Predation model Hybridisation

Raphael Klein, EPFL

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1 The problem tree

Overall, the problem tree is given as follows:

- Policy core problems:

    1. Sheep - The amount of sheep on the grid.
    2. Wolf - The amount of wolves on the grid.
    3. Fully grown grass - The amount of fully grown grass on the grid.

- Secondary problems:

    1. Net sheep population change - This is the difference between initial and final amount of sheep.
    2. Net wolf population change - This is the difference between initial and final amount of wolves.
    3. Net grown grass patch change - This is the difference between initial and final amount of grown grass patches.

Note that the secondary issues and the policy core issues are the same. The main reason behind this choice is the simplicity of the model. The model is so simple that the it is difficult to find any different policy core issues.

2 The policy instruments

The policy instruments within the policy tree are implemented using incremental increases and decreases in the following exogenous parameters.

1. Change sheep reproduction [CR-0.01/+0.01]

2. Change wolf reproduction [WR -0.01/+0.01]

3. Change grass regrowth [GR-2/+2]

3 The steps for model integration

This section presents the steps that are needed to connect a policy context model, in this case the predation model, to the policy process model.

1. Before any coding, define what the belief tree and the policy instruments will be for the predation model.

2. Copy the policy emergence model files into the same folder.

3. In `runbatch.py`, replace the policy context items by the predation model.

4. In `runbatch.py`, make sure to initialise the predation model appropriately.

5. Change the `input goalProfiles` files to have the appropriate belief tree structure of the predation model.

6. In `model module interface.py`, construct the belief tree and the policy instrument array.

7. Make sure that the step function in the `model predation.py` returns the KPIs that will fit in the belief system in the order DC, PC and S. If no DC is considered, then include one value of 0 at least. All KPIs need to be normalised.

8. Modify the step function of the `model predation.py` to include a policy implemented.

9. Introduce the changes that a policy implemented would have on the model in `model predation.py`.

4 The steps for model simulation

This section presents the steps that are needed to connect a policy context model, in this case the predation model, to the policy process model.

1. For the policy process:

   (a) Define a set of hypotheses to be tested
   (b) Define scenarios that will be needed to assess the hypotheses
   (c) Choose the agent distribution based on the scenarios constructed
   (d) Set the preferred states for the active agents and the electorate along with the causal beliefs to be used. This should all be based on the scenarios that have been constructed.

2. For the predation model:

   (a) Define the initial values for the main parameters
   (b) Define the parameters that will be recorded

3. Save the right data from the model.

5 Model hypotheses

Several hypotheses are made for testing the policy process model. They are given as follows:

- H1: The introduction of the policy emergence model will affect the Schelling model outcomes.

- H2: The change of decision making power balance will lead to policy change.

- H3: A sudden change in the preferred states of the policy agents will lead to policy change.

- H4: The electorate has a long term impact on policy change.

- H5: A change in the system's understanding impacts policy selection.

6 Model scenarios

Four scenari are considered. All but one focus on a change in the decision making power balance throughout the policy emergence.

	PC1 Sheep	PC2 Wolves	PC3 Grass	S1 Sheep growth	S2 Wolves growth	S3 Grass growth
Scenario 0						
Policy makers	300	300	2000	100	50	200
	0.60	0.60	0.80	1.00	0.75	0.70
Scenario 1						
Policy makers	150	0	2000	100	50	200
	0.30	0.00	0.80	1.00	0.75	0.70
Scenario 2						
Policy makers	300	300	2000	50	-25	100
	0.60	0.60	0.80	0.75	0.38	0.60
Scenario 3						
Policy makers	300	300	2000	100	50	200
	0.60	0.60	0.80	1.00	0.75	0.70
Scenario 4						
Policy makers	300	300	2000	100	50	200
	0.60	0.60	0.80	1.00	0.75	0.70
Electorate	150	0	2000	100	50	200
	0.30	0.00	0.80	1.00	0.75	0.70
Scenario 5						
Policy makers	300	300	2000	100	50	200
	0.60	0.60	0.80	1.00	0.75	0.70
Electorate	300	300	2000	50	-25	100
	0.60	0.60	0.80	0.75	0.38	0.60

Table 1: Preferred states for the policy makers on a the interval [0,1].

1. Scenario 0 - Benchmark

2. Scenario 1 - Change in the policy core issue goals

Scenario 0/1/2/4/5				Scenario 3		
	PC1	PC2	PC3		PC1	PC2	PC3
-S1	1.00	0.75	-0.75	-S1	-0.50	-0.10	0.25
-S2	-0.75	1.00	0.25	-S2	0.05	-0.50	-0.25
-S3	0.50	0.75	1.00	-S3	-0.25	0.00	-0.50

Table 2: Causal beliefs for the policy makers. These causal relations can be read as: an increase of 1 in S2 will lead to a decrease of 0.75 in PC1. They are all given on the interval [-1,1].

