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Simulation showroom

AI FORA 1st General Partner Meeting

Mainz, 5 April 2022

cress

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Agent-Based Modelling

What is an ABM?

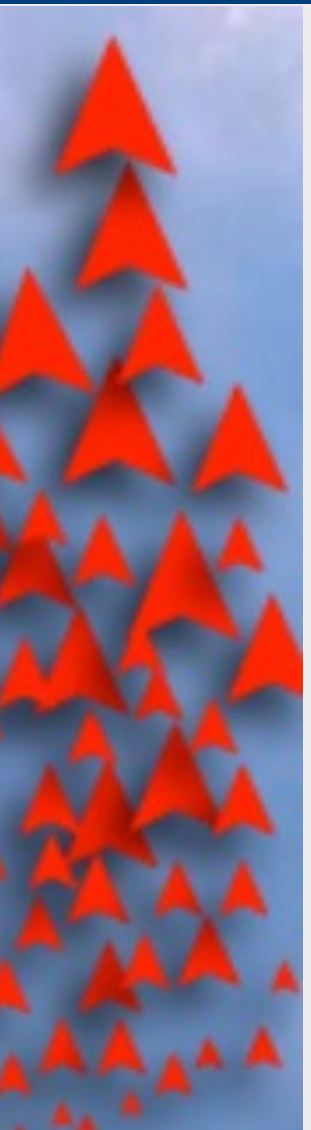
An Agent-Based Model (ABM) is a computational model that simulates the actions and interactions of agents.

What is an ABM?

The key elements of an ABM include:

1. agents
2. an environment
3. interactions, according to rules of behaviour
4. time

1. Agents



Agents are individual decision-making or 'behaviour-doing' units

For example, agents could be:

- people
- households
- organisations
- countries

They:

- are autonomous
- are heterogeneous
- have behaviour
- have memory
- interact

2. Environment

- The ‘environment’ in an ABM is typically a 2D space.
- It is made up of a grid of ‘patches’ like a chess board.
- Just like agents, different patches can have different attributes.

3. Interactions & rules

- Agents interact with one another and with their environment, influencing each other's behaviour directly or indirectly.

- Agents interact and behave according to a set of rules that we define for the ABM. For example, they may have a decision, action or goal that they are programmed to carry out.

4. Time

- Time passes in an ABM
- Each time-step is called a ‘tick’ and represents a unit of time, e.g.:
  - a second
  - a year
  - a cycle of actions

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An ABM for the Corona Game

Corona game ABM

- We have created an ABM for the Corona game
  - to check the consistency, completeness and clarity of the rules
  - to check that the game has a terminating condition and that implausible outcomes are not possible
- With it, we can also:
  - test the effect of variations in the rules
  - check whether varying the Hofstede dimension parameters has the expected consequences on the game play

Corona game ABM

Agents	Players
Environment	The ‘stations’: • home • mall • school • office • lounge • hospital
Interactions & rules of behaviour	Players move around the stations and carry out the station actions according to the rules of the game
Time	1 tick = 1 round of the Corona game

Corona game ABM

- At the beginning of the game, we create 100 agents - the players. They each start off with a certain amount of money and health points, and a 10% chance of having Covid.

- During each round, players visit ‘stations’ at random (home, the mall, school, the office and the lounge) where they can carry out different actions, such as earning money or buying things.

Corona game ABM

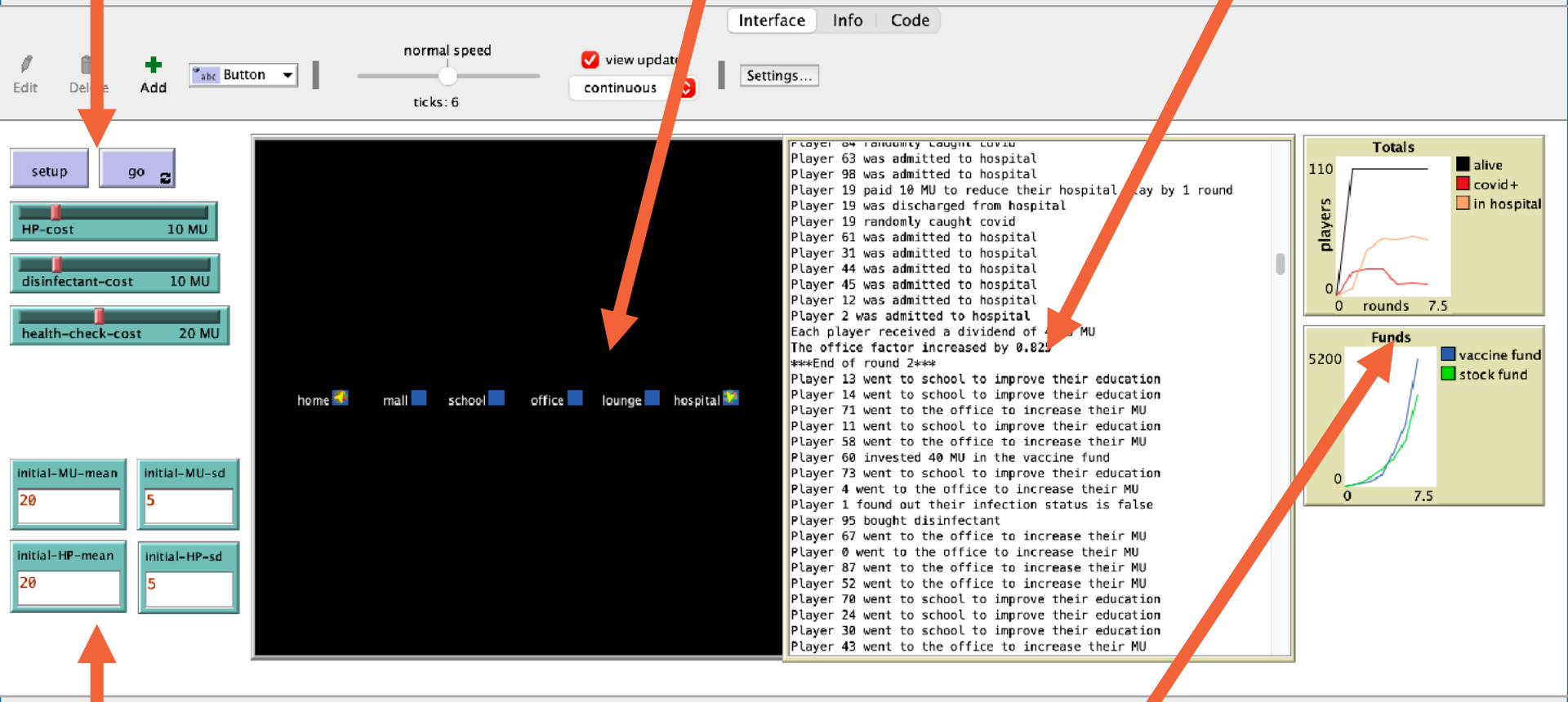
- At the end of each round:
  1. Players lose a certain number of health points depending on whether they are Covid-positive or not. Players who have lost all of their health points go to hospital for one or two rounds.
  2. Some players catch Covid:
     - At the end of each round 10% of players randomly catch Covid.
     - Players may also catch Covid if they visited a station after a Covid-positive player.
  3. There's a chance of finding a vaccine. This chance increases if players go to the mall and invest in something called the 'vaccine fund'.

