Models: a state of exception

Andrea Saltelli

Oxford Martin School, November 20 2023
Launch of The Politics of Modelling

upf. BARCELONA SCHOOL OF MANAGEMENT

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UNIVERSITAS BERGENSIS

The Politics of Modelling

Numbers Between Science and Policy

Andrea Saltelli and Monica Di Fiore

"*The Politics of Modelling: Numbers between Science and Policy* is a breath of fresh air and a much-needed cautionary view of the ever-increasing dependence on mathematical modelling in ever-widening directions. The five aspects of modelling that should be 'minded' are a sensitive summary of factors that should be considered when evaluating any mathematical model."

ORRIN H. PILKEY, PROFESSOR, DUKE UNIVERSITY'S NICHOLAS SCHOOL OF THE ENVIRONMENT, CO-AUTHOR, WITH LINDA PILKEY-JARVIS, OF *USELESS ARITHMETIC: WHY ENVIRONMENTAL SCIENTISTS CAN'T PREDICT THE FUTURE*, COLUMBIA UNIVERSITY PRESS, WASHINGTON, DC, 2009

Where to find this talk: www.andreasaltelli.eu

Andrea Saltelli

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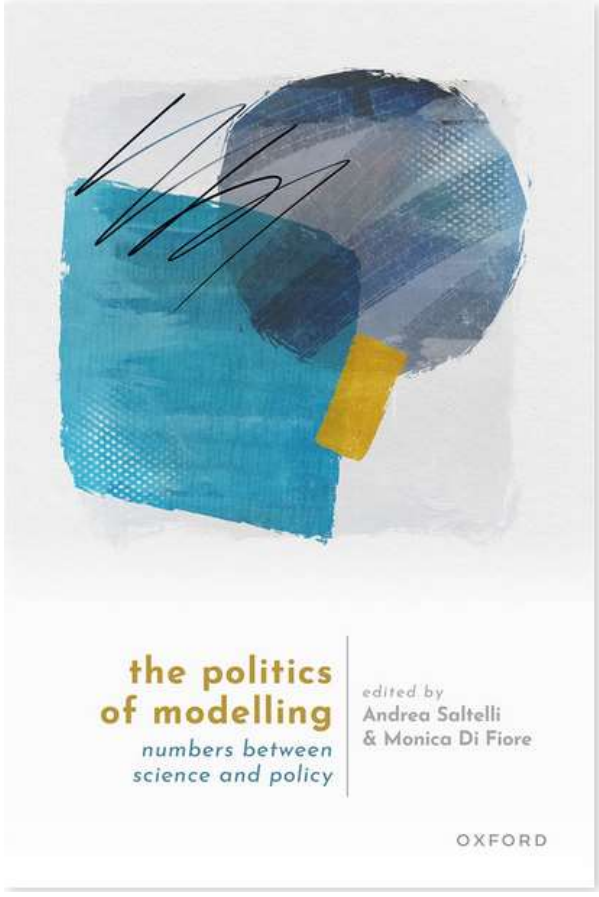
August 25 2023: The politics of modelling is out!



Praise for the volume

"A long awaited examination of the role —and obligation —of modeling."
Nassim Nicholas Taleb , Distinguished Professor of Risk Engineering, NYU Tandon School of Engineering. Author, of the 5 -volume series Incerto.

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"A breath of fresh air and a much needed cautionary view of the ever-widening dependence on mathematical modeling."
Orrin H. Pilkey, Professor at Duke University's Nicholas School of the Environment, co-author with Linda Pilkey-Jarvis of Useless Arithmetic: Why Environmental Scientists Can't Predict the Future, Columbia University Press 2009.

***

"The methods by which power insinuates itself

Mastodon Toots by
@AndreaSaltelli

AndreaSaltelli
2023/8/28 11:24
August 26 Podcast (16m) - interview for ABC NET RADIO, AUS: Assumptions and consequences: the politics of modelling, Guests: Ehsan Nabavi and Andrea Saltelli, Producer - Chris Bullock.

abc.net.au/listen/programs/sun

View on mstdn.social

Do we live immersed in fantastic numbers?

OPINION

PETER COY

‘The Most Important Number You’ve Never Heard Of’

Sept. 17, 2021

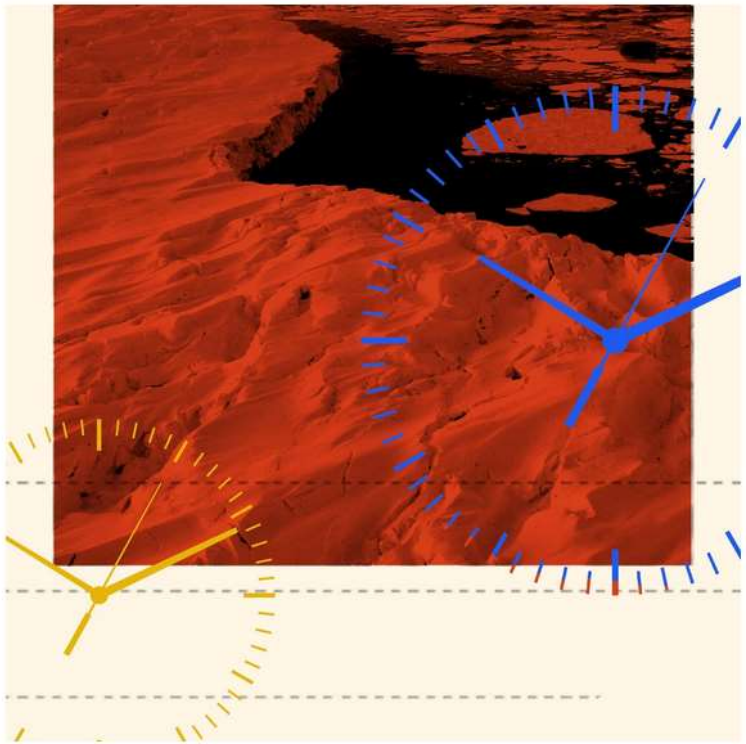


Illustration by Arsh Raziuddin, The New York Times

“social cost of carbon:

