

From sensitivity analysis to Latinorum: twenty years of SAMO conferences



SAMO 2013

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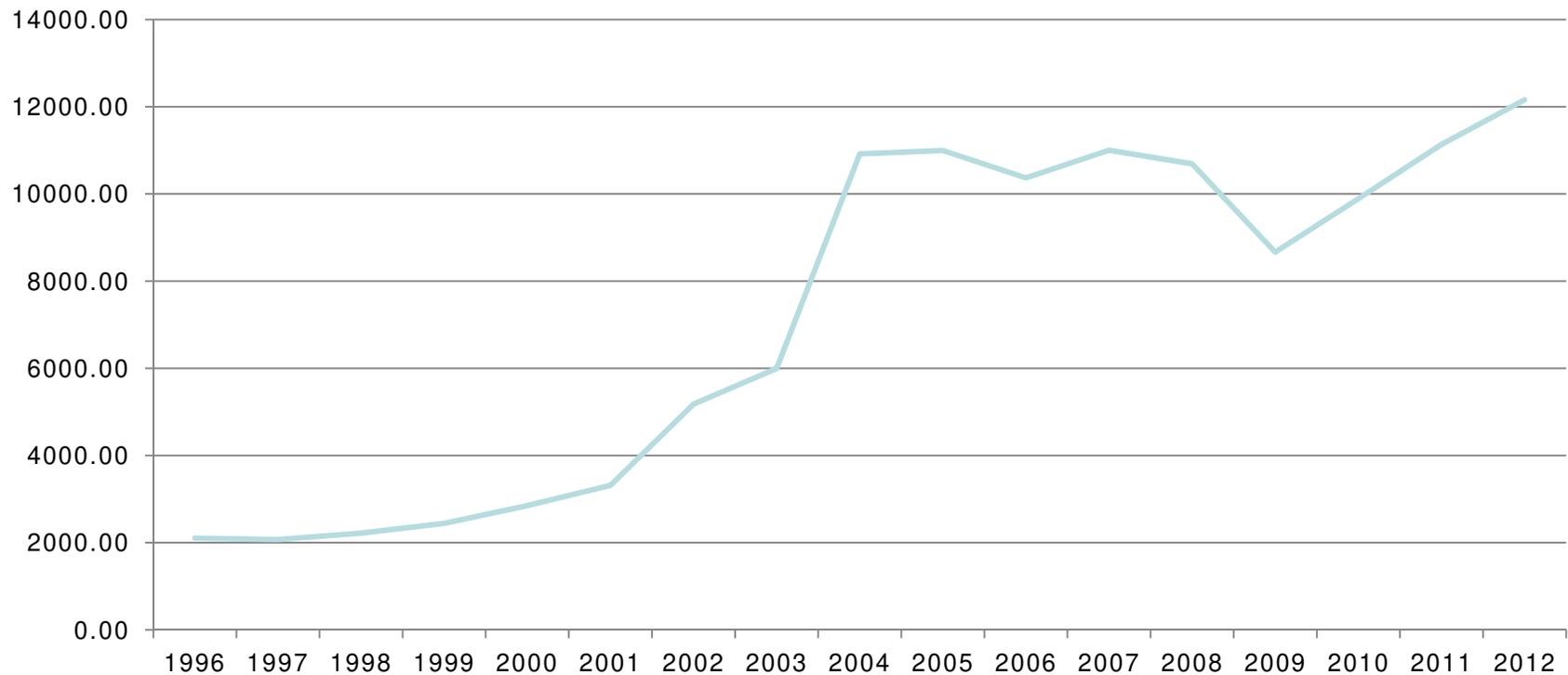
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Where it all started, Belgirate 1995



SAMO 1995 First International Conference – Belgirate (I)
SAMO 1998 Second International Conference – Venice
SAMO 2001 Third International Conference – Madrid
SAMO 2004 Fourth International Conference – Santa Fe
SAMO 2007 Fifth International Conference – Budapest
SAMO 2010 Sixth International Conference – Milano

publications mentioning "sensitivity analysis" since 1996



Source: Scopus Elsevier; www.scopus.com
(data retrieved: 01/07/2013 at 9:55)

What do we [the SAMO usual suspects]
have to show for 18 y of practice?

Methods

Algorithms

Applications

Trainings

Guidelines ...

→ Sensitivity analysis for wicked problems?

Wicked problem:

A problem whose solution requires a great number of people to change their mindsets and behavior is likely to be a wicked problem [1]

Problems met in impact assessment studies tend to become wicked as a result of conflicting stakes

When where facts are uncertain, values in dispute, stakes high and decisions urgent a novel mode of scientific problem-solving suitable to policy issues is offered by Post Normal Science [2]

[1] Wikipedia; Rittel, Horst W. J.; Melvin M. Webber (1973). "Dilemmas in a General Theory of Planning". *Policy Sciences* 4: 155–169. Retrieved 25 April 2013.

[2]Funtowicz, S.O. , Ravetz, J.R., 1993,
Science for the post-normal age, *Futures*, 25(7), 739–755.

When science becomes 'post normal' how should sensitivity analysis adapt?

