Donald Saari: A new approach to social dynamics

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How can we understand historical process?

1. Math is a tool. Too often, investigators attempt to force social science into the math, so that both are bad. Rather, force math into social science to get good math and good science.

2. And we should take our results from math seriously, i.e., take consequences seriously.

a. Prediction. Math is a tool to facilitate prediction, not the science. If the implications and predictions of the models are not valid, then change the model and the assumptions.

Always stay with the data so that there is a basis for challenging the assumptions of models.

b. Explanation. If we are attempting to understand history, be careful. "Be suspicious." No curve fitting. Does the explanation have validity? If you attempt to predict a specific event, you tend to force the result. Always ask, does the model also predict something else? [Once you have predicted something in Moscow, ask, does it also predict in Estonia?] Evolutionary biology has the same problem.

c. Testing beliefs and assumptions. Arrow's Impossibility Theorem tests our beliefs (it is one of the most important theorems of the century). Things that we thought were true are not. But we can modify our assumptions and get positive results. That is the next step. But little has happened since Arrow, except for 1000s of articles on impossibility theorems. We have been stagnant for 50 years. What we want are advances by modifying assumptions.

3. Modeling dynamics in the social sciences

e.g., Turchin, *Historical Dynamics* 2003:

He has models of Area expansion/contraction such that change in A, ΔA or Å = f(x_i), where are the variables that influence A. Å = f(x_i) is a correct beginning. He he makes an error, however, with such equations as that on p. 17, which also implies a threshold between exponential growth and decline:

Å = c(A – d) (Turchin's 2.10)

This assumes the conclusion in order to prove the conclusion. This is a standard social science error: assume what you want to get and get a nice exponential equation. Then to believe that the nice equation describes what we are looking at. But these assumptions already contain the conclusions. It is not surprising that you get the results that you have assumed. We should take the attitude "I don't believe it" unless the equation accurately describes a body of data we are looking at, as in experimental data. The same errors occur in evolutionary biology or the study of party systems in political science.

In experimental social science you have lots of data and can test hypotheses quite exactly. But in most social science, tests are difficult. We cannot write down equations that describe outcomes with precision, which would lead to the next state of refined predictions. If we have data where you can refine precitions then write down the equations of interaction: can then test them. But more generally:
We need a qualitative approach to understand dynamics in general social science.

To know if a story is right or not, e.g., Adam Smith, take model assumptions seriously. You have to seriously modify his assumptions to get he invisible hand.

Qualitative does not imply non-quantitative but no need to rush toward the quantitative.

Avoid 'model dependent' results. How do we know when we write down f where the outcome is model dependent? E.g., sensitive to perturbations? Sensitive to changes in assumptions? To changes in variables?

We want robust, structurally stable, results that survive changes in assumptions.

Discussion points:
Experimental vs. observational world where causality not clear (Hal Stern), e.g. for smoking and cancer there is no piece of evidence that is conclusive. Have to tease apart alternatives.
DS: that's one of the powerful aspects of statistics: but what are the variables?
HS: Stats speaks to trying to codify, take from qualitative to quantitative
DS: but what you have in time series is data, not dynamics.
Duncan: what you often have in experimental studies are recognition of qualititave variables that lead to quantification
DS: as separating another class than experimental, which is replication, my comments will apply here. E.g., Charles Plott: finds cycles; they replicate. Can study the dynamics qualitatively to get general results.
Kim: by qualitative, it should be clear, you do not mean antiquantitative
DS: yes, goal of qualitative analysis is to (come to) know what to measure.

Difficulty is taking measurements but not knowing (what they represent) what you get when you do so.

1. When you choose f how do we know if the outcome is model dependent

2. Is the outcome structurally stable? – If we perturb and is stable. If we change the model by throwing in policy or intervention – can we predict consequences?

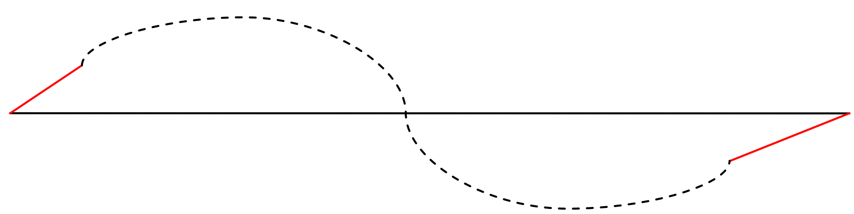
e.g. study of Spruce budworm, pesticides and lifecycle of the budworm – showed pesticides ineffective, held at steady state. The dynamics (phase space) of life cycle showed why – it interfered at a crucial point. By letting go of pesticides, problem righted itself.

In historical dynamics, down know what happens in terms of global equilibria. And don't know f.

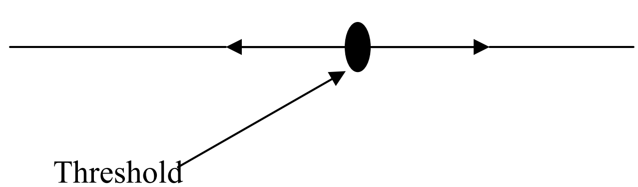
3. So for policy: can we say what equations to write down? E.g., what if fighting over area? What if 2 polities? What if 3? We don't know f. The most we know is about some of the local equilibra.

Saari's approach requires only "local information," [later: i.e., information on local equilibria]

If we have knowledge about the end points, we know that there must be at least one equilibrium in the middle, or perhaps, three. We must assume continuity. This is a strong assumption, but not as strong as those made by others.



We can also define thresholds, such that if you are on one side of it, you go in one direction, but on the other side, you go in the other.



Saari then solved a Winding Number problem defined by three types of voters, on a triangle.

The goal of qualitative development of the problem is to get to the quantitative. So we will "know what to look for."

The purpose of the simple models (as above) is to test assumptions. If the models don't work, the assumptions are wrong. Try a different set of assumptions. Need to test with local information, but the general shape of the curves tells us something about the dynamic, if we are generally correct about the direction of change (e.g., area expands, area contracts). This kind of work is essentially "qualitative," Don said, and does not require explicit equations.

In the discussion, Kim raised the issue that such models might be curve-fitting "numerology." He said we need a "real experiment" and some measurements. "Let's look at the data."

Don did not disagree but cautioned about rushing to measurement before assumptions had been examined to find out if the model is sound.

Don said most models are "too specific" and he doesn't believe them. Need to reexamine the basic assumptions. If you follow their logic and the data fit, then you can look for more data. "Look at the easiest picture first." With this approach, we can "now test assumptions" which is more than we can do otherwise. There is always the possibility that more variables need to be introduced.

Don said "local" meant "in the neighborhood of equilibrium."

Doug and others: asked the lengths of time at which different observed configurations studied are stable - how do we use those data in the study of dynamics?

Don: There is a second part to approach, dealing with time, which was to be the second part of the lecture, but we're out of time.

Doug: Lets then have a second lecture

Notes by bell, nardi, white