=$56 a ton on average at a 3 percent discount rate

=$171 a ton on average at a 2 percent discount rate”

The New York Times

nature climate change

Article

https://doi.org/10.1038/s41558-023-01680-x

Social cost of carbon estimates have increased over time

Richard S. J. Tol

Received: 3 August 2022

Accepted: 23 April 2023

Published online: 15 May 2023

Check for updates

Mathematical models predicting the damage in dollars from hurricanes and draughts up to the year 2300

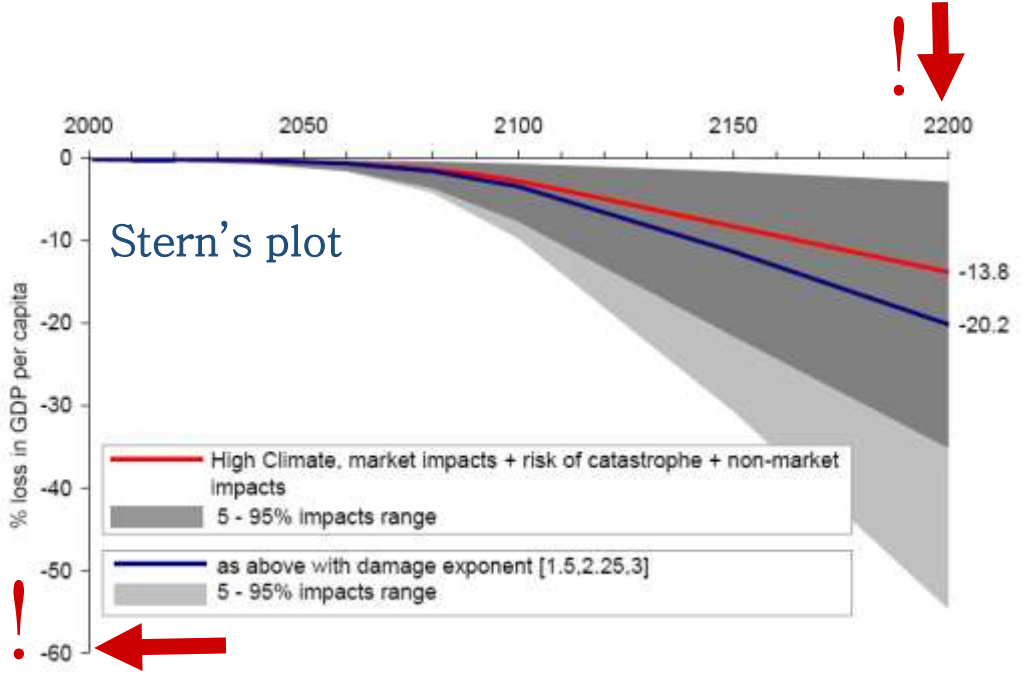
RESOURCES *for the* FUTURE

The Social Cost of Carbon: Advances in Long-Term Probabilistic Projections of Population, GDP, Emissions, and Discount Rates

Kevin Rennert, Brian C. Prest, William A. Pizer, Richard G. Newell, David Anthoff, Cora Kingdon, Lisa Rennels, Roger Cooke, Adrian E. Raftery, Hana Ševčíková, and Frank Errickson

Working Paper 21-28
October 2021

The Stern-Nordhaus controversy; a reverse engineering the model: ➔ uncertainty is too large to take decisions ➔ both Stern and Nordhaus are wrong



Global Environmental Change 20 (2010) 298–302

Contents lists available at ScienceDirect

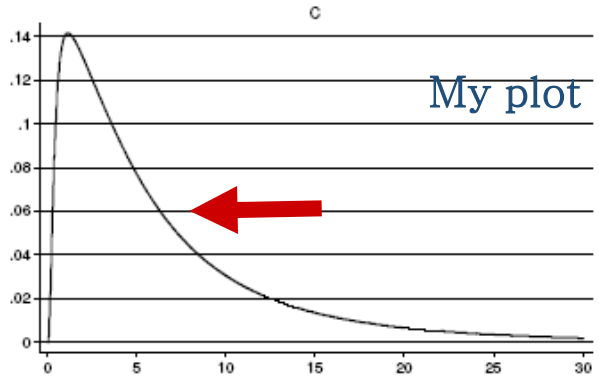
Global Environmental Change

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

Sensitivity analysis didn't help. A practitioner's critique of the Stern review

Andrea Saltelli *, Beatrice D'Hombres

Joint Research Centre, Institute for the Protection and Security of the Citizen, Ispra, Italy



