

The Art of Modelling: Lying By Omission

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Models Lie

- Models misrepresent some aspects of the target system.
- Mostly they leave out detail—*lying by omission*—as when a predator–prey population model fails to mention that the predator is not a specialist.
- Sometimes they *distort*, as when fluid flow model treats the fluid as having no turbulence.
- Sometimes they exaggerate, as when economic models treat agents as perfectly rational.



Why Do Models Lie?

- Sometimes the lies are little white ones: it's close enough for the purposes at hand: "it's close enough for jazz".
- Sometimes the lies cancel out as when air pressure from all directions is ignored in a pendulum model.
- Sometimes the lies make the model tractable, as when we use differential equations in economic models.
- Sometimes we simply can see no other way, as when we treat various risk factors as independent when we have no clue about dependencies.



Yet, They Work

- Despite the lies, omissions, exaggerations, and distortions, models work.
- How can this be?
- In some cases it's easy to see: if the lies are small enough and the level of precision required is large enough, the lies don't matter.
- Or when the lies are large but they cancel.
- More puzzling are other cases where the lies are neither small nor cancelling. Garbage in, garbage out, right?



Musical Notation

- Musical notation can serve many different purposes:
 - (i) a model of a particular performance
 - (ii) a model of some abstract/limiting/perfect performance
 - (iii) a recipe for the performance.
 - (iv) an invitation to perform an underspecified piece
 - (vi) a reminder of how the piece is supposed to go
 - (v) a means of legally protecting musical pieces
- Consider the first role:
 - (i) the notation omits considerations of timbre.
 - (ii) the notation *distorts* timing: treating every note as a 1/2, 1/4, 1/8, 1/16ths etc.
 - (iii) the notation *exaggerates* the accuracy of instrument intonation.



Impressionist Landscapes

- There are various misrepresentations in impressionist paintings (and the kind and severity of the misrepresentations depend on the style of painting):
 - Landscapes are three-dimensional but paintings are two-dimensional.
 - Landscapes are changing and paintings are static.
 - Landscapes do not come with a privileged perspective but paintings do.
 - Landscapes are not made up of many tiny dots yet some (pointillist) paintings are.
 - Landscapes are sharp and fully determinate but some paintings are not.



Success Through Misrepresentation

- A musical score or an impressionist painting can achieve its goal, not *despite* the inaccuracies, but *because* of them.
- It doesn't much matter whether you have a Gibson or a Fender guitar: what matters for many purposes is the arrangement and timing of the sounds the guitar makes.
- A Monet painting of a lily pond, for example, with its many and obvious inaccuracies, better conveys the interaction of light on the lily pond than any photograph or naked-eye viewing.
- Take the analogy between an impressionist work and a scientific models seriously.
- Scientific models can also achieve their goals *because* of (well chosen) inaccuracies.



"How Possibly" Models

- Minimal models are models stripped down to the bare bones.
- Consider Schelling cellular automata models of segregation.
- These models are not accurate nor even close to accurate.
- For example, the earth is not flat with four edges and composed of an array of square neighbourhoods.
- Yet these models show that the phenomenon of racially segregated neighbourhoods is possible without overt racism.
- These models thus demonstrate that it is possible for some phenomenon to occur even in a very idealised setting.
- The lack of realism is an important feature of these models.



Minimal Models

- Minimal models are models stripped down to the bare bones.
- Consider the classic Lotka-Volterra model of predator and prey.
- This model abstracts away from a great deal of (relevant yet misleading) detail to get to the heart of the phenomenon in question.
- Population cycles, are a result of the interaction between predator and prey; they do not ride on temperature variations, variable growth rates and many other factors.
- Like a Monet painting or a good musical score, a good minimal model goes to the heart of the matter by ignoring misleading details.
- How do we know what the misleading details are in advance? That's *the art of modelling*.



Sets of Models

- Sometimes every model in a set of models is inadequate yet the collective is not.
- Just as individuals opinions can be combined (in the right sort of way) to deliver judgements better than any individual's, outputs of models can be combined to improve accuracy.
- Sensitivity analysis is one way to use sets of models to bolster confidence.
- Meta-analysis is another familiar tool for this.
- And there are others ...



Discussion

- It simply won't do to criticise a model on the basis of its misrepresentations.
- The purpose of the model must be considered and the role of the misrepresentations in achieving that purpose must be appreciated.
- This is particularly important for models used in the public sphere (as in risk models used in public policy).
- We would all do well to be more explicit about the purposes of our models and why some of the idealisations and misrepresentations are not only harmless but necessary.



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