3. Scenario 2 - Change in the secondary issue goals

4. Scenario 3 - Change in the causal beliefs

5. Scenario 4 - Electorate influence on the policy core issue goals

6. Scenario 5 - Electorate influence on the secondary issue goals

Scenario 0 - Benchmark The benchmark scenario is to be used as a benchmark. It is a simulation of the predation model with the policy emergence model. The preferred states for the agents is provided in Table 1. The causal beliefs used as given in Table 2.

Scenario 1 - Preferred states - Policy core issues Scenario 1 looks at what would change if the policy core issue preferred states of the policy makers were different. The new selection of preferred states is given in Table 1.

Scenario 2 - Preferred states - Secondary issues Scenario 2 looks at what would change if the secondary issue preferred states of the policy makers were different. The new selection of preferred states is given in Table 1.

Scenario 3 - Difference of understanding For Scenario 3, we compare a difference in the understanding of how the system works and its impact on policy change. For this we create a different causal beliefs structure that is presented in Table 2. This is to be compared with results from the benchmark in scenario 0.

Scenario 4 - The electorate - Policy core issue influence For scenario 3, we also check what is the impact of different electorate influence weight values. The aim is to visualise the impact of the influence electorate on the overall system for this. We have the same scenario as for scenario 2 but this time the electorate is much more driven and has a quick impact on the policy makers (quadrupling to 0.20 their influence on policy makers). The weights considered are 0.20, 0.02 and 0.50.

Scenario 5 - The electorate - Secondary issue influence

7 Initialisation of the predation model

The parameters that need to be initialised for the predation model are given by:

- Grid height: 50

- Grid width: 50

- Initial amount of grass: about 50% of the grid

- Initial number of sheep: 250

- Sheep reproduce rate: 4%

- Sheep gain from food: 6

- Initial number of wolves: 25

- Wolf reproduce rate: 5%

- Wolf gain from food: 35

- Grass regrowth time: 30

Note that the initial parameter as chosen such that if only the predation model is run, it has a stable configuration. Furthermore the onus is placed on the simulation of the policy process, therefore no scenarios are placed on the predation model side of the simulation.

8 Results

The results section is divided up into the different hypotheses that were brought up previously.

8.1 On hypothesis 1

The introduction of the policy emergence model will affect the Schelling model outcomes.
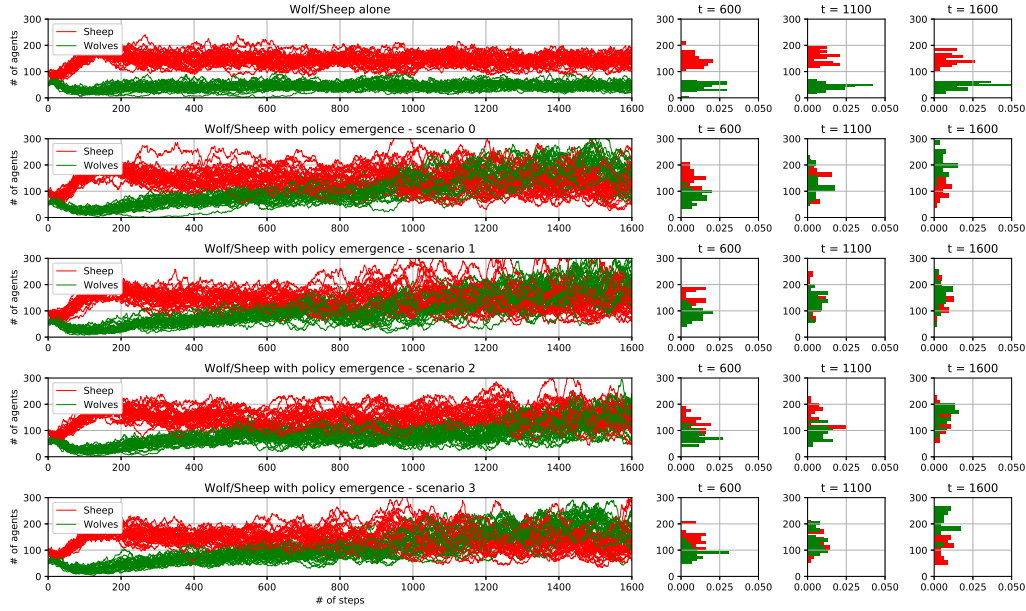

Figure 1: Comparison of the results from the predation model for all scenarios plus the predation model without policy emergence model.

Clearly they have an effect. They have a destabilising effect on the model. As the distributions show, the wolf and sheep concentration are closer together when the policy actors intervene based on their goals and beliefs.

8.2 On hypothesis 2

The change of decision making power balance will lead to policy change.

8.3   On hypothesis 3

A sudden change in the preferred states of the policy agents will lead to policy change.

Plot the right scenario for this - Scenario 4

8.4   On hypothesis 4

The electorate has a long term impact on policy change.