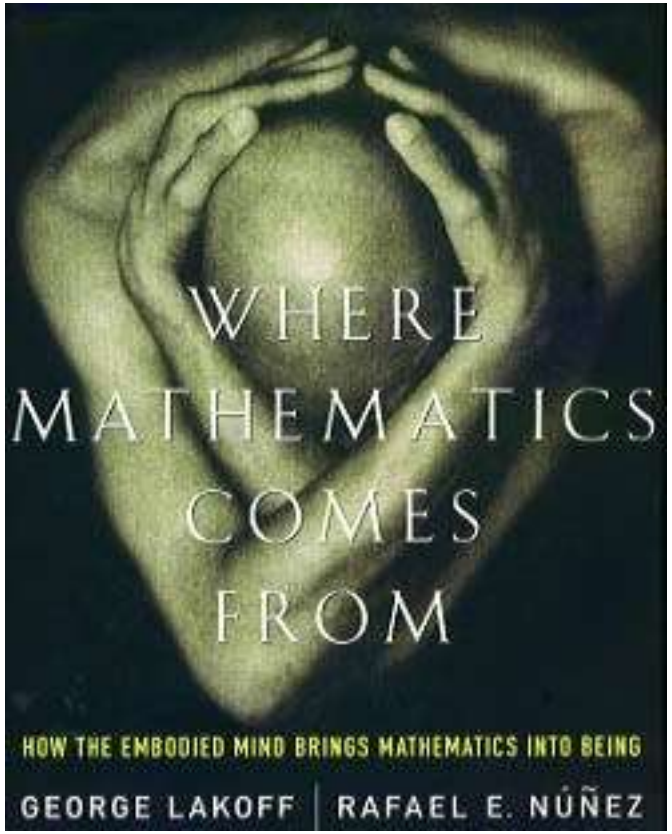
Why models live in a state of exception

Unparalleled palette of methods / epistemic authority / invisible models

Models dispose of a unique repertoire of methods.

Are endowed with unparallel epistemic authority that originates from mathematics, the highest ranked among scientific disciplines (Davies & Hersh, 1986), considered by the fathers of the scientific revolution the language of God himself, up to the point that reconnecting it to human experience is up today an unfinished project (Lakoff & Núñez, 2001).

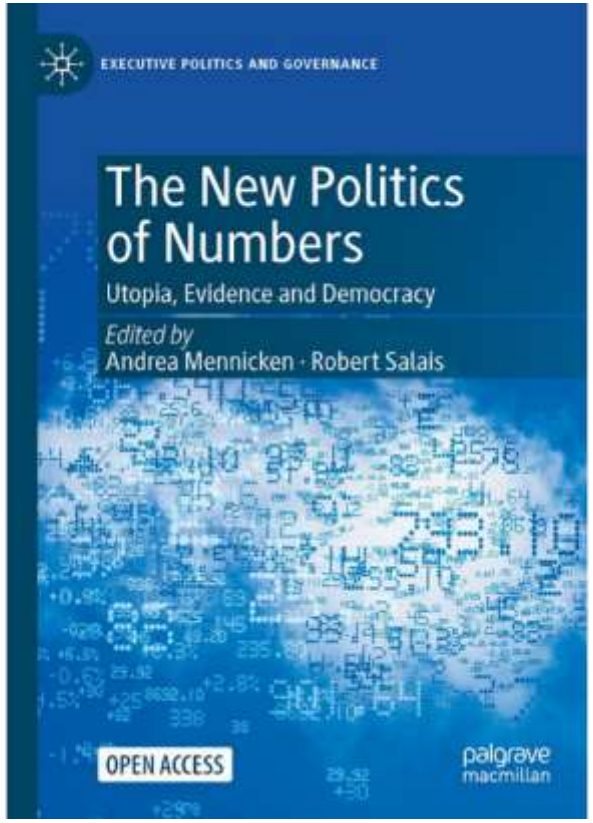
Lack of agreed standards. Modelling as art/craft (Rosen).



Why models live in a state of exception

Mathematical models escape sociology of quantification

Statistics has a much deeper connection to sociology, and to sociology of quantification in particular (Desrosières, 1998; Mennicken & Espeland, 2019; Mennicken & Salais, 2022) than mathematical modelling. Sociology of quantification is more concerned with statistical indicators than it is with modelling, be it that impact assessment tools such as cost benefit analysis are a classic theme in this discipline (Porter, 1995) and that the field is not entirely deserted (Morgan & Morrison, 1999).

