



# Is there need for an ethics of quantification?

Andrea Saltelli



Open Evidence Research, Open University of Catalonia



Virtual 'Library Talk' organised by DG for Research and  
Innovation (RTD.A.1),  
Wednesday December 2, 2020

# Books, people, and quantification



# Occasion for the present talk



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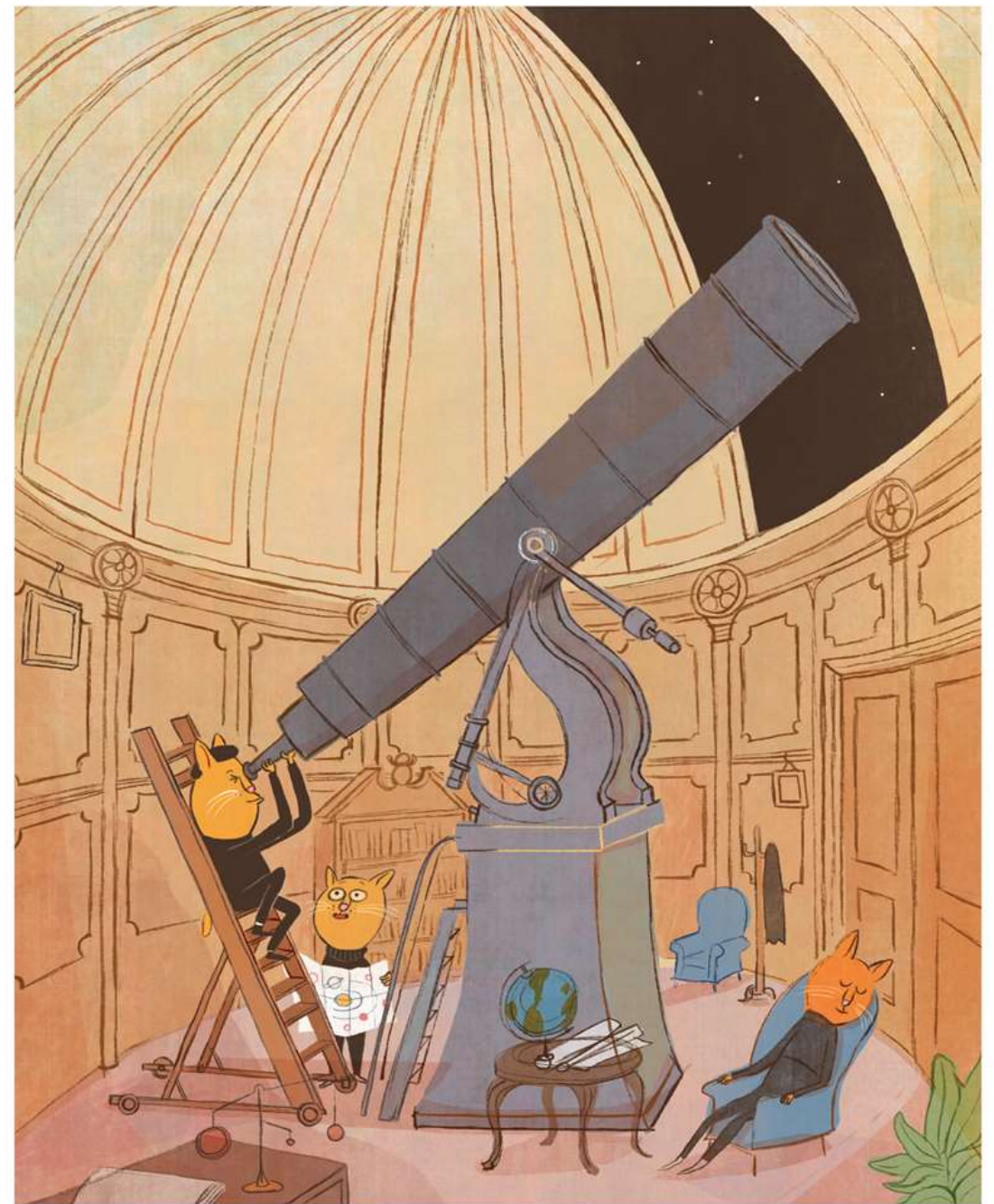
COURSE

## Numbers for policy: Practical problems in quantification (Postponed)

Take home point:

Need to rethink the way  
we use and produce  
visible and invisible  
numbers.

An observatory?



Source: Tor Freeman, <http://tormalore.blogspot.com/>

Numbers, visible and invisible...



