Communication on my books "A logic of exceptions" and the 2nd edition of "Voting theory for democracy" – with some additional notes on causality, graphical models, artificial intelligence and bureaucracy

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February 26 2007, JEL A00

Abstract

In January 2007 I completed the book "A logic of exceptions" which is a course in elementary logic but written by an econometrician and using the Mathematica software in The Economics Pack. Subsequently I also found time for a second edition of "Voting theory for democracy". Both books have been set up as a course starting-from-scratch and with some final more challenging chapters discussing errors in the literature. Last month I collected some meta-considerations that can be included with this communication to clarify more about the context.

Contents of this communication

Where to find ALOE and VTFD 2007

Colignatus (2007a), "A logic of exceptions" - henceforth ALOE - is available now, see http://www.dataweb.nl/~cool/Papers/ALOE/Index.html. Readers who already looked before February 26 2007 should look again for the February update where typing errors have been corrected.

Colignatus (2007b), "Voting theory for democracy", 2nd edition - henceforth VTFD - is available now too, see http://www.dataweb.nl/~cool/Papers/VTFD/Index.html

The websites contain printable PDFs. These books are also included in the now updated version of The Economics Pack, see Cool (1999, 2001) and http://www.dataweb.nl/~cool/TheEconomicsPack/index.html. Please note that the print version of this Guide still is 2001 while the software version on the web is 2007.

One can benefit from these books also when one doesn't have the software. However, with the software, one will have an interactive environment. The software can be freely downloaded, but one needs a licence to run it.

Shone (2000) contains a useful review of *Mathematica*, http://www.wolfram.com.

The books are currently published in the printing-on-demand format. This is kind of awkward, since it tends to limit the circle of prospective users. Readers who have contacts with a big publishing house are invited to contact me for republication.

On the context of these books

When I completed ALOE a friend called my attention to Judea Pearl (2000), "Causality". Indeed, page 29 there contains a boolean model with exceptions. So it may be that the attention for exceptions is in the air. Conversely, ALOE p 135-138 contains a discussion on induction, which would be mainly causal induction though I did not extend on that. Statistical induction namely causes its own rules of inference – probability theory – (notably on "left out variables").

Interestingly ALOE has been written by an econometrician and one of the claims by Pearl is that precisely the approach of "structural equations models" importantly used in econometrics would be the best if not the only way to describe causality. That is, by econometricians of the generations of Tinbergen and Theil, since the recent generations seem to have gone astray due to the influence of statisticians who only observe correlation and not causality. While structural equations contain parameters, the structure of their connections could be represented by graphs (arrow diagram). Indeed, it is known that Tinbergen used to make path diagrams. Theil (1971:437) gives an arrow diagram of the Klein model.

It may be noted that VTFD contains graphs for the voting margins, i.e. the margin of votes one candidate gets over another. Given this experience, it would conceivably be relatively easy to write a Mathematica package on graphical models and causality, using the combinatorica package in Mathematica, documented in tbe book by Skiena & Pemmaraju (2003).

A point to note is that some structural equations relating to causality need not be linear. For example when rain or a baby may wet the grass, then {rain, baby} → wet grass, or {r, b} → w, so that the logical equation becomes $w = 1 - (1 - r)\,(1 - b) = b + r - b\,r$ which is nonlinear. Obviously, Tinbergen and Theil were interested in quantitative and not logical relations, so they would write $x_w = x_r + x_b + \varepsilon$ with x_C the amount of wetness from cause C. In boolean causality, the degree of wetness does not enter the discussion. So it may still be that there is a difference with those pioneers in econometrics though the kind of reasoning would be the same, and a likely intention is to use both types of equations in parallel.

Incidently, it seems perfectly OK when statisticians, following Pearson and his discovery of the Simpson paradox (later called after Simpson), only think in terms of correlations. It would be the subject fields, that use statistics, who should provide the causality. But it would be logic and philosophy to design the theory of causality itself. Incidently, the Simpson paradox also occurs in Voting Theory. A discussion is included in The Economics Pack, in the packages on the Life Sciences.

According to Pearl, the confounding as shown in the Simpson paradox is the core case where causality and the statistical approach differ. Pearl (2000:199): "As much as I admire the rigor introduced by Greenland and Robin's analysis through the framework of exchangeability, I am thoroughly convince that the opacity and inflexibility of counterfactual contingency tables are largely responsible for the slow acceptance of the GR framework among epidemiologists and, as a byproduct, for the lingering confusion that surrounds confounding in the statistical literature at large. I am likewise convinced that formulating claims and assumptions in the language of structural models will make the mathematical analysis of causation accessible to rank-and-file researchers and thus lead eventually to a total and natural disconfounding of confounding." One would also look at Greenland, Pearl & Robins (1999), "Causal diagrams for epidemiologic research". Just be careful with the term “structural equations”.