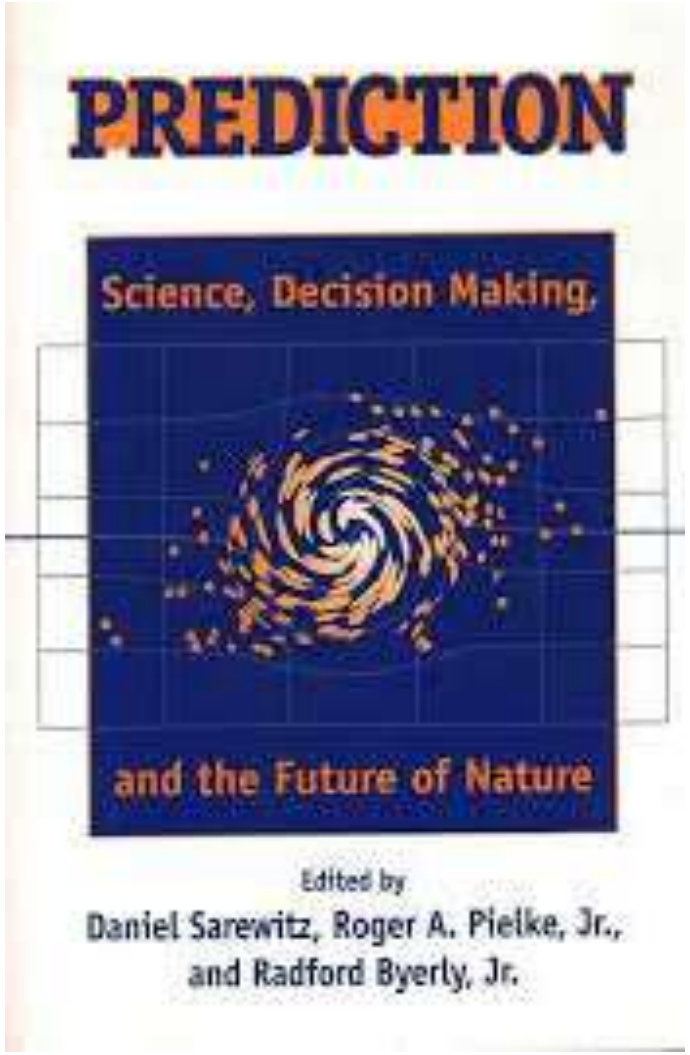


Why models live in a state of exception

Models cannot be falsified

Models do not meet classic (Popperian) criteria of scientificity. Oreskes (2000) has observed that model-based predictions tend to be treated like logical inferences in a classic hypothetic-deductive model.

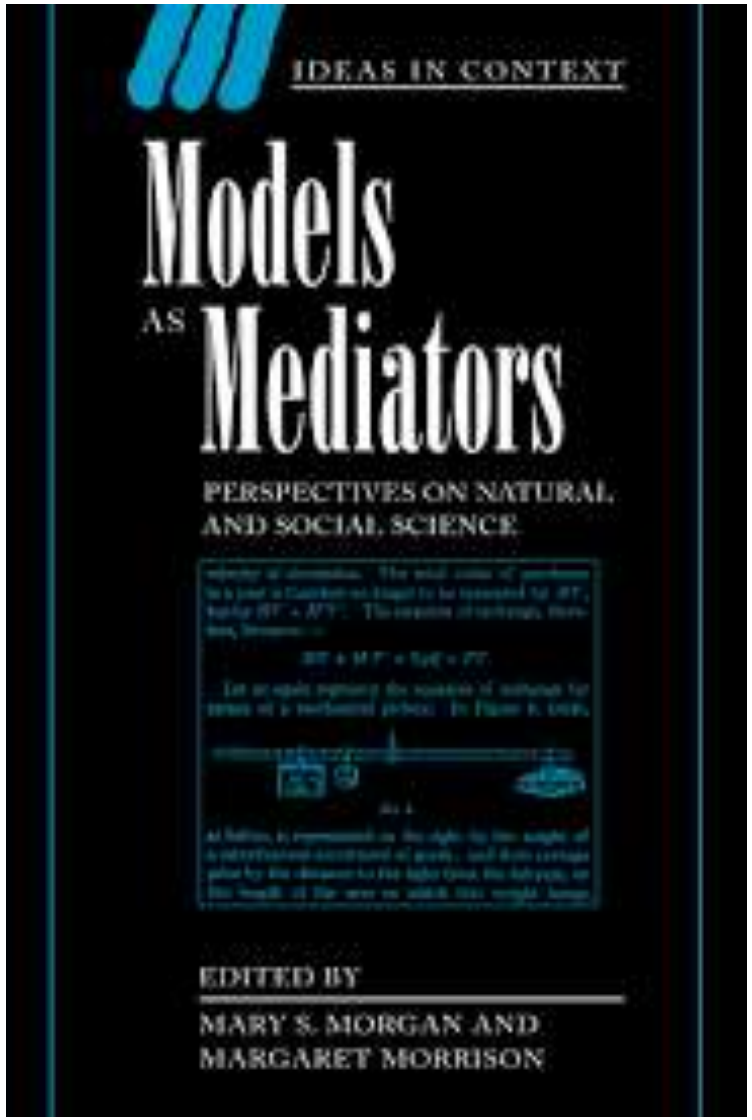
The relation between models and data is often more symbiotic than adversarial. In climate studies this relation has been defined as 'incestuous', exactly to make the point that in modelling studies using data to prove a model wrong may not be straightforward (Edwards, 1999).



Why models live in a state of exception

Models as the most effective mediators between theory and reality

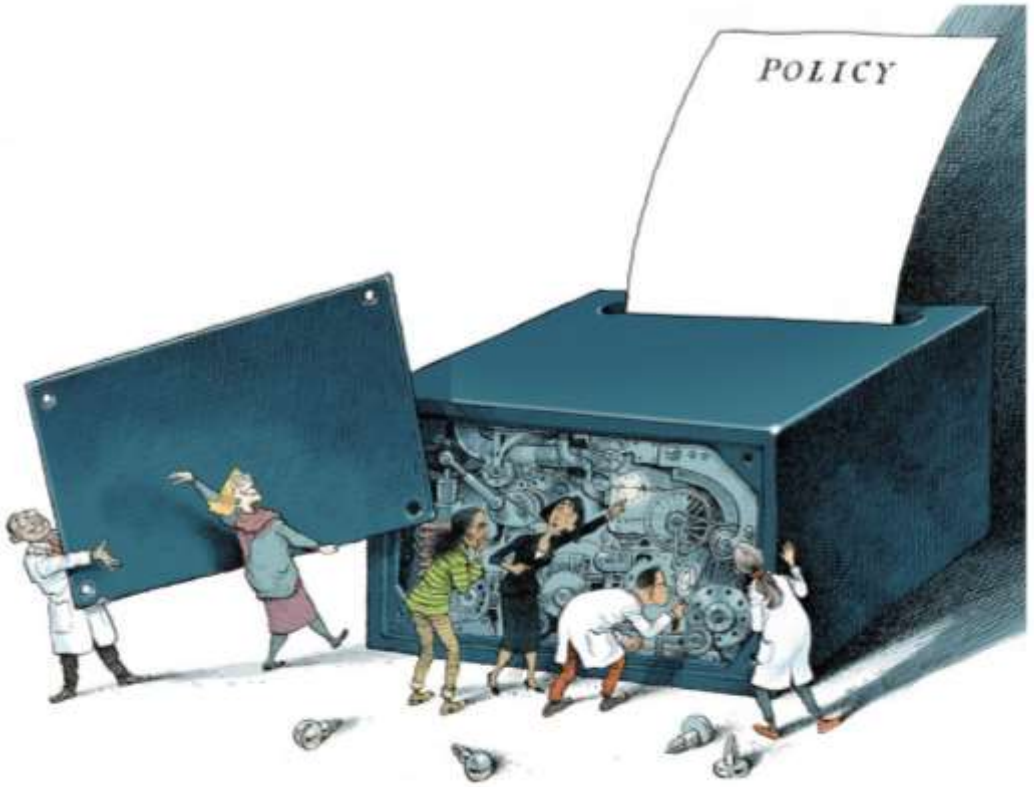
Due to their independence from both theory and the world, models are understood as “mediators”, instruments that act and describe things in ways that advance understanding thanks to the tacit craftsmanship of scientists (Morgan & Morrison 1999). They are even regarded as metaphors that help us understand how we see the world: they express “in an indirect form our presuppositions about the problem and its possible solutions”, and can thus assist in an extended community of peers to deliberate about social or ecological problems (Ravetz 2023).