- The game ends when a vaccine is found.

1. To run the ABM, click ‘setup’ and then ‘go’

2. Here you can see the agents at the different stations

3. Read more about what actions the different players are taking here



4. See more information here about the fund levels and numbers of players with covid or in hospital

5. Play around with some of the parameters of the game here and see how it influences the game’s outcome

Next steps and questions for discussion

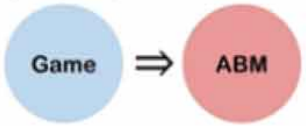
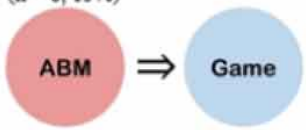
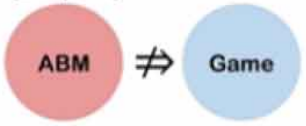
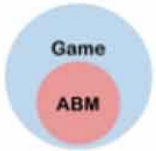
Next steps (1)

Next, we plan to add sliders to the Corona game ABM which allow us to 'tweak' the Hofstede dimensions of the players and see how this influences gameplay.

Q: What else (if anything) do we want to do with the Corona game ABM now we have it?

Q: How else might we use it for further analysis and/or comparison with empirical results from the 'live' games?

(see the next slide for a range of possible options)

Type	Game/ABM sequencing	Target system	Game/ABM correspondence	Purpose and application
Type 1: Game => ABM (n = 9, 17%) 	*from game to ABM*	*identical*	*the ABM design is influenced by the processes and scheduling of the game*	*Suitable to promote communication, mutual understanding or learning among stakeholders and scientists. Aims to understand a group of stakeholders on the collective level. Most used:* - *stakeholder involvement* - *citizen science*
Type 2: Game ≠> ABM (n = 3, 6%) 	*from game to ABM*	*different*	*ABM is independent from game processes and scheduling; results from the ABM might influence the further development of the game*	*Aims to understand or analyse decisions or interactions in a game through the application of an ABM.* *Most used:* - *improve game performance & calibration*
Type 3: ABM => Game (n = 8, 15%) 	*from ABM to game*	*identical*	*the game design is influenced by the processes and scheduling of the ABM*	*Suitable to gather additional knowledge. Aims to verify, validate or calibrate the simulation.* *Most used:* - *community-based science* - *stakeholder involvement*
Type 4: ABM ≠> Game (n = 9, 17%) 	*from ABM to game*	*different*	*the game design is independent from the processes and scheduling of the ABM; results from the game might influence the further development of the ABM*	*Aims to use games to investigate questions revealed by the construction and analysis of the ABM that were not obvious when making the ABM. Aims to discover knowledge/answers posed by the ABM and its analysis.* *Most used:* - *research human behaviour*
Type 5: ABM + Game (n = 6, 12%) 	*simultaneously*	*identical or different*	*the ABM is part of the game*	*The ABM implements a (sub-)component of the game.* *Most used:* - *stakeholder involvement*
Type 6: ABM = Game (n = 17, 33%) 	*simultaneously*	*identical*	*ABM and game are intertwined in one application (AB-game)*	*The ABM provides the infrastructure for game interaction and play.* *Most used:* - *stakeholder involvement* - *business games / simulation games*

https://www.tandfonline.com/doi/10.1080/13645579.2022.2050119

Next steps (2)

We also plan to develop an ABM for the 'employment game' (to test rules and help to quickly develop and finalise the employment game before planned workshops in May).

Q: What else might we do with this ABM once it has been created?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