A point to keep in mind is that causality itself would be deterministic and boolean while quantities might be probabilistic. ALOE p 177 contains the triangle of Determinism, Volition and Randomness (chance). These are different perspectives only and their differences are not as dramatic as may seem. For a die the list of possible outcomes {1, …, 6} is deterministic. Volition is when one takes an element by free will (or the illusion of that). If an element is taken by Nature then you might call it deterministic or chance, depending whether you assume some hidden volition/cause/process or not. The big words of Determinism, Volition and Chance thus are mainly perspectives that can be caught in simple operations. Which would transfer to the mathematics of modeling. But it would remain strange to try to describe causality in terms of probability.

The branch of research of Graphical Models appears to be related to artificial intelligence. It so happens that ALOE p8 states:

“Since the Egyptians, mankind has been trying to solve the problem of bureaucracy. One frequent approach is the rule of law, say, that a supreme law-giver defines a rule that a bureaucracy must enforce. It is difficult for a law however to account for all kinds of exceptions that might be considered in its implementation. Ruthless enforcement might well destroy the very intentions of that law. Some bureaucrats might still opt for such enforcement merely to play it safe that nobody can say that they don't do their job. Decades may pass before such detrimental application is noticed and revised. There is the story of Catherine the Great regularly visiting a small park for a rest in the open air, so that they put a guard there; and some hundred years after her death somebody noticed that guarding that small park had become kind of silly. When both law-givers

and bureaucrats grow more aware of some logic of exceptions then they might better deal with the contingencies of public management. It is a long shot to think so, of course, but in general it would help when people are not only aware of the rigour of a logical argument or rule but also of the possibility of some exception."

The cover of the book contains the line "The approach to keep exceptions in the back of one's mind is a general sign of intelligence." Where researchers in graphical models relate their work to artificial intelligence and robotics, they might as well link up with the research on bureaucracy.

Morgan (2002) in an interview with Jeff Paris on his work on logic and common sense has him emphasizing the importance for robotics. The argument runs: "If we are planning to delegate important decisions to computers, it's important that we know that the computer is actually acting in a way that we would describe as common sense." However, my suggestion would be that before we delegate such power to robots we first try to put some common sense into our bureaucracies.

My suggestion therefor is that this whole line of logic, causality, graphical models, common sense and exceptions is also important for economics and the management of the state.

Reading Deutscher (2005), I can extend the Egyptians with the early Sumerians. It is interesting to observe that the word "all" is linked etymologically to "whole", which is reconstructed in set theory where the whole (set) consists of all its elements. Deutscher also shows that linguistic structure can support instant thought. In the same way, much of logic and mathematics seems to flow from a good look at language, where patterns have been ingrained and empirically tested in the course of thousands of years. My impression is that ALOE and its approach to the Liar paradox and Russell's set paradox and Gödel's theorems finds support in linguistics. And it would be nice if we can design bureaucratic patterns that support instant consumer friendliness and awareness of exceptions.

Pearl (2000:349) states: "As I mentioned earlier, the surgery idea of Herman Wold was stamped out of the economics literature in the 1970s, and all discussions on policy analysis that I could find assume that the mutilated model prevails throughout. That taxation is under government control at the time of evaluation is assumed to be sufficient for treating taxation as an exogenous variable throughout, when in fact taxation is an endogenous variable during the model-building phase and turns exogenous only when evaluated." However, Colignatus (1992, 2000, 2005), and earlier unpublished work at the Dutch Central Planning Bureau, not only regard taxation but the whole of policy making as endogenous.

Pearl (2000:358): "But the really challenging problems are still ahead: We still do not have a causal understanding of *poverty* and *cancer* and *intolerance,* and only the accumulation of data and the insight of great minds will eventually lead to such understanding." Well, I don't know about "great minds" yet in my own dim-witted way I must mention that Colignatus (1992, 2000, 2005) already solve poverty. Colignatus (2006) confirms that analysis for a small Caribbean island economy.