Consequences descending from state of exception

Gross asymmetry developers/ users

Models operate in a context of asymmetry of knowledge between developers and users (Jakeman *et al.*, 2006)). One can contest this claim referring to ‘black boxes’ used in other families of quantification, typically algorithms or statistics. We contend that this asymmetry is especially of concern for large mathematical models (Puy et al., 2022).



Nature 582: 482–84, 2020

Consequences descending from state of exception

Ritual use

Models lend themselves to ritual use. An important analogy between statistical and mathematical modelling is in the 'ritual' use of methods. Existence of rituals in statistics has been discussed extensively by Gigerenzer (Gigerenzer, 2018; Gigerenzer & Marewski, 2015).

An anecdote by Kenneth Arrow. - production of month-ahead weather forecasts

"... The commanding general is well aware that the forecasts are no good. However, he needs them for planning purposes".

See also Niklas Luhmann 'deparadoxification' (Moeller, 2006); 'We follow the science' during COVID-19

Consequences descending from state of exception

Models and trans-science

Models lend themselves to trans-science (Weinberg, 1972).

> How many people will drive autonomous cars by 2050. How will the spread of malaria change if global temperature increases by 1.5ºC. What will be the cost of CO2 averaged over the next three centuries

Model as Borges' (1946) one-to-one map of the empire

Consequences descending from state of exception

Have the strongest grip in policy

Models have their own political economy - economicism, solutionism, reductionism, transforming of the qualitative into quantitative (Stirling, 2023a, 2023b).

The percentage of non-reproducible studies in the field of clinical medical research could reach 85% (Chalmers and Glasziou, 2009). Nobody can provide a similar figure for mathematical modelling.

‘Navigating the political’ (van Beek *et al.* 2022)

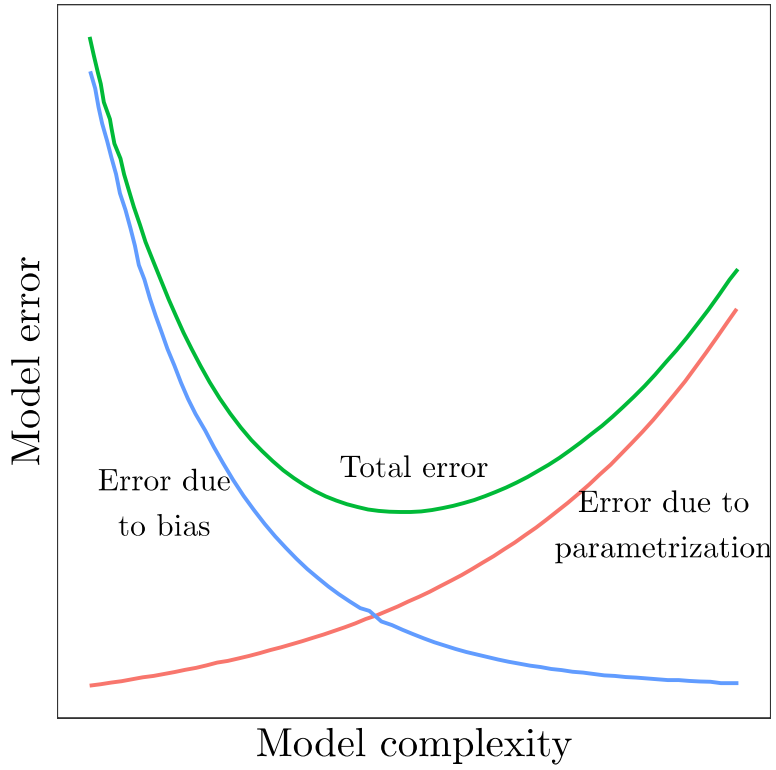
Acting as chameleons [jumping across contexts, Pfleiderer (2020)].

National Geographic

Consequences descending from state of exception

Models are vulnerable to modelling hubris

The conjecture of O'Neill (1971), see also Turner & Gardner (2015), posits that too simple a model may miss important features of the system, and thus lead to systematic error, while a too complex one – burdened by an excessive number of estimated parameters, may lead to a greater imprecision due the error propagation.



