Complex Systems and ABMs: practical examples that people have paid money for

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Overview

- Some reflections on scientific questions
- What happens when these meet practice
- (maybe) An overview of an actual model

Some ABM clients

- Financial Services Authority

- Department of Health

- South West Regional Health Authority

- British Telecom

- Svenska Handelsbanken

- Advertising Association

- Hedge fund

- Water company consortium

- Network Rail/ORR

Imperfect knowledge, deterministic and stochastic models

- At least four areas of imperfect knowledge:

  Initial conditions

  Order in which agents make decisions – very important in many networks

  Structure of network

  Behavioural rules

- In many practical examples, the principle of commercial confidence will place further limits on our knowledge

- The more precise our knowledge (in part or almost in whole the knowledge claimed by 'domain experts'), the narrower the range of uncertainty from which we draw the parameters

- Is it ever feasible to build deterministic models?

Model dimension

- Parsimonious or large?

- Risk of over-fitting – complex systems science lacks the equivalent of concepts such as the Akaike Information Criterion to penalise this

- The potential of dimension reduction in large models is rarely investigated (Osgood, 'Low dimensional dynamics in agent based models', *System Dynamics*, 2006)

Model validation

- Ormerod and Rosewell (2009), 'Validation and Verification of Agent-Based Models in the Social Sciences', in F.Squazzoni, ed., *Epistemological Aspects of Computer Simulation in the Social Sciences - Lecture Notes in Computer Science*, Springer Berlin

- validation requires a clear view of what the model is attempting to explain and for what purpose. What are the key facts that the model needs to explain and how well must it do it?

- Justify behavioural rules with evidence outside the model

- Account for emergent macro phenomena

- Investigate predictability

Why do people want them?

- **To answer specific question(s) they may have e.g.**

- Why has our market/company evolved the way it has and what will happen next?

- What happens if......?   *This is the single most frequent use*

- How do we persuade the regulator that.....?

- They are all practical questions to which practical answers are needed

- They are conditioned to want unequivocal answers – points towards deterministic models

- But there are usually time (and resource) constraints – implies smaller models with stochastic elements

The process (1)

- To varying degrees, domain specific knowledge from the client needs to be extracted

- Domain experts may have a preference for high dimension models – they feel somehow these are more realistic, the more complete a description you can give the better

- BUT the individuals who you deal with usually face serious time constraints – they are very busy

- This points to high level, parsimonious models

- The domain experts themselves may be uncertain

The process (2)

- Need to specify the agents, how/what they decide, who they are connected to

- Plausibility of the results to the client is a key part of validating the model – ideally, you want most results to be expected plus a few which are not!

- This is not to forget the need for scientific merit – the model may often face external scrutiny