JRC experience of sensitivity analysis in the context of impact assessment:

- Few takers for a purely 'technical' sensitivity analysis
- A broader concept of sensitivity is called for that looks at the quality of the entire process ...
- And incorporate more reflexive and participatory ingredients

What do I make of your Latinorum?

Sensitivity auditing of mathematical modelling

Andrea Saltelli⁺, Ângela Guimarães Pereira⁺,

Jeroen P. van der Sluijs⁺⁺, Silvio Funtowicz⁺⁺⁺

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Institute for the Protection and Security of the Citizen

⁺⁺Copernicus Institute of Sustainable Development, Utrecht University (NL)

⁺⁺⁺University of Bergen (NO), Centre for the Study
of the Sciences and the Humanities (SVT)

Foresight and Innovation Policy, Special Issue on Plausibility,
to appear 2013, arXiv:1211.2668 [physics.soc-ph]

Sensitivity auditing's seven rules

- I. Check against rhetoric use of mathematical modelling;
- II. Adopt an 'assumption hunting' attitude;
- III. Detect uncertainty inflation or deflation;
- IV. Find sensitive assumptions before these find you;
- V. Aim for transparency;
- VI. Do the right sums;
- VII. Exploring carefully the entire space of the assumptions.



Sensitivity auditing in pills (1): Check against rhetorical use of mathematical modelling;



The instrumental use of mathematical modelling to advance one's agenda can be termed rhetorical, or strategic, like the use of Latin by the elites and the clergy in the classic age.

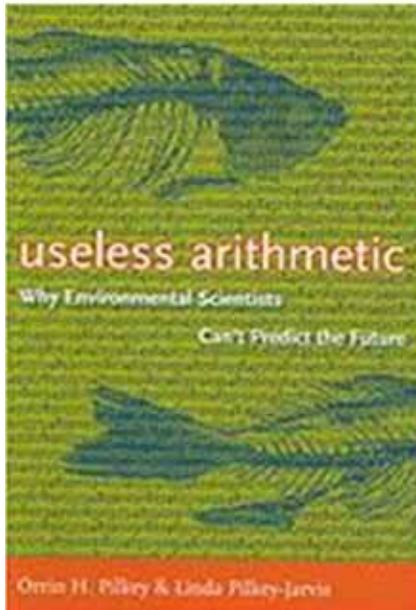
What do I make of your Latinorum?



*Che vuol ch'io
faccia del suo
latinorum!*

Manzoni, A., 1827, *The Betrothed*, English translation from Project Gutenberg at <http://www.gutenberg.org/ebooks/35155>

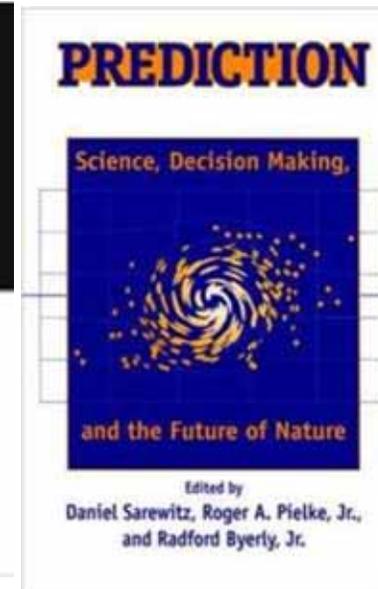
At a time of deteriorating trust...



Water levels in the Mekong Basin could rise or fall with climate change -- models cannot say which.

Climate models at their limit?

Estimates of climate-change impacts will get less, rather than more, certain. But this should not excuse inaction, say Mark Maslin and Patrick Austin.



...

Present times display a critical attitude toward model based inference or narrative. Some authors call modelling counterproductive e.g. in relation to complex settings in hydrogeology, climate, economics...

When models make it to the headlines

“Environmental institute lies and deceits”;

“The bankruptcy of the numbers”;

“Agitation in parliament after criticism on environmental numbers”;

“Perils of placing faith in a thin theory”

“Beware the spell of magic numbers”,

“Environmental institute lies and deceits”;
“The bankruptcy of the numbers”;
“Agitation in parliament after criticism on environmental numbers”;

+ van der Sluijs, J.P., (2002), A way out of the credibility crisis around model-use in Integrated Environmental Assessment, *Futures*, **34**, 133-146.