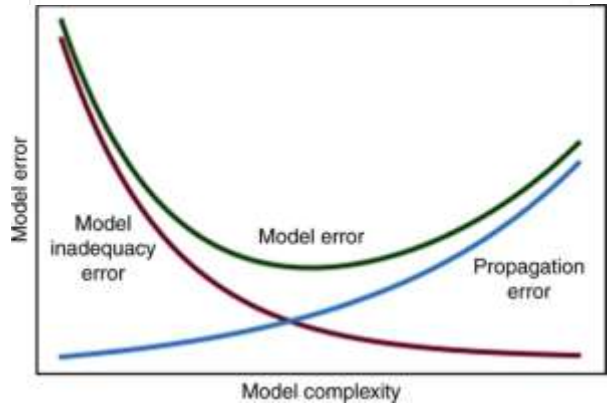
Solutions to resolve the state of exception

Modelling of the modelling process (Sensitivity analysis, sensitivity auditing for de- and re-construction, on the example of statactivism)

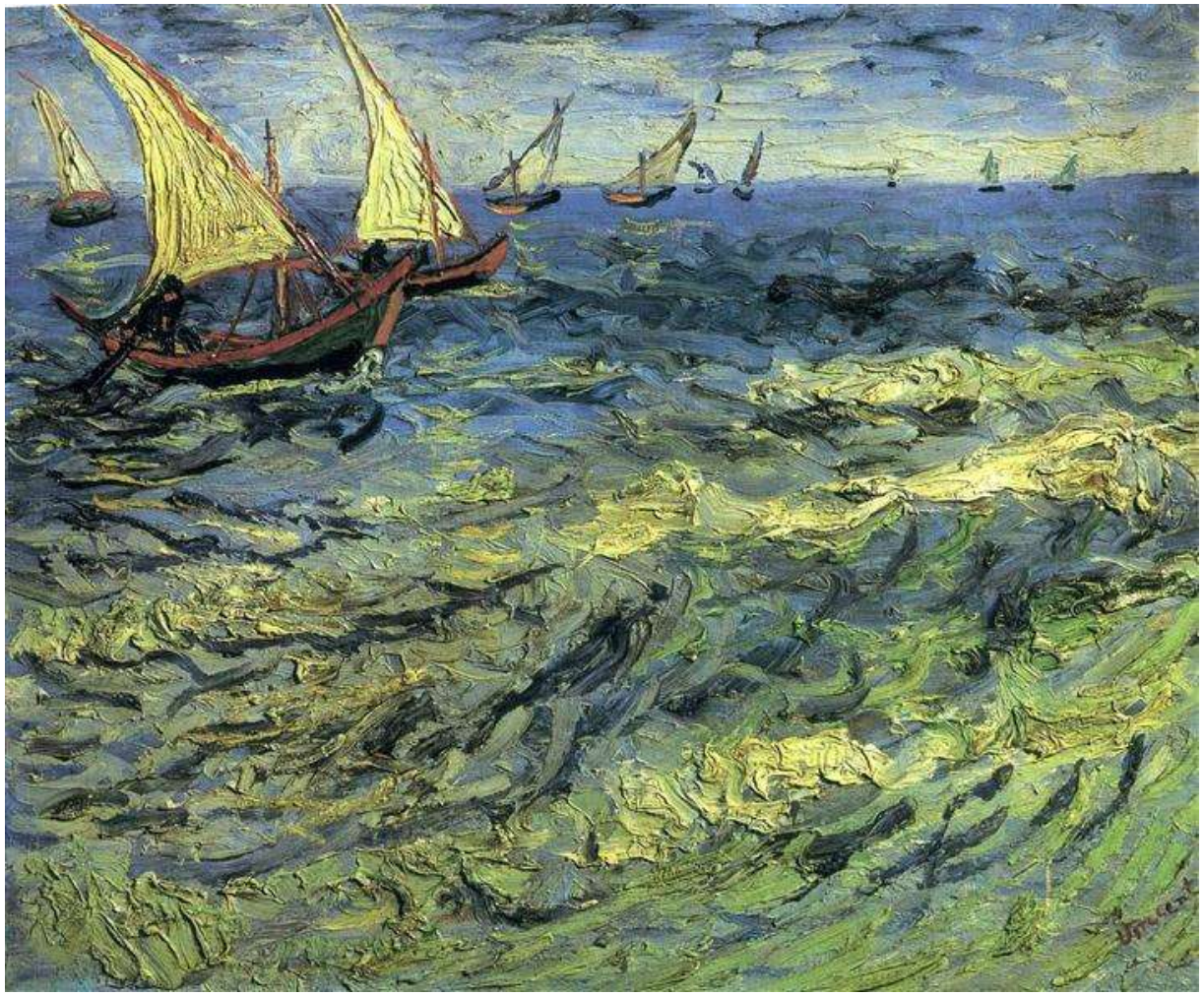
➔ retrace what was assumed

➔ check the level of complexity

…



Why is all this important? Fishing expeditions and forking paths …



Jorge Luis Borges
(1899-1986)

Taking different narratives within the same novel like Ts'ui Pên

The garden of forking paths: Why multiple comparisons can be a problem, even when there is no "fishing expedition" or "p-hacking" and the research hypothesis was posited ahead of time*

Andrew Gelman† and Eric Loken‡

14 Nov 2013

The garden of forking paths: Why multiple comparisons can be a problem, even when there is no "fishing expedition" or "p-hacking" and the research hypothesis was posited ahead of time*