Pearl wrote a great book. But a new edition is required that increases its didactic tone. Pearl refers to econometrics, epidemiology, statistics, computer science, but only a few readers will be at home in all these areas, and when delving in one area the new book should provide at least a shortcut explanation for readers from the other areas. In ALOE and VTFD I try to get a good balance between text, formulas, graphics, numbers, and, programs. Pearl does likewise except for the programs, which would give interactive support. Also, he gives a verbal definition of

confounding only at the end of the chapter on confounding, in the line of an argument, and it would be better to start out with it. The book would benefit from more contingency tables, with numerical examples and operational calculations.

Summary of ALOE

A LOGIC OF EXCEPTIONS provides the concepts and tools for sound inference. Discussed are: (1) the basic elements: propositional operators, predicates and sets; (2) the basic notions: inference, syllogism, axiomatics, proof theory; (3) the basic extra's: history, relation to the scientific method, the paradoxes. The new elements in the book are: (4) a logic of exceptions, solutions for those paradoxes, analysis of common errors in the literature, routines in Mathematica. The book is intended to be used in the first year of college or university. The last two chapters require a more advanced level that is worked up to.

Logic is used not only in science and mathematics but also in business and sometimes in politics and government. Logic and inference however can suffer from paradoxes such as the Liar paradox "This sentence is false" or the proof-theoretic variant by Gödel "This statement is not provable" or the Russell set paradox of "The catalogue of all catalogues that don't mention themselves". This book explains and solves those paradoxes, and thereby gives a clarity that was lacking up to now. The author proposes the new approach that a concept, such as the definition of truth or the notion of proof or the definition of a set, also reckons with the exceptions that may pertain to its very definition. The approach to keep exceptions in the back of one's mind is a general sign of intelligence.

Some key points:

(1) For the Russell set paradox. Let $R = \{y \mid y \text{ ne } y\}$ where "e" stands for being an element and "ne" for not being an element. Given the induced contradiction in two-valued logic we conclude that for all x it would hold that $x \neq \{y \mid y \text{ ne } y\}$. Russell and Whitehead solved that by a theory of types, so that it is ingrained in the axioms of set theory and the syntax that such an R cannot be formed. Let us however consider the close approximation of the R-idea in $Z = \{y \mid y \text{ ne } y \ \& \ y \text{ e } Z\}$. In this case we allow selfreference and break the theory of types. This set is inspired by Zermelo's axiom of *Aussonderung,* and identifies that selfreference is the working part of that axiom. Thus, it is useful to allow selfreference and rewrite the axioms. Since this allows the formation of *R,* it can be regarded as a nonsensical concept, such that the expressions R e R and R ne R get truthvalues "indeterminate" instead of true or false. In this case we rely on inference rather than syntax to prevent paradox, with the premium that we can define sets using selfreference when it is useful. Note that Z can be understood as $Z = \{y \mid y \text{ ne } y \ \text{ unless } y = Z \text{ for then } y \text{ ne } y \ \& \ y \text{ e } Z\}$ which means that R is equipped with an exception.

(2) The Liar paradox. Let $L = \text{Not}(L)$. Given the induced contradiction in two-valued logic we conclude that for all x it would hold that $x \neq \text{Not}(x)$. Russell and Tarski solved that by a theory of types in language. Yet this causes truthpredicates $true_n$ for language level n which is rather odd since natural languages don't seem to have use for this. If we allow for three-valued logic then we keep the freedom of definition and a single concept of truth. While three-valued logic seems cumbersome, the routines in Mathematica show that it can be handled easily.

(3) The meaning of three-valued logic. In two-valued logic we have the "convention of the assertoric usage of language", in that we say only what we consider true. With two values of saying (saying and not saying) and two values of truth (true and false) this fits. What happens when there is a third value ? The solution is to recognize "hypothetical speech" as a third possibility in the use of language, e.g. used in a "reductio ad absurdum".

(4) Paradoxes of threevalued logic. Can be solved by repeated application of the third value operator.

(5) Gödel's theorems. In this case, wild philosophical conclusions have been based upon a sentence that is a cousin of the liar sentence, the Gödeliar "This sentence is not provable". These wild philosophical conclusions still might be true, but not based upon this nonsensical Gödeliar. First it is strange that logicians recognize the relationship between truth and provability, and that they require levels for truth, but drop this for provability. Gödel's numerical coding allows self-reference, as this already exists in language. However, he only allows selfreference for sentences and not for systems. The solution is to allow selfreference for systems too. With the added rule that "when something is proven, then it is also proven that it is proven" (a bit complex since the Gödeliar is similarly complex) we can derive the same contradiction as with the Liar paradox. Gödel's theorems are based upon nonsense, and we need only weak additional properties to show this.