“Perils of placing faith in a thin theory” ++

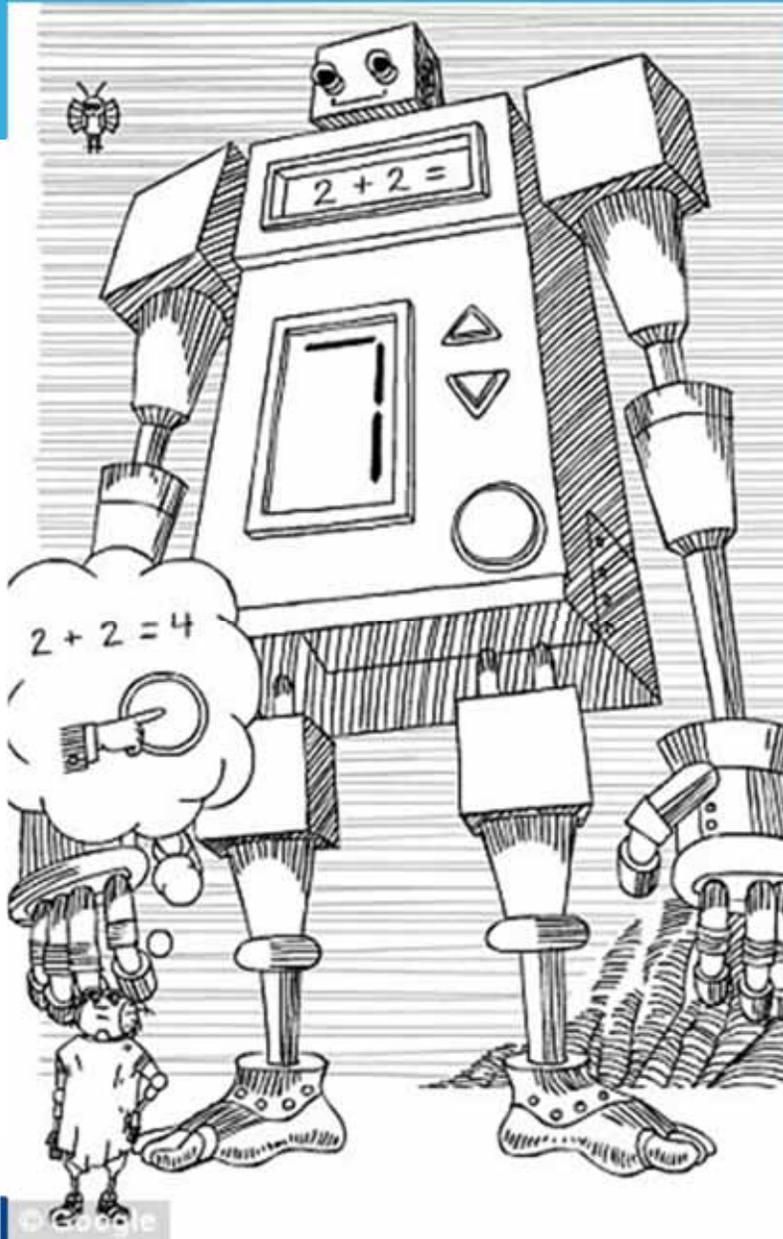
“Beware the spell of magic numbers” +++

++ Münchau, W., Perils of placing faith in a thin theory. Reinhart and Rogoff told policy makers what they wanted to hear,

Financial Times, April 21, 2013. Brittan, S.,

+++ Beware the spell of magic numbers, Economics would benefit from a less credulous acceptance of each purported research finding,

Financial Times, May 2, 2013.



Do we need better
models?
... or better ways of
using them?

Why is it so easy to use models rhetorically?

‘In many cases, these temporal predictions are treated with the same respect that the hypothetic-deductive model of science accords to logical predictions. But this respect is largely misplaced.’ “[...] to be of value in theory testing, the predictions involved must be capable of **refuting** the theory that generated them.’

Oreskes, N., 2000, Why predict? Historical perspectives on prediction in Earth Science, in *Prediction, Science, Decision Making and the future of Nature*, Sarewitz et al., Eds., Island Press, Washington DC



PREDICTION

Science, Decision Making,

and the Future of Nature

Edited by
Daniel Sarewitz, Roger A. Pielke, Jr.,
and Radford Dyer, Jr.

What when the ‘theory’ is not a law but a mathematical model?

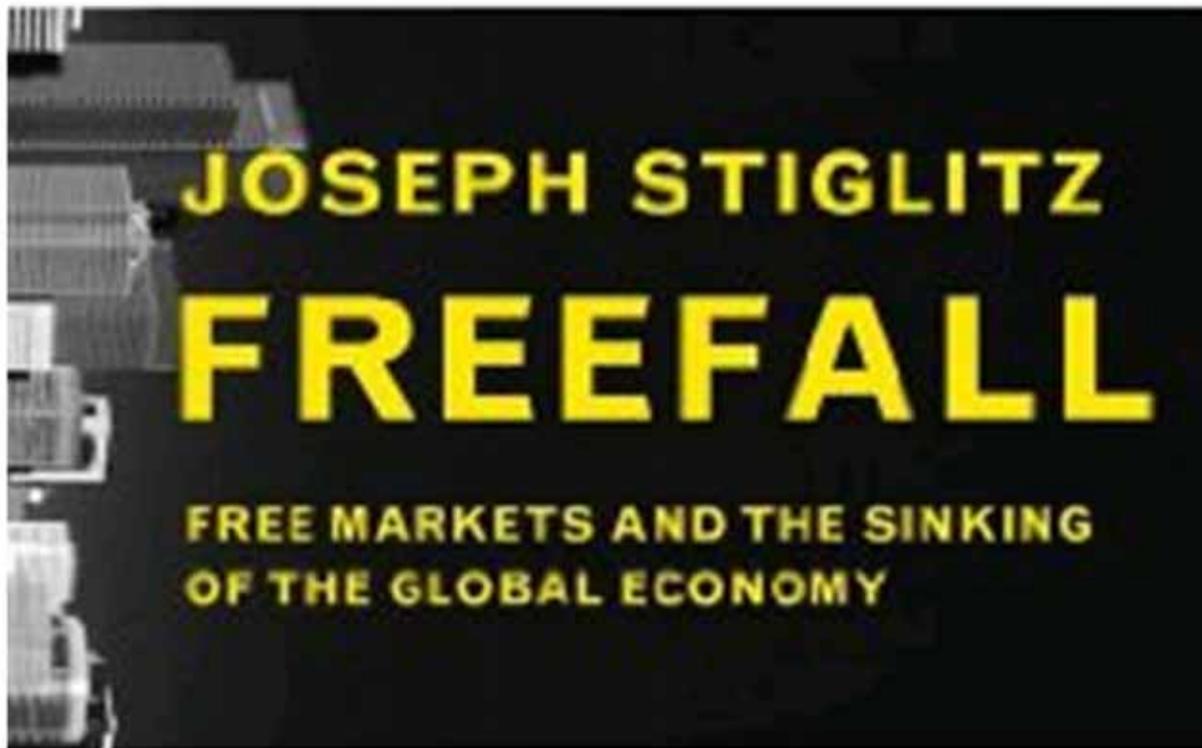
“This is where predictions [...] become particularly sticky.[...] models are complex amalgam of theoretical and phenomenological laws (and the governing equations and algorithms that represent them), empirical input parameters, and a model conceptualization.