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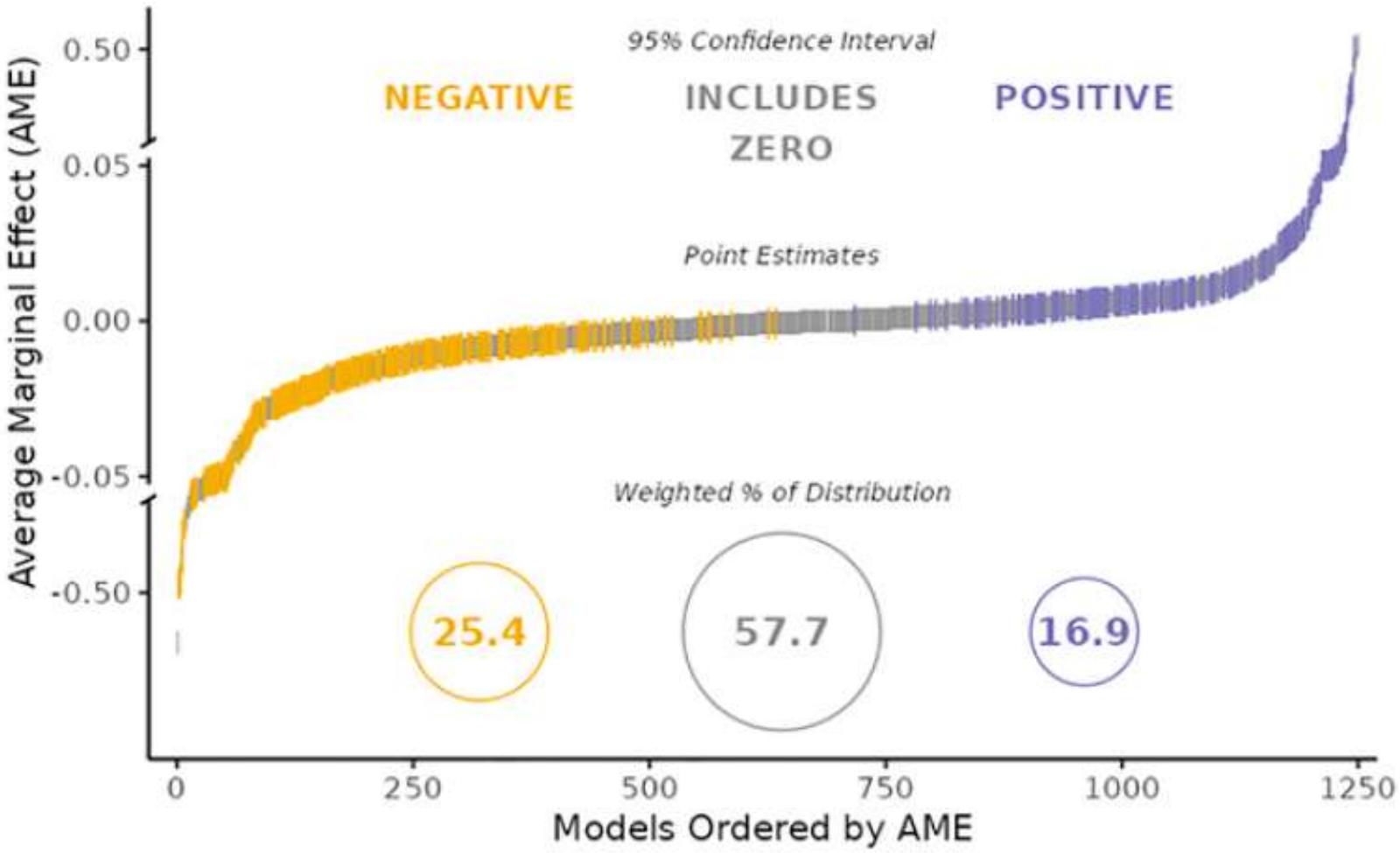
Why this matters?

PNAS RESEARCH ARTICLE | SOCIAL SCIENCES OPEN

Observing many researchers using the same data and hypothesis reveals a hidden universe of uncertainty

Edited by Douglas Massey, Princeton University, Princeton, NJ; received March 6, 2022; accepted August 22, 2022



"Will different researchers [73 teams] converge on similar findings when analyzing the same data?

…teams' results varied greatly, ranging from large negative to large positive effects"
(Breznau et al. 2022)

…

➔Avoid “quantifying at all costs”, expose ‘funny numbers’

Culture Unbound
Journal of Current Cultural Research

Funny Numbers

By Theodore M. Porter

Solutions to resolve the state of exception

Complexity of interpretation rather than complexity of construction

A finite elements model of an engine, a bridge, or of a human hearth, cannot possibly fall in the category of parsimonious. On the other hand, we like to recall when the simplest of models led to an informative and participated debate. Thus was the I=PAT model, whereby the human impact on the environment is driven by population (P) times affluence (A) and technology (T). In the seventies, this model allowed a debate on the limit of growth that continues to the present day (Ehrlich & Holdren, 1971).

Solutions to resolve the state of exception

Reciprocal domestication between models and society

The COVID pandemic of 2020 has dramatically increased the visibility of mathematical modelling, accompanied by a considerable level of controversy, either for the deficiencies of the model, or because of disagreement about the policies (Pielke, 2020; Rhodes & Lancaster, 2020). From ‘Flattening the curve’ to … distrust?

Journal of Evaluation in Clinical Practice
International Journal of Public Health Policy and Health Services Research

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COMMENTARY | Open Access

What did COVID-19 really teach us about science, evidence and society?

