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Editorial

As simple as possible: styles of model, styles of science

One of the canons of modern scientific inquiry is the concept that, if there are two theories which explain an event, the one that is simpler is preferable. This is enshrined in the principle of parsimony that invokes Occam's razor, so-called after William of Ockham, a 14th-century English theologian and Franciscan monk, who argued that the virtues of simplicity must involve stripping away any idea that does not add to the essential nature of the argument: in his phraseology, "plurality ought never be posited without necessity" (Adams, 1987). Indeed, Einstein (1934) said that "Make everything as simple as possible, but not simpler", adding to the mystery of what the notion of 'simple' actually means in scientific research. Popper (1992) also argued, regardless of any aesthetic criterion, that simple theories are preferable to the more complex because they require less empirical evidence and are easier to falsify.

Much then turns on how 'simpler' is defined, but in our own world of cities and design let us consider two theories of how poverty emerges spatially: the first theory relates this to industrial structure, arguing that different types of structure and their spatial configurations generate greater levels of wealth and, by assumption, lesser levels of poverty. A second theory argues that industrial structure as well as the power structure of the local society both determine, in an additive way, levels of poverty. By an ingenious construction, let us assume that the first theory has equal explanatory power to the second, and thus, by Occam's razor, we must accept the first theory as it is simpler. Yet the second theory suggests an additional mechanism that is equally as plausible as the first. On the basis of our intuitions about the 'way the world works', we might be inclined to accept the second.

This example, I hear you saying, has many potential difficulties, for in most theories, it would appear difficult, if not infeasible, to isolate conditions under which such separability of causes could be defined unambiguously. Nevertheless, much of modern science, and until fifty years or so ago most social science, rested on the assumption that the search for good explanations depended on identifying parsimonious theories that were applicable under a wide variety of circumstances. In urban theory and models the effort was to define theories in terms of a balance between explanatory and predictive variables, between knowns and unknowns: in econometric terms, between models that were appropriately identified, not overidentified with more equations determining an outcome than there were variables to be predicted and not underidentified where many unknowns were determined by a lesser number of known variables. In fact, the predominant style of model building in this era was one of beginning with a well-specified model in terms of knowns and unknowns and then, if the model performed poorly, to restrict its scope by adding more constraints on the values of the unknowns that could be predicted: in this way, the performance of the model might be improved but its explanatory power clearly lessened. In short, the dominant style of modelling was searching for parsimonious but balanced structures, reducing the degree of explanation until the point at which the model could produce explanations that fit a progressively more constrained set of outcomes.

The classic example of this style of modelling is illustrated by spatial interaction. If such a model does not fit the data well, then given its structure as a set of accounting relations which simulate interactions conserved in some way, an obvious strategy to improve the model is to introduce a fuller set of constraints, thereby reducing its predictive power while giving it a chance to improve in performance. Usually predictive outcomes are narrowed in this way and this is sometimes likened to introducing auxiliary hypotheses which reduce the power and scope of the original hypothesis, sometimes casting doubt on the nature of the hypothesis being predicated in the first case. In a sense, such modifications tend to go against the grain of scientific discovery because they are tantamount to admitting that the original hypothesis has already been falsified. Nevertheless, on pragmatic grounds such a strategy is invariably invoked.

In the last fifty years attempts to discover theories of human behaviour which are founded on simple theories in analogy to the way physics has developed during the last three centuries have floundered. Human systems appear to manifest an order of complexity that defies the search for simple principles. Such systems are made of up entities—ourselves—with 'free will', which fight against the very notion that we can predict the future at any level. In our own domain, gradual acceptance of the fact that the world is considerably more complex than our past theories have tended to admit, has produced a rather different class of models whose falsifiability will always be in doubt. These are based on the idea that, if there is some plausible and widely regarded process or structure that we all agree upon as being essential, then any model must somehow account for this, regardless of whether or not it is possible to falsify hypotheses built around this. If there are processes and outcomes that we agree are important, it is thus irrelevant whether or not we can build models that can be validated or falsified in the classical sense. This has created a dilemma which has thrown the social sciences into disarray. Much of economics is predicated on theoretical processes that cannot be validated in any way, with the choice of theory being often based on aesthetic or formal logic rather than any relationship to real-world events.

In contrast in our own field, new classes of model have emerged that appeal to human behaviour, which generate spatial outcomes from the bottom up. These models are often referred to as 'agent based' with several variants such as cellular automata, or microsimulation structures. These models tend to be much richer than their traditional counterparts—more aggregate than land-use – transportation models that they are often compared against, but they are harder to falsify and contain many assumptions and hypotheses that, although plausible, are not testable in any way. To an extent, this debate casts the whole notion of predictability in social systems in doubt and it suggests that the choice of model is conditional on what it is likely to be used for.

Short-term forecasting requires very different kinds of models than long-term; different scales require different models; while emphasis on land development, regeneration, controlling sprawl, and the whole gamut of policy interventions that we agree are socially necessary, all require different types of model. Under some circumstances, cross-sectional models are appropriate; in others it is essential to have dynamic models. The debate is considerably more intricate than any we have engaged in hitherto in our field; it raises doubts about the development of models that are generic and packaged, which imply widespread usage. This is an argument that I would like to see discussed at length in this journal as theories and models about cities and the different contexts in which they might be used continue to proliferate.

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