When a model generates a prediction, of what precisely is the prediction a test? The laws? The input data? The conceptualization?

Any part (or several parts) of the model might be in error, and there is no simple way to determine which one it is.”

‘Perverse incentives and flawed models – accelerated by a race to the bottom’, p. 92

[...] Part of the agenda of computer models was to maximize the fraction of, say, a lousy sub-prime mortgage that could get an AAA rating, then an AA rating, and so forth,[...] This was called rating at the margin, and the solution was still more complexity”, p. 161



Sensitivity auditing in pills (2): adopt an 'assumption hunting' attitude;



*E.g. in 'Bogus Quantification: Uses and Abuses of Models' John Kay uncovers that the UK transport WebTAG model (the standard for transport policy simulation) needs as **input** 'Annual Percentage Change in Car Occupancy up to 2036.'*

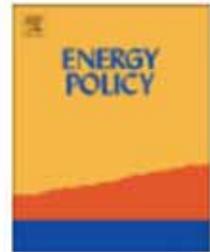




Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol



On the contribution of external cost calculations to energy system governance: The case of a potential large-scale nuclear accident

Erik Laes^{a,*}, Gaston Meskens^b, Jeroen P. van der Sluijs^c



Contents lists available at ScienceDirect

Environmental Modelling & Software

journal homepage: www.elsevier.com/locate/envsoft



A method for the analysis of assumptions in model-based environmental assessments

Penny Kloprogge^a, Jeroen P. van der Sluijs^{a,b,+}, Arthur C. Petersen^c

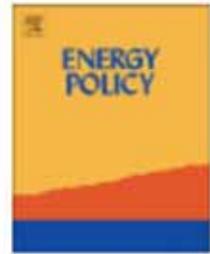




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‘[...] calculation of the external costs of a potential large-scale nuclear accident [...] ‘An [analysis] resulted in a list of 30 calculation steps and assumptions’ ...

→ Stakeholders rejected the model as a relevant tool for policy

An example of participatory approach

‘Coproduction of knowledge model, CPM’

A team composed of experts, both certified (academic natural and social scientists) and noncertified (local people affected by flooding)

The team ended up substituting the off the shelf model already available for the hydrogeological and hydraulic analyses with a co-produced own model, using which an alternative framing of the problem and alternative solutions were coproduced.

Lane, S.N., Odoni, N., Landström, Whatmore, S.J., Ward, N. and Bradley, S. 2011. Doing flood risk science differently: an experiment in radical scientific method. *Transactions of the Institute of British Geographers*, 36, 15--36.

Sensitivity auditing in pills (3):
find sensitivities before sensitivities find you;



The example of the 2007 Stern Review,
where the SA was published after the annex



William Nordhaus,
University of Yale

Nicholas Stern, London
School of Economics



Stern, N., Stern Review on the Economics of Climate Change. UK Government Economic Service, London, www.sternreview.org.uk. Nordhaus W., Critical Assumptions in the Stern Review on Climate Change, *SCIENCE*, 317, 201-202, (2007).

See: Saltelli, A., D'Hombres, 2010, Sensitivity analysis didn't help. A practitioner's critique of the Stern review, *GLOBAL ENVIRONMENTAL CHANGE*, 20, 298-302.