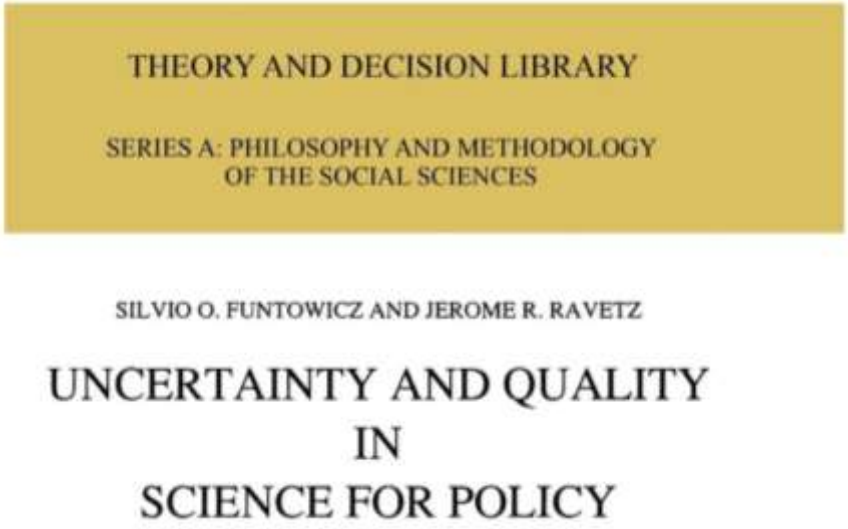
Andrea Saltelli, Joachim P. Sturmberg, Daniel Sarewitz, John P. A. Ioannidis

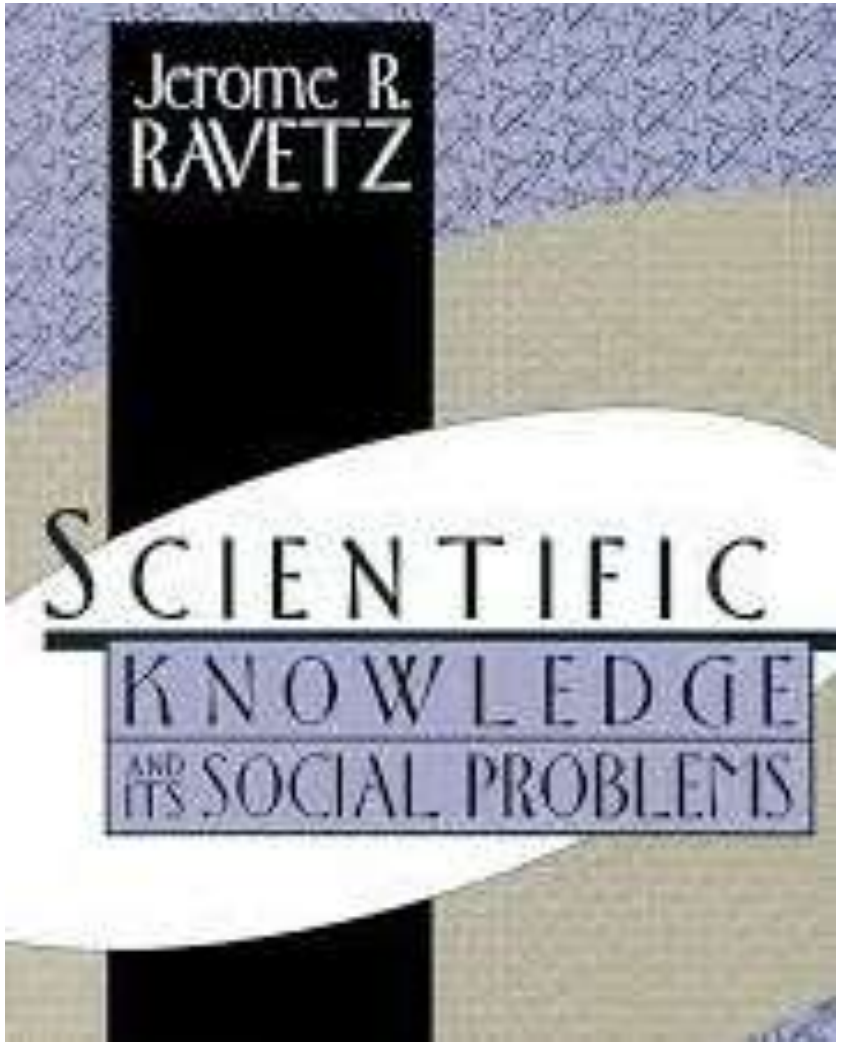
First published: 06 June 2023 | https://doi.org/10.1111/jep.13876

Solutions to resolve the state of exception

Defog the mathematics of uncertainty

An important issue in mathematical modelling is the management of uncertainty. Uncertainty quantification should be at the heart of the scientific method, and *a fortiori* in the use of science for policy.





Conclusions

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Summary

Models live in a state of exception. Their versatility, the variety of methods, the impossibility of their falsification and their epistemic authority permit mathematical models to escape, better than other instances of quantification, the lenses of sociology and other humanistic disciplines. This endows models with a pretence of neutrality that perpetuates the asymmetry between developers and users. Models are thus underexplored and overinterpreted. While retaining a firm grip on policy, they reinforce entrenched cultures of transforming political issues into technical ones.

To combat this state of exception one should start discussing the reproducibility of models, foster complexity of interpretation rather than complexity of construction, and encourage forms of activism following the French statactivists, aimed to achieve a reciprocal domestication between models and society. To breach the solitude of modellers, more actors should engage in practices such as assumption hunting and modelling of the modelling process.

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