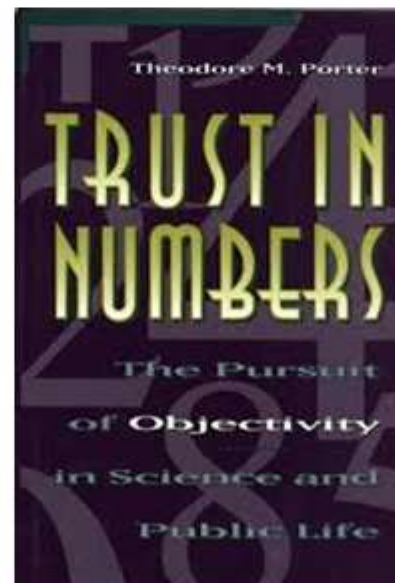
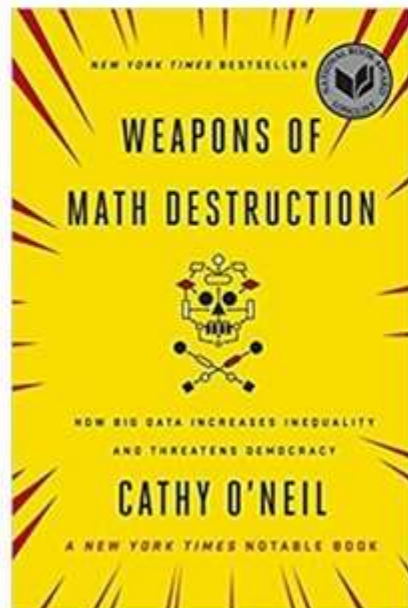
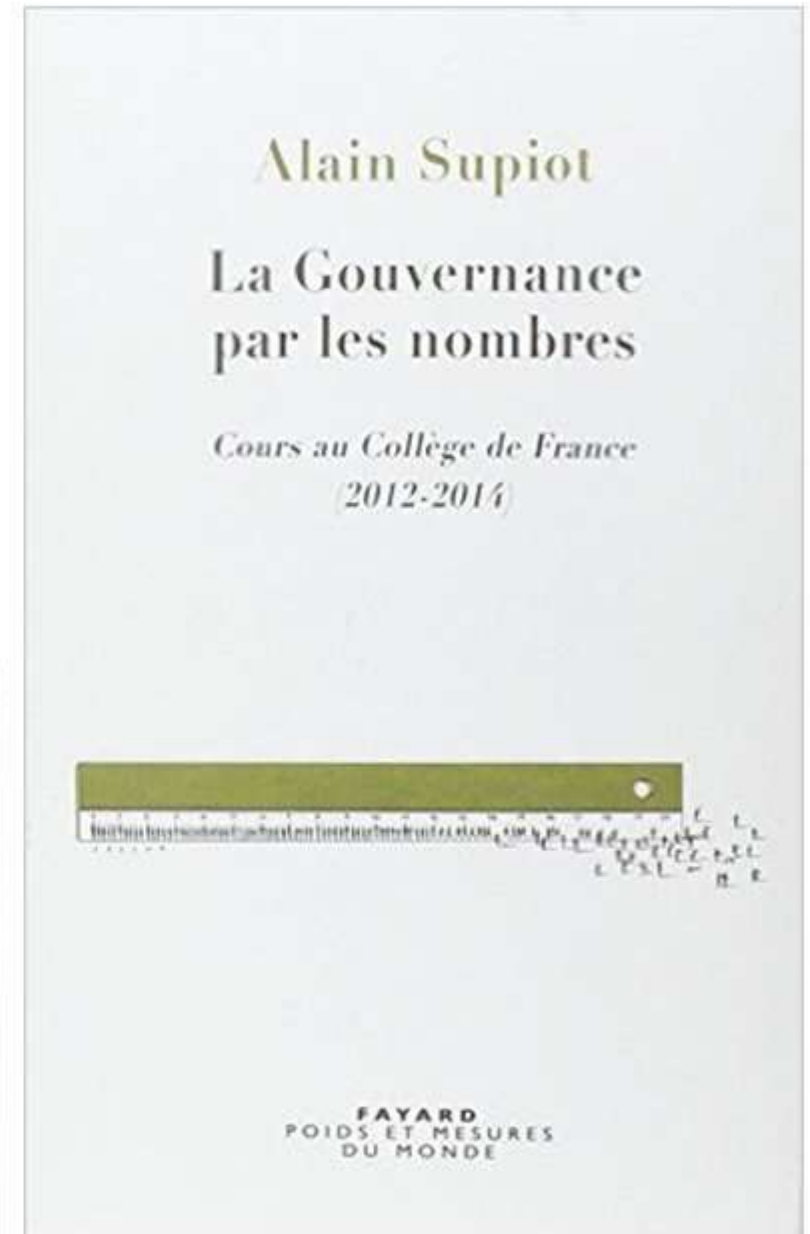
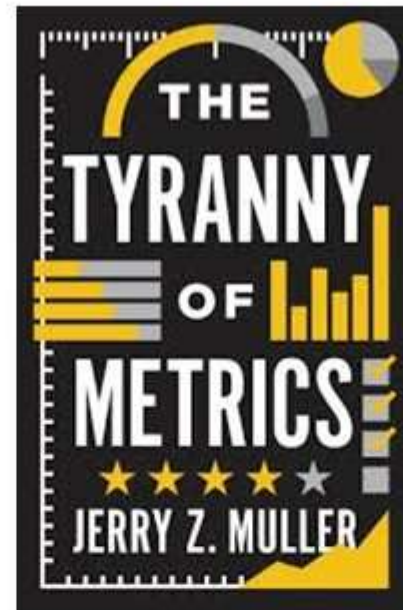
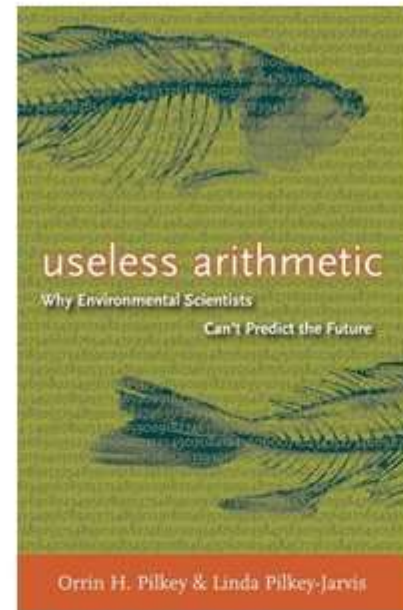
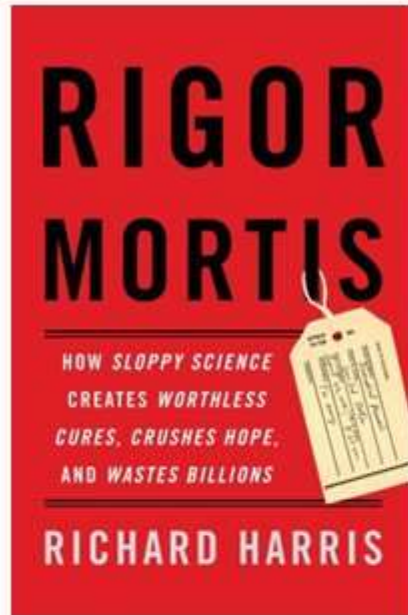
“what qualities are specific to rankings, or indicators, or models, or algorithms?”