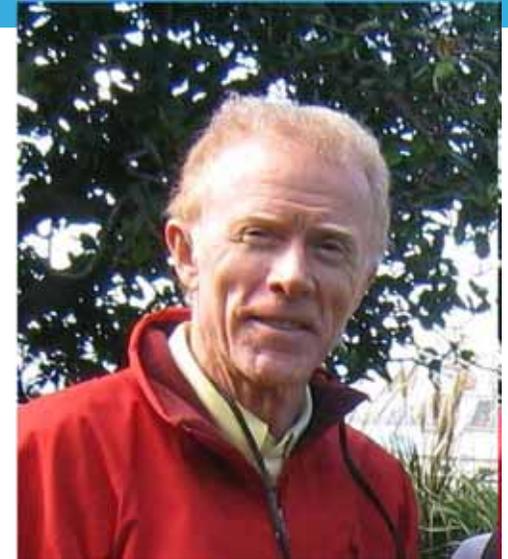
Find sensitivities before sensitivities find you;

Peter Kennedy, A Guide to
Econometrics.

Anticipating criticism by applying
sensitivity analysis. This is one of the
**ten commandments of applied
econometrics** according to Peter
Kennedy:

<<Thou shall confess in the presence
of sensitivity.

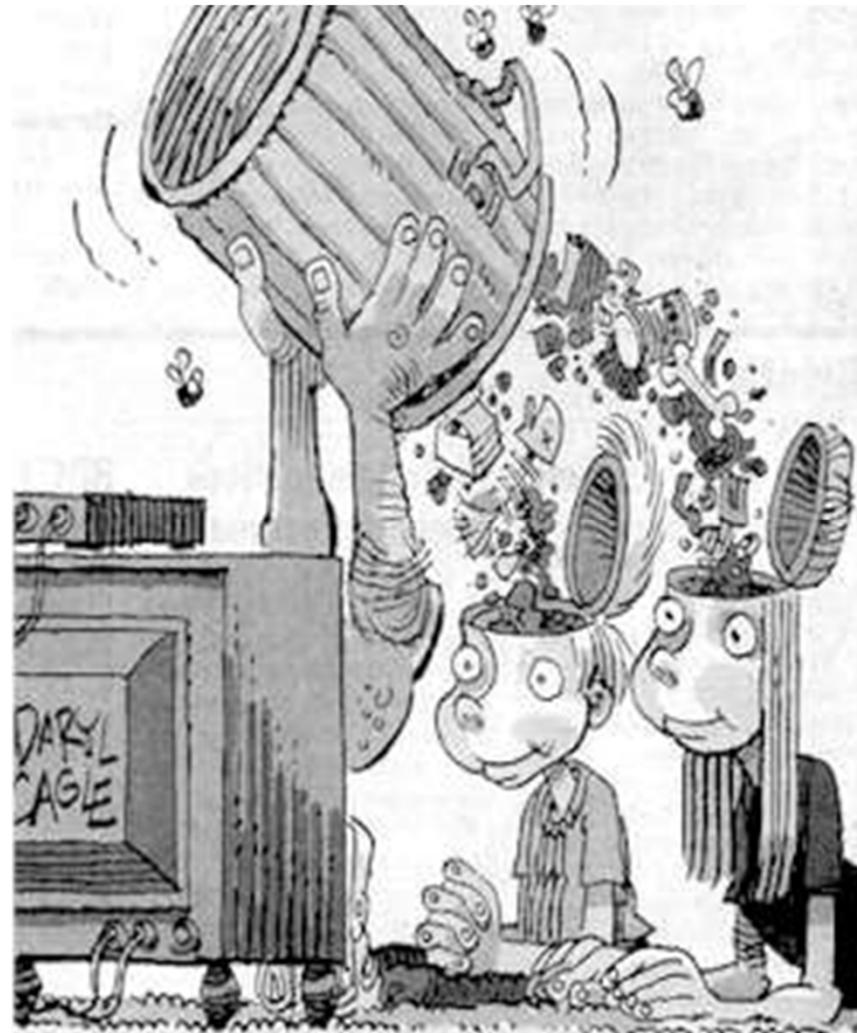
Corollary: Thou shall anticipate
criticism >>



(1943–2010)

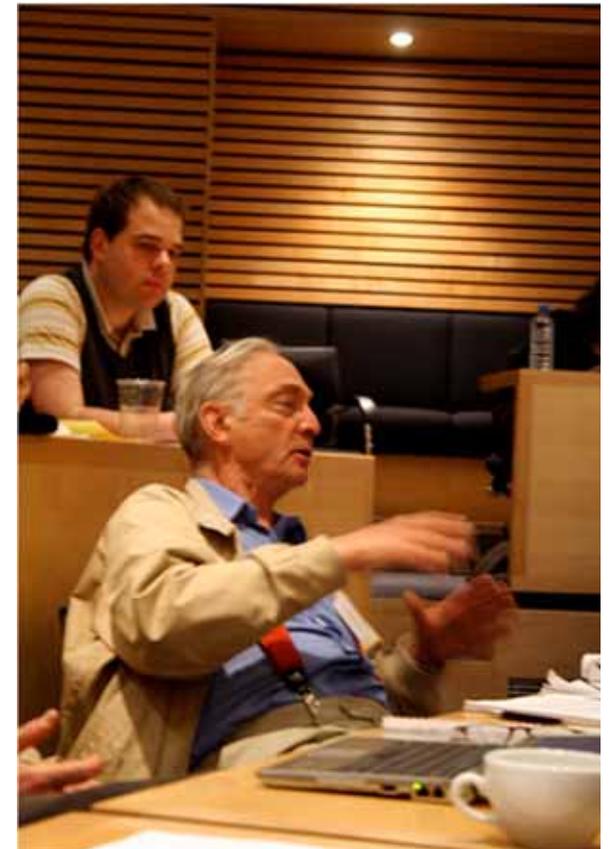


Sensitivity auditing in pills (4): detect GIGO;



GIGO (Garbage In, Garbage Out) Science –
or pseudo-science – “where uncertainties in
inputs must be suppressed lest outputs
become indeterminate”

From: *Uncertainty and Quality in Science for Policy*
by Silvio Funtowicz and Jerry Ravetz, Springer 1990.