(6) Brouwer's intuitionism. This was important for the development of theory but its method can be summarized in now standard concepts. Heyting's axioms are incomplete for those purposes. Perhaps the philosophy still stands but then for another reason.

(7) ALOE was actually written when I was still a student of econometrics, 25 years ago. My teachers didn't enjoy my analysis and the book was shelved since I needed to graduate (in econometrics, anyway). Users of The Economics Pack already noted elements of logic in earlier versions of the Pack. Last holiday season gave me the opportunity and energy to retype the old material in Mathematica and provide additional programs. I had to edit the material of course, making it more didactic, but to my satisfaction the analysis stood up against my renewed critical look. Note that I have not looked at developments in logic research since 1980-1981 so that ALOE may miss some of this, though I don't expect that this will be much, given the strength of dogma e.g. on Gödel in the 1936-1980 period anyway. I feel sorry for the researchers who have missed out on my results of 1980-1981 and who have spent their research climbing dead-end hills. One of the elements in ALOE is the application of the (economic) distinction between statics and dynamics to the distinction between propositions and inference. I told one of my teachers about this too in 1980 and this was one aspect that he said he liked. Recently I checked the internet and discovered that he has written various papers on dynamic logic and received big research grants on it. I don't know whether he has done so with proper reference. I must mention this since otherwise people might think that the distinction as used in ALOE originates with someone else and that I myself wouldn't give proper reference.

Summary of VTFD

VOTING THEORY FOR DEMOCRACY provides the concepts and tools for democratic decision making. Voting is used not only in politics and government, but also in business - and not only in the shareholders' meetings but also in teams. Voting however can suffer from paradoxes. In some systems, it is possible that candidate *A* wins from *B, B* from *C*, and *C* from *A* again. This book explains and solves those paradoxes, and thereby it gives a clarity that was lacking up to now. The author proposes the new scheme of 'Pareto Majority' which combines the good properties of the older schemes proposed by Pareto, Borda and Condorcet, while it adds the

notion of a (Brouwer) ‘fixed point’. Many people will likely prefer this new scheme over Plurality voting which is currently the common practice.

The literature on voting theory has suffered from some serious miscommunications in the last 50 years. Nobel Prize winning economists Kenneth Arrow and Amartya Sen created correct mathematical theorems, but gave incorrect verbal explanations. The author emphasises that there is a distinction between ‘voting’ and deciding. A voting field only becomes a decision by explicitly dealing with the paradoxes. Arrow and Sen did not solve the paradoxes and used them instead to conclude that it was ‘impossible’ to find a ‘good’ system. This however is a wrong approach. Once we understand the paradoxes, we can find the system that we want to use.

This book uses also the theory of games (with Rasch - Elo rating) to show that decisions can change, even dramatically, when candidates or items are added to the list or deleted from it. The use of the fixed point criterion however limits the impact of such changes, and if these occur, they are quite reasonable. Groups are advised, therefor, to spend time on establishing what budget they will vote on.

With respect to the first edition, the book has been extended with some voting schemes such as run-off plurality, the use of Donald Saari’s triangles, and the chapter “Without time, no morality”.

Comment on scientific integrity

It may be noted that DRGTPE (2005) and VTFD (2007b) originally derive from my research at the Dutch Central Planning Bureau, originally founded by Jan Tinbergen. In 1990, the then-director Gerrit Zalm, currently just retiring from the post of Minister of Finance of the Netherlands, blocked this analysis and censored its publication by blocking the internal discussing with the argument that this would needlessly wear the furniture in the lecture room. I still protest against this abuse of power and censorship of science. Since Dutch people don’t seem to mind I can only advise to a boycott of Holland till this matter is resolved, see my website for more details, http://www.dataweb.nl/~cool/AdviceToBoycottHolland.html.

By itself it is interesting that DRGTPE and VTFD came up against a similar block as ALOE, though in the latter case it were mere teachers who hadn’t an open mind and thereby hindered a young person’s way into life. Apparently I enjoy to focus on incongruous notions and it may well be that such notions are incongruous since people have strong opinions on them otherwise they would have been resolved long ago. To be sure, I don’t only focus *only* on such notions. But these three issues are gems that are worth developing. Anyway, people in power shouldn’t block this development, so much should be obvious. It is interesting to observe that VTFD as well meets with strange unvoiced opposition from established circles in social choice theory, also in Holland. These researchers don’t mind that the CPB directorate censors science, they are not interested in innovative use of Mathematica, a system for doing mathematics with the computer, and they have their own ways of blocking discussion without giving any argument. Boycott Holland, I would say.

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