Elizabeth  
Popp Berman

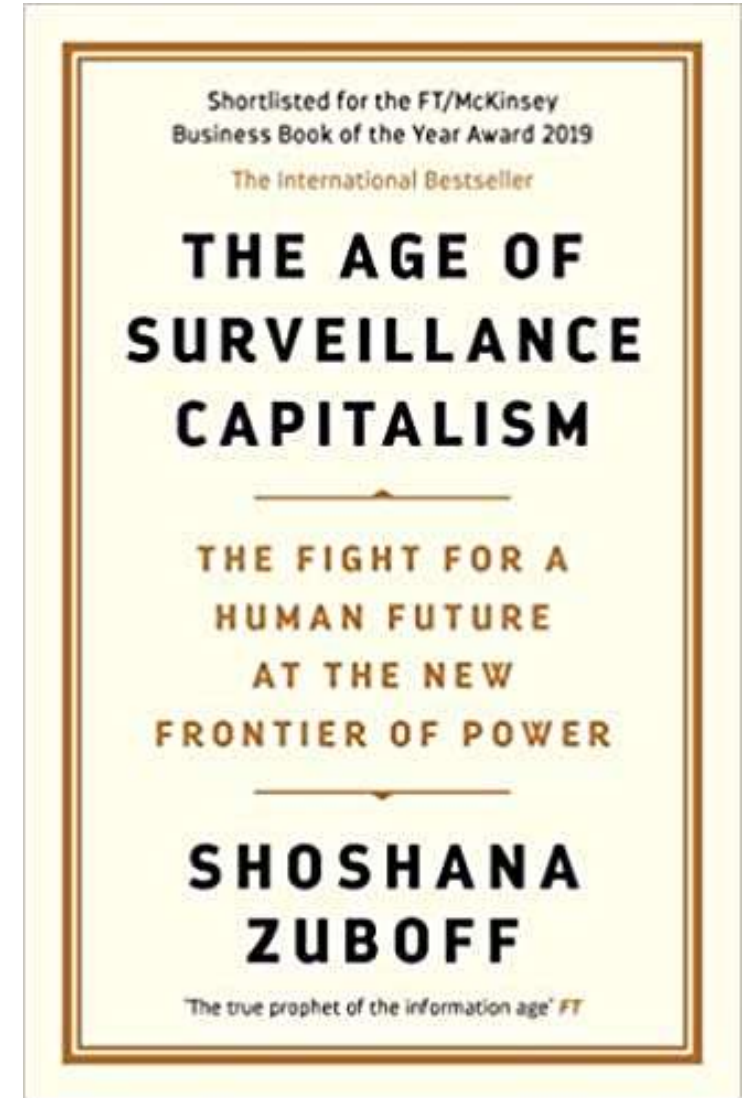
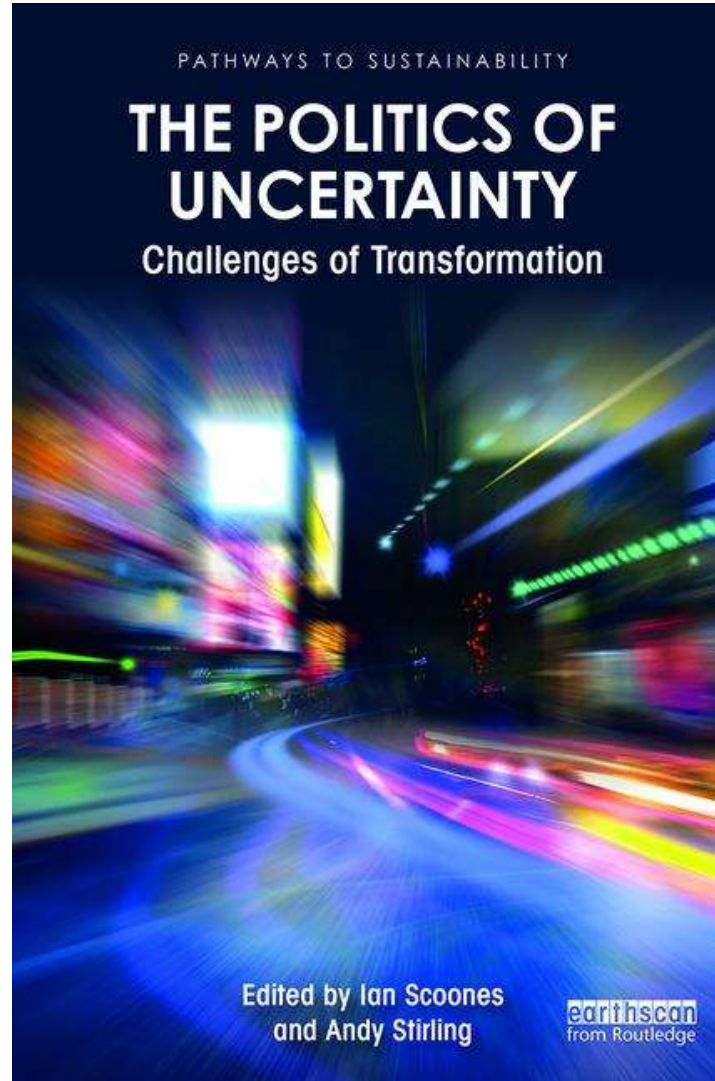
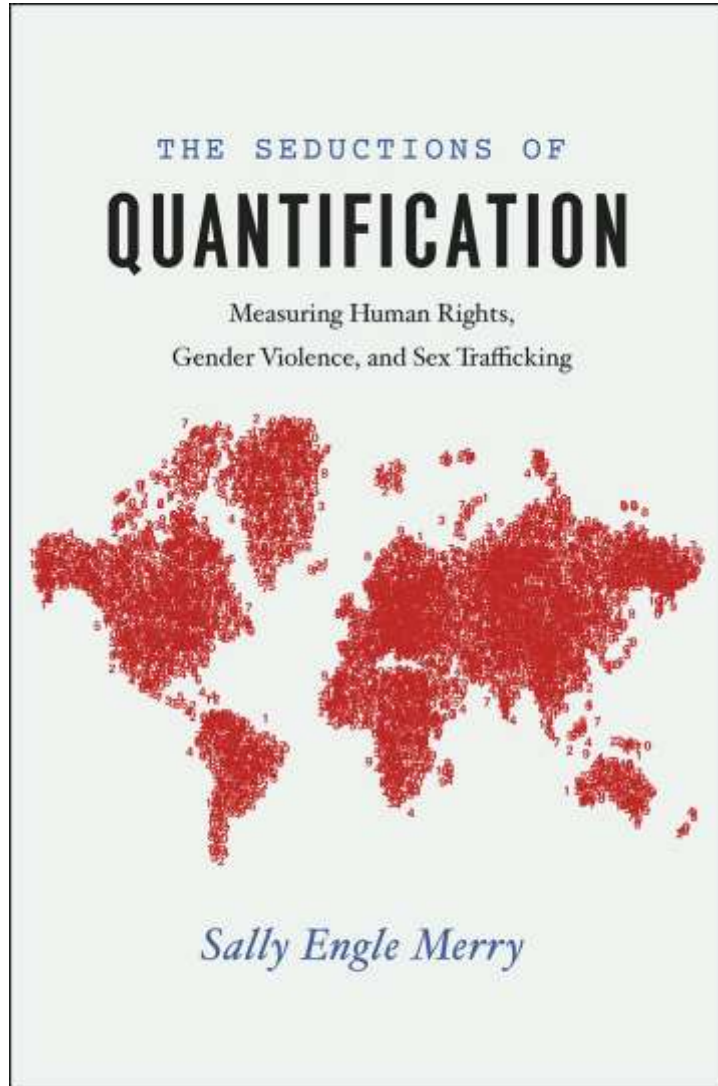
E. Popp Berman and D. Hirschman, *The Sociology of Quantification*: Where Are We Now?, *Contemp. Sociol.*, vol. in press, 2017.