Sensitivity auditing in pills (5): Aim for transparency;



Doubts raised over Europe's green energy plan

Host of questions from advisers

Economic model lacks transparency

By Peter Clark in London

The credibility of a European energy review has been cast into doubt by specialist advisers who say plans to cut carbon emissions up to 2050 are based on an economic model based by a single think tank, a view that cannot be independently verified.

The energy experts have "raised a host of questions" on how the European Commission's use of a non-transparent model could affect the review, according to a leaked report by advisers chosen by Brussels to comment on the "Energy Roadmap 2050" proposals.

The economic model, known as Pines, is owned by the National Technical University of Athens and is designed to show how the use of different sources of energy affects the wider economy.

The European Commission has used it for years to help guide the bloc's energy policies. But industry critics complain that its assumptions are impossible to question because the model is privately owned. One trade group, Business Europe, has called for the Commission to use other, more transparent models.

The forthcoming edition of the energy road map, which will review the effect of climate change, energy and the use of nuclear power to meet Europe's green targets, has heightened concern about the model's transparency, the expert advisory group report shows. One of the group's three concerns was "limited transparency" to how the Commission was using the Pines model to produce different energy mix scenarios for the road map.

"There was considerable debate about the role of fossil fuel price assumptions in the Pines model," said the report by the group, which is chaired by Einar Steffan, an Oxford University economic professor, and



A cooling plant in Germany: the viability of plans to cut CO2 emissions has been called into question by reports

includes bodies such as the International Energy Agency.

There were also questions on "the costs of different technologies" and "the assumption of perfect free rights by companies but not by individuals".

The group's key concern was "where the transparency of the Pines work, and in particular the property rights in the algo-

of the group pointed out that it does have strong connections to the credibility of the road map."

The advisory group also comments that the Pines model could be made publicly available "so that its results can be replicated by interested parties".

Stavros Giannakopoulos, an associate from the National Technical University of Athens who built the Pines model, told the Financial Times he agreed that "transparency" was important and would not mind if some of the model's workings were made public. "We will be more than willing to discuss it."

Independent parties cannot replicate the results because the model is private property

claims and detailed worked workings of the model", says the report, which is marked "Top Secret".

"The model remains the private property of the National Technical University of Athens" it says.

"The consequence is that independent parties cannot replicate the results. This is a commercial matter for the Commission, but members

A spokeswoman for the energy commissioner, Günther Verbraut, said she could not comment on an unpublished document. The final version of the advisory group's report would be released with the energy road map next month.

Peter Capros has been an energy consultant for many years and has held positions as bodies meeting from Brussels energy inspectors in the country's Public Power Corporation.



European Commission

Sensitivity auditing in pills (5): Aim for transparency;



“Experts have “raised a host of questions” about how the European Commission’s use of a **non-transparent model** could affect the energy review, according to a leaked report by energy specialists chosen by Brussels to advise on the forthcoming “Energy Roadmap to 2050”, FT November 6, 2011

Sensitivity auditing in pills (5): Aim for transparency;



“The credibility of a European energy review has been cast into doubt by experts who point out that long-term plans to cut carbon emissions are based on **an economic model owned by a single Greek university** that cannot be independently scrutinised.”

Solution: → A new model is developed at JRC to internalize the process

Sensitivity auditing in pills (5): Aim for transparency;

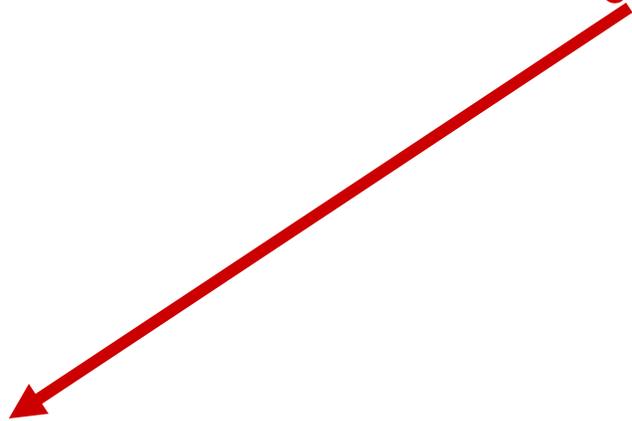
Reproducibility

a necessary
condition for



Transparency

a necessary
condition for



Legitimacy

of knowledge & power, see Lyotard, J.-F., 1979, La Condition postmoderne. Rapport sur le savoir, Paris : Minuit, p.19-20)

[models should be made available to a third party so that it can] **use the same data, computer model or statistical methods to replicate the analytic results reported in the original study.**

