# ABM... what's is good for?

MASS, 1st March 2013. Dan Olner

Plan: as open a discussion as possible. I'll start off with this doc but if we get sidetracked, all the better. If we don't, I'll go over the next point from it and take it from there. But my stuff is massively navel-gazey, we may want to discuss more concrete matters! (Note Epstein's 'why model' points at end.)

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* "The game": simple rules. Show without explaining them. What is relevant to working out what's happening?
* ABM:
  + Tesfatsion: “encapsulation into agents is done in an attempt to achieve a more **transparent and realistic representation of real-world systems** involving multiple distributed entities with limited information and computational capabilities.” (ibid p.838)
  + Is a closer match to reality is its own ‘validation’?
* Virtual worlds vs engines of analysis
  + Di Paulo et al. contrast: "**maximally faithful replicas**" versus "**thought experiments**: unrealistic fantasies which nevertheless shed light on our theories of reality" (Di Paolo et al., 2000 p.4)
  + Not new arg. Cf. Friedman on Marshall vs Walras: Marshall "took the world as it is; he sought to **construct an 'engine' to analyse it**, not a photographic reproduction of it (Friedman, 1953 p.35) cf. Walras (creator of the first general equilibrium models) – Blaug: "a peculiar vision of a sort of 'realistic utopia' " (Blaug, 1997 p.569)
  + Cf. Farmer / Foley on the promise of ABM: "Agent-based models potentially present a way to model the financial economy as a complex system, as Keynes attempted to do, while taking human adaptation and learning into account, as Lucas advocated. Such models allow for the creation of a **kind of virtual universe**, in which many players can act in complex - **and realistic** - ways" (Farmer and Foley, 2009 p.685-6)
* My problem with OOP. ABM built on OOP. OOP makes us think we can map every real-world feature to its virtual counterpart, encouraging a strong ideal of model realism.
  + E.g. Tesfatsion uses OOP’s distinctions between **public, private and protected methods** to define private behaviours and to allow agents to “communicate with each other through their public and protected methods” (Tesfatsion, 2006 p.837).
  + So both the strength and weakness of ABM.
* Scott: **models and maps share a common purpose**, both being "designed to summarise precisely those aspects of a complex world that are of immediate interest to the map maker and to ignore the rest" (Scott, 1998 p.87).
* Craik (via Stafford): models "**need not resemble the real object pictorially**; Kelvin's tide-predictor, which consists of a number of pulleys on levers, does not resemble a tide in appearance, but it works in the same way in certain essential respects" (Craik, 1967 p.51).
* "A very simple tautology: that 1 + 2 = 3. Model simulations only differ from this tautology in their degree of complexity, and their consequent opacity." (Stafford, 2009)
  + Model is quite separate thing from reality. A complete description of an alien world (however simple or complex) that may manifest useful parallels to our world.
  + Friedman also says theory is a 'tautologous filing system': “The objective is to **construct a language** that will be most fruitful in both clarifying thought and facilitating the discovery of substantive propositions.” (Friedman, 1962 p.8)
* Prediction? Cf. Flake graph of simplicity-complexity-simplicity scale
* Moss/Edmonds on utility: “The standard, naıve response... follows Friedman’s classic claim that the **descriptive accuracy of assumptions is irrelevant** and all that counts is predictive accuracy... its ceteris paribus conditions fly in the face of common observation, common sense and experimental evidence.” (Moss and Edmonds, 2005 p.9)
  + Friedman's 'f-twist' actually discusses ‘**basic confusion between descriptive accuracy and analytical relevance**’
  + Assumptions are not irrelevant. Friedman: "There is too much smoke for there to be no fire.” (Friedman 1953 p.41)
  + But what counts as a ‘crucial’ assumption will **depend on the problem at hand**, and is something that Friedman thinks is beyond the scope of any simple methodology to determine
  + Friedman: ‘**leaves seek to maximise the sunlight they receive**’ - an egregious simplification of the processes a tree goes through to achieve that maximisation, but it is nevertheless “more compact and at the same time no less comprehensive” than a list of particular rules would be (Friedman 1953 p.24).
  + Friedman: how one would go about **modelling billiard players**? A successful model - that is, one able to make good predictions of game outcomes, on average - might assume that they “knew the complicated mathematical formulas that would give the optimum directions of travel, could estimate accurately by eye the angles, etc... could make lightning calculations from the formulas, and could then make the balls travel in the direction indicated by the formulas” (ibid. p.21).
  + Conlisk: “But what of a beginner taking the first shot, in poor light, on a badly warped and randomly moving table, with assorted friends and relatives guiding the cue stick?” (Conlisk, 1996 p.684)
  + Then the assumptions would be poor ones for this situation: the model would not work
  + **"Everything depends on the problem."** Cf. description of objects moving in gravity or planets spin speed and assumptions of heat gain (simplications that work for Earth don't for the moon.)
* Cf. use of utility in travel models:
  + “the general conclusion about the idea that some overall budget mechanism governs individual travel decisions, however, must be that, to date, the evidence available still leaves many questions unanswered and **the theory is still largely unproved**” (Button, 2010 p.92).
  + But v useful results e.g.: “savings in walking and waiting times are valued at between two and three times savings in on-vehicle time - parameters that have proved to be remarkably robust over the years.” (ibid. p.104)
* For my stuff: ABM provides way to allow actors to make spatial economic decisions from their point of view. This allows a certain kind of emergence, but the agents themselves are very simple.

### Epstein's 'why model' points (Epstein, 2008)

Explain (very distinct from predict)

Guide data collection

Illuminate core dynamics

Suggest dynamical analogies

Discover new questions

Promote a scientific habit of mind

Bound (bracket) outcomes to plausible ranges

Illuminate core uncertainties.

Offer crisis options in near-real time

Demonstrate tradeoffs / suggest efficiencies

Challenge the robustness of prevailing theory through perturbations

Expose prevailing wisdom as incompatible with available data

Train practitioners

Discipline the policy dialogue

Educate the general public

Reveal the apparently simple (complex) to be complex (simple)

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