# Algorithms, models, metrics, statistics...





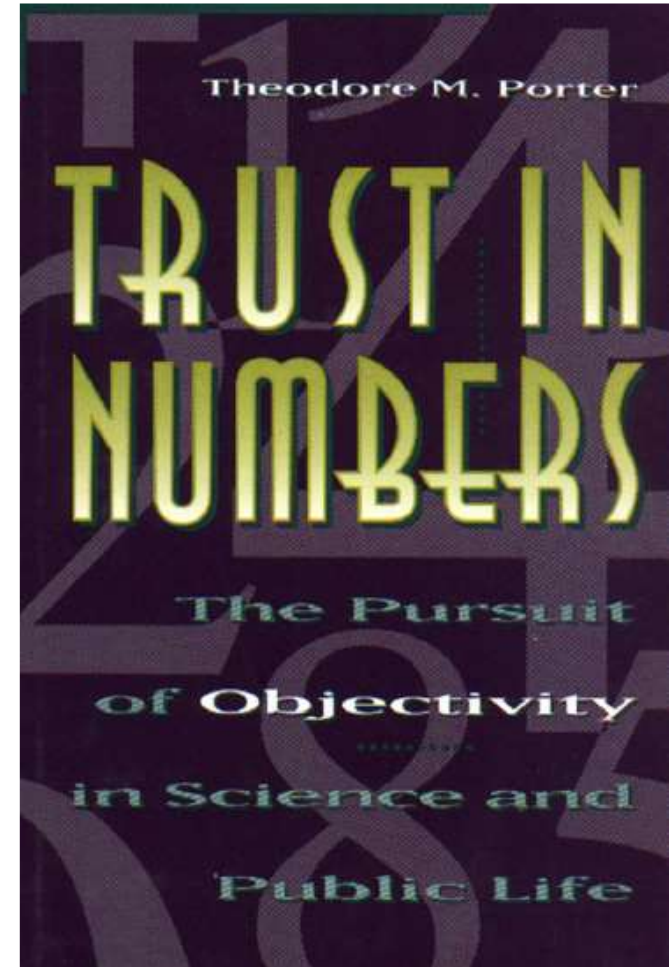
# Algorithms, models, metrics, statistics...





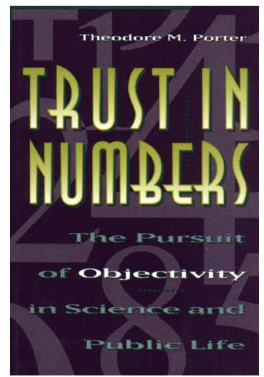


Theodor  
M. Porter

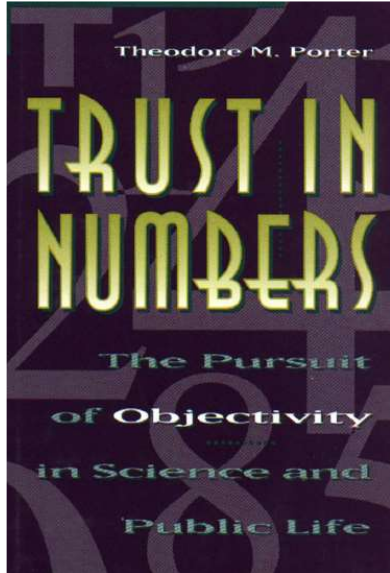


Theodore M. Porter, *Trust in Numbers,  
The Pursuit of Objectivity in Science and Public Life*, Princeton 1995

p. 8: “The appeal of numbers is especially compelling to bureaucratic officials who lack the mandate of a popular election, or divine right.



A decision made by the numbers (or by explicit rules of some other sort) has at least the appearance of being fair and impersonal.”