[...] **The more important benefit of transparency is that the public will be able to assess how much an agency's analytic result hinges on the specific analytic choices made by the agency.**

Friday, February 22, 2002

Graphic - Federal Register, Part IX

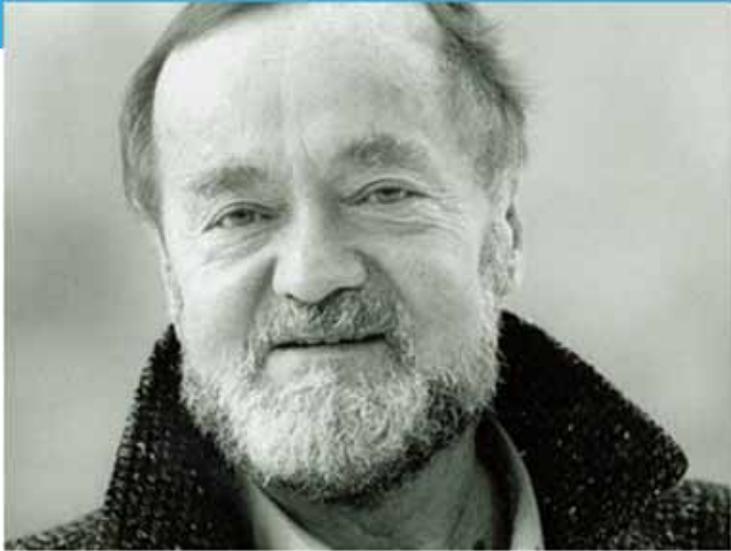
Office of Management and Budget

Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by Federal Agencies; Notice; Republication

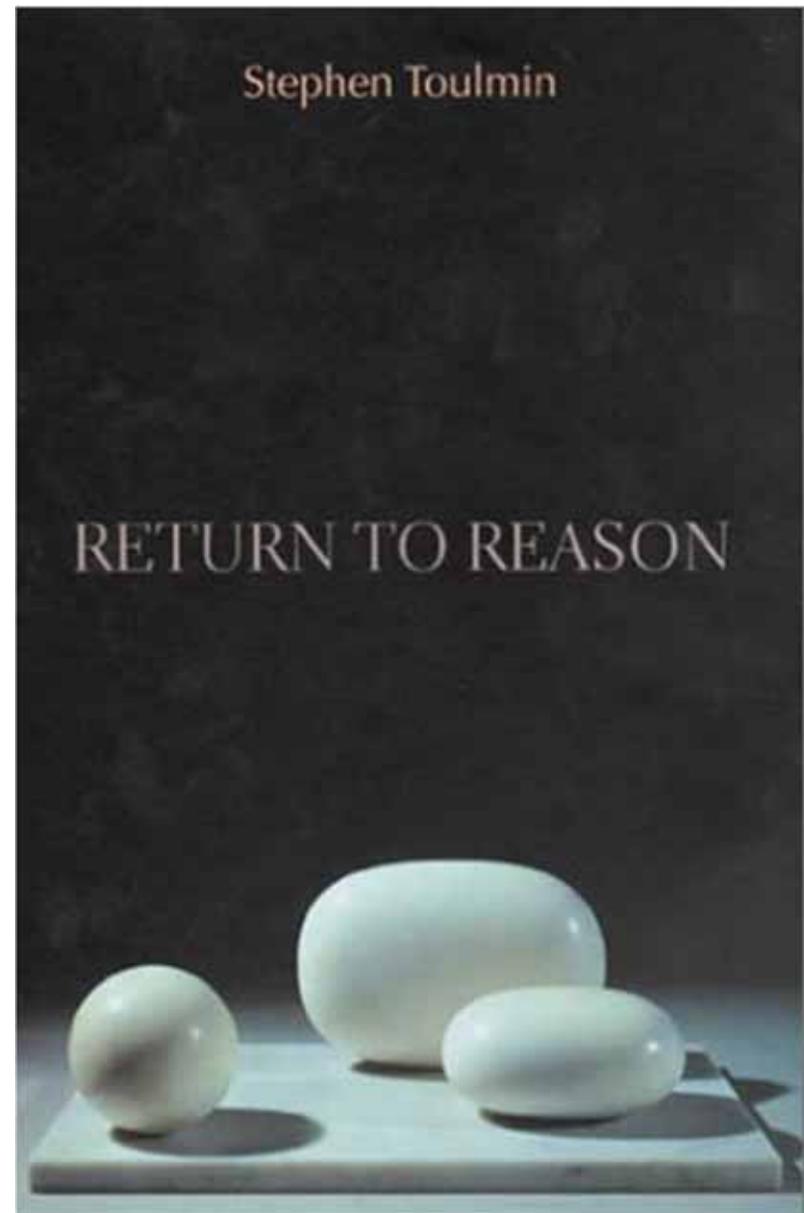
<http://www.whitehouse.gov/omb/inforeg/>



Sensitivity auditing in pills (6): Do the right sums;



Do the sum right
Versus
Do the right sums
(*Stephen Toulmin*)
A plea for
reasonableness versus
rationality



In sensitivity auditing:

Type I error: assessing as important a non important factor

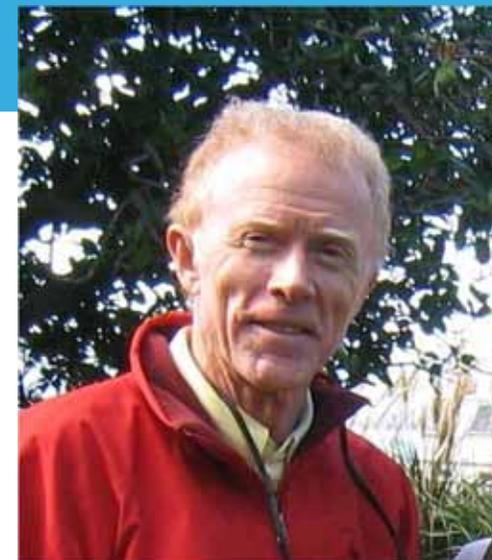
Type II: assessing as non important an important factor

Type III: analysing the wrong problem

The spectre of type III errors:

= **answering the wrong question**

Peter Kennedy's II commandment of applied econometrics: 'Thou shall answer the right question', Kennedy 2007



Sensitivity auditing in pills (7): Explore diligently the space of the assumptions;



Recommendation wasted on the SAMO's suspects!

Sam Savage's The flaw of averages

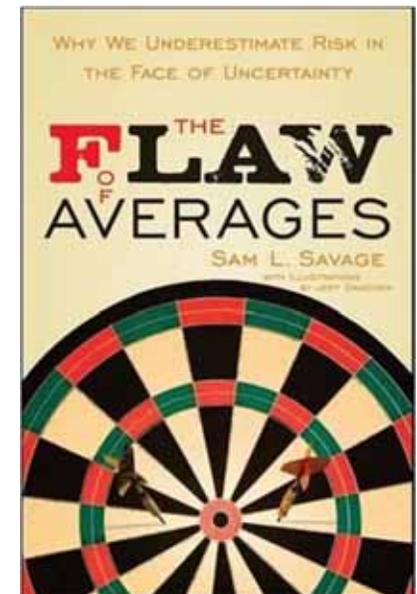
How coupled stairs are shaken in most of available literature



How to shake coupled stairs



See: Saltelli, A., Annoni, P., How to avoid a perfunctory sensitivity analysis, *Environmental Modeling and Software* (2010), 25, 1508-1517.



The rules imply a participatory approach to model's screening:

[...] in a democracy local populations not only will, but also should, use the sciences in ways most suitable to them.

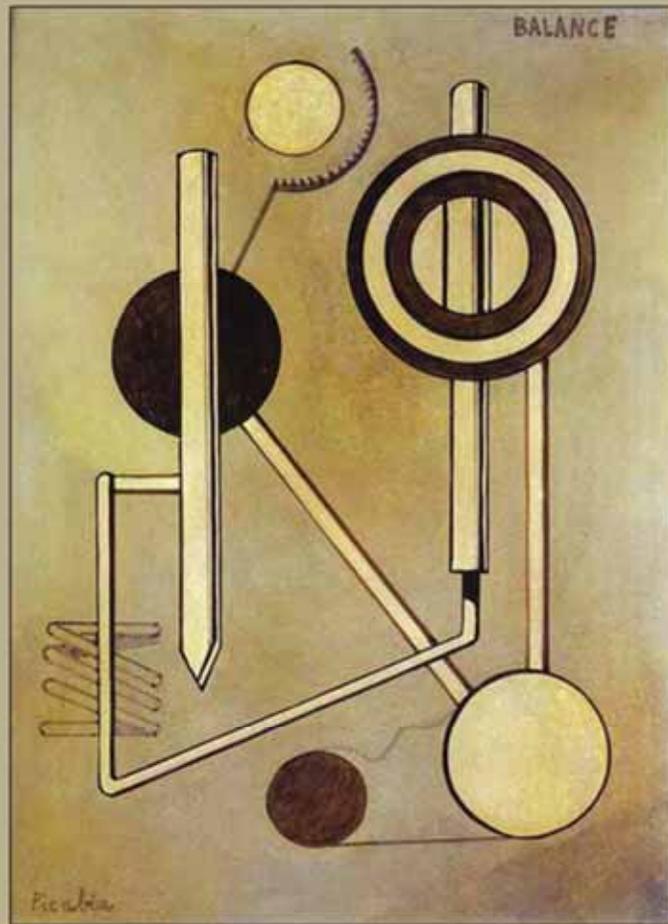
The objections that citizens do not have the expertise to judge scientific matters overlooks that important problems often lie across the boundaries of various sciences so that scientists within these sciences don't have the needed expertise either.

The rules imply a participatory approach to model's screening:

Moreover doubtful cases always produce experts from one side, experts for the other side, and experts in between. But the competence of the general public could be vastly improved by an education that exposes expert fallibility instead of acting as if it did not exist.

Paul Feyerabend, *Against Method*
(first published 1975),
Verso publisher 2010 edition.





New Edition
AGAINST METHOD
Paul Feyerabend
Introduced by Ian Hacking



European
Commission