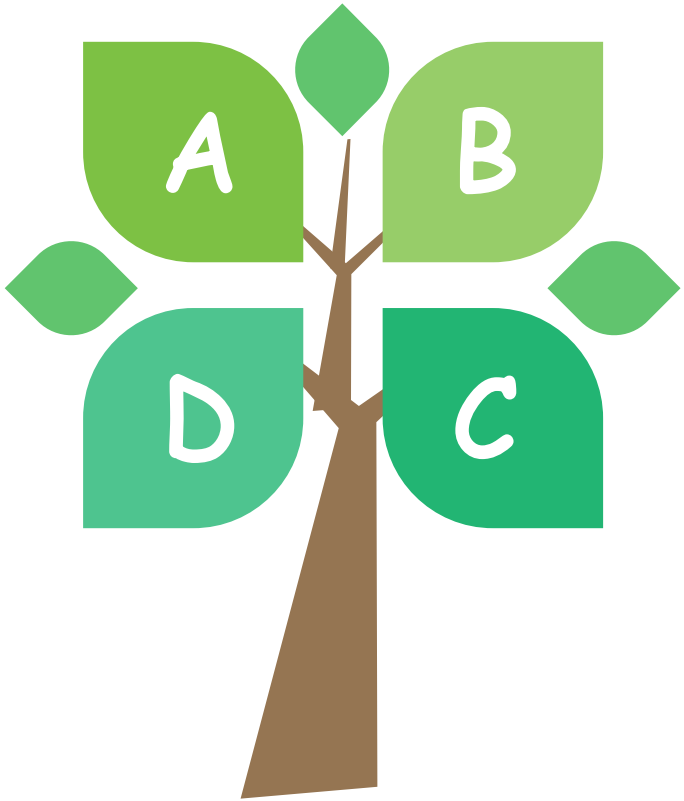
What's the potential application?

Rural Development

Help rural areas find a balance between economic development and environmental protection

Policy Development and Decision-Making

Policymakers can gain insights into the trade-offs and synergies between economic and environmental outcomes



Sustainable Resource Management

Help inform resource management strategies that optimize both economic and environmental objectives.

Environmental Education and Awareness

Fostering greater environmental awareness and responsible decision-making.

Q&A

If you have any question,
feel free to ask me!

Thanks!

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