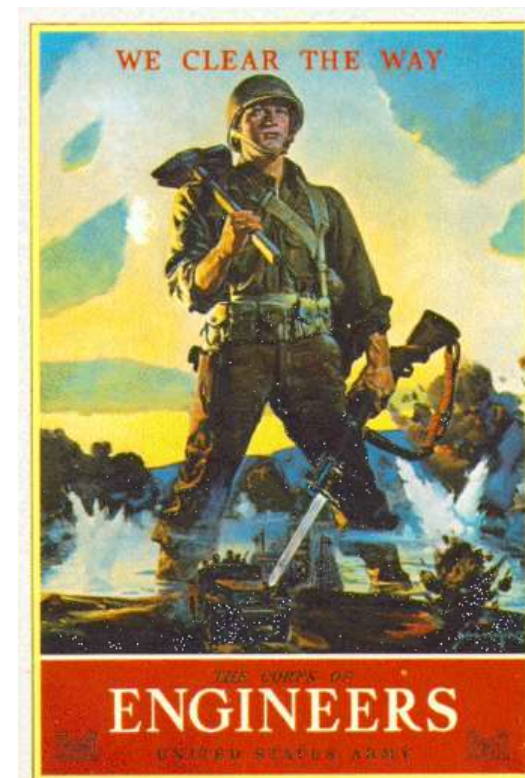
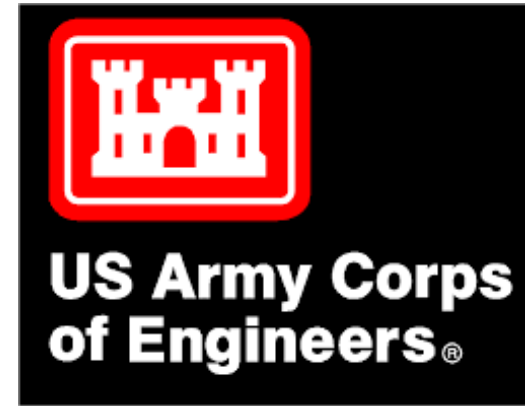


p. 8: “Scientific objectivity thus provides an answer to a moral demand for impartiality and fairness.

Quantification is a way of making decisions without seeming to decide.

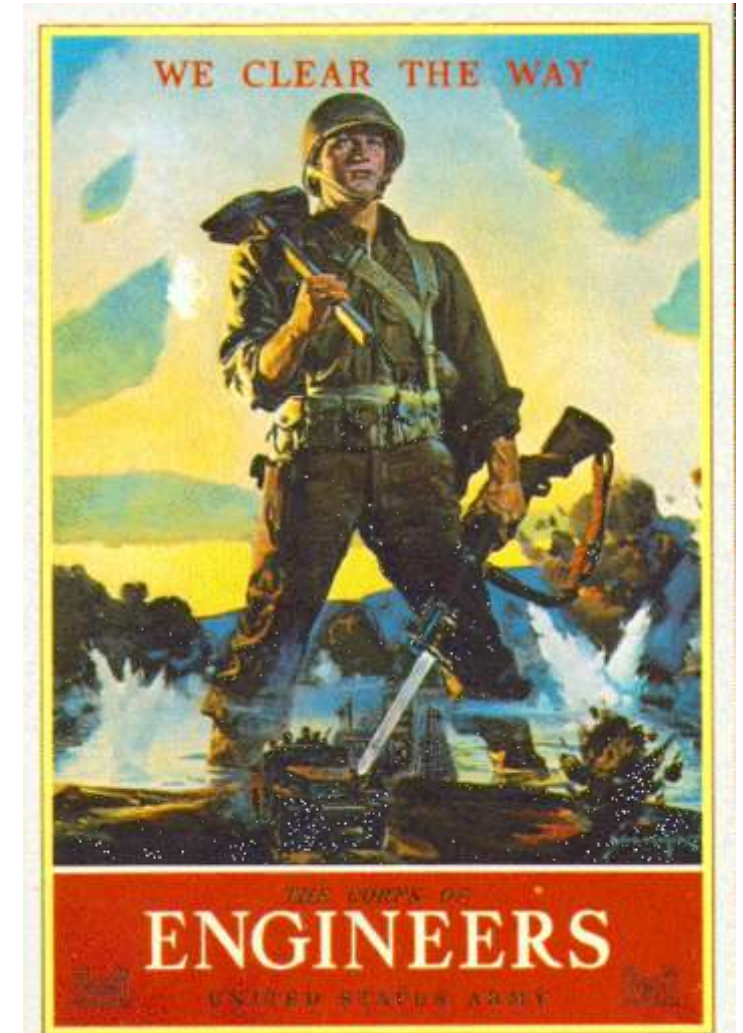
Objectivity lends authority to officials who have very little of their own.”

# Trust, authority and styles of quantification: two different stories





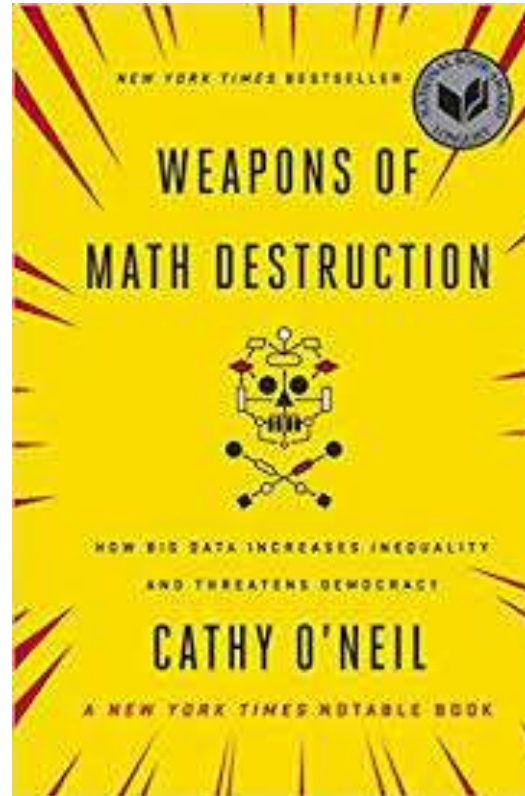
Porter's story: Quantification needs judgment which in turn needs trust ...without trust quantification becomes mechanical, a system, and 'systems can be gamed'.



# Alarm for Weapons of Math Destruction



Cathy O'Neil

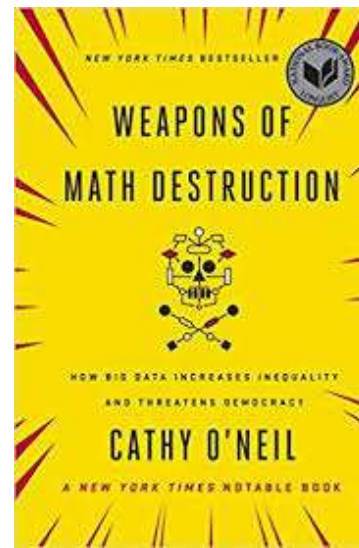


O'Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

Opacity (also because of trade secrecy) of algorithms used to decide on recruiting, carriers (including of researchers), prison sentencing, paroling, custody of minors, political campaigns...

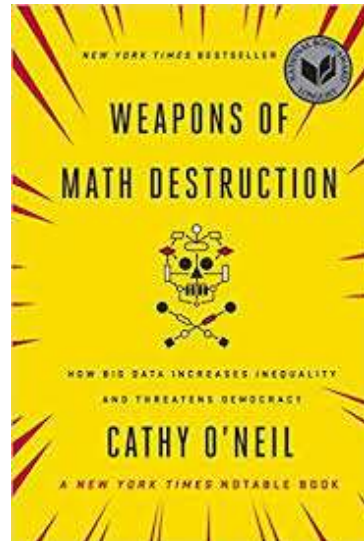
O'Neil, C. (2016). Weapons of math destruction : how big data increases inequality and threatens democracy. Random House Publishing Group.

Brauneis, R., & Goodman, E. P. (2018). Algorithmic Transparency for the Smart City. Yale Journal of Law & Technology, 20, 103–176. Retrieved from [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3012499](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3012499)



Opacity coupled with opportunity for **scale** and **damage** and with non-appealability make them an instrument of oppression & inequality

Cathy O'Neil Google talk <https://www.youtube.com/watch?v=TQHs8SA1qpk>

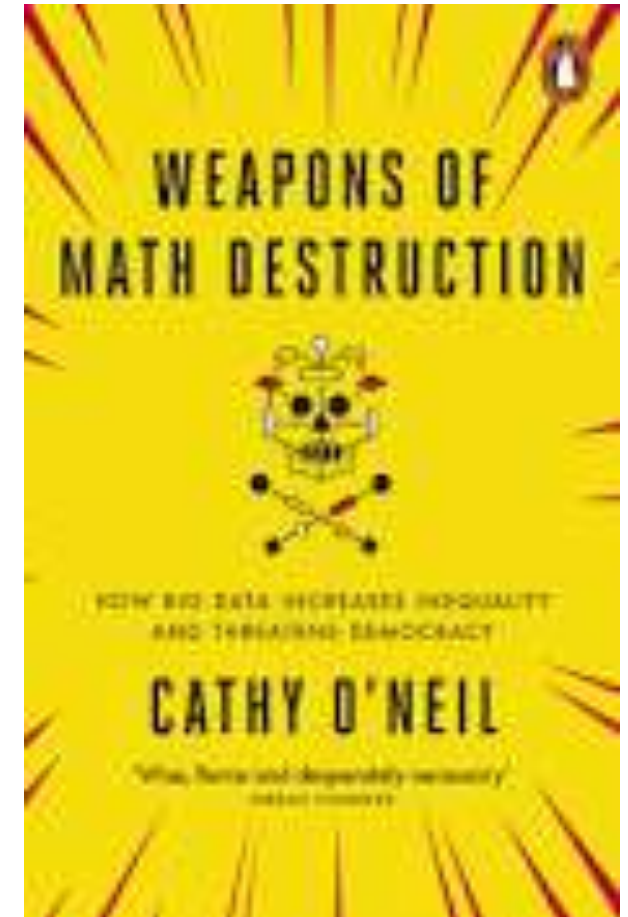


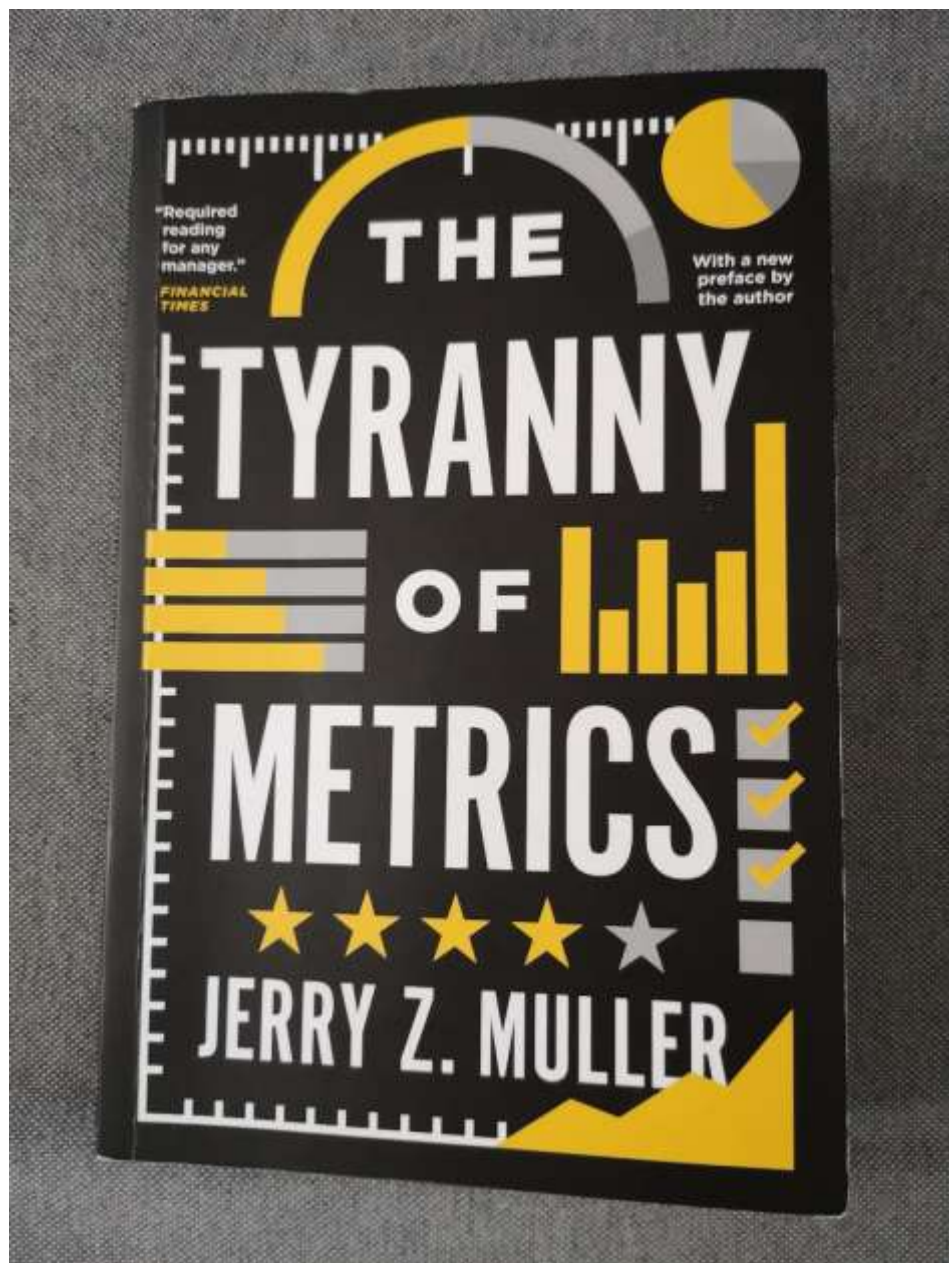


# Weapons of math destruction: opaque, harm, scale



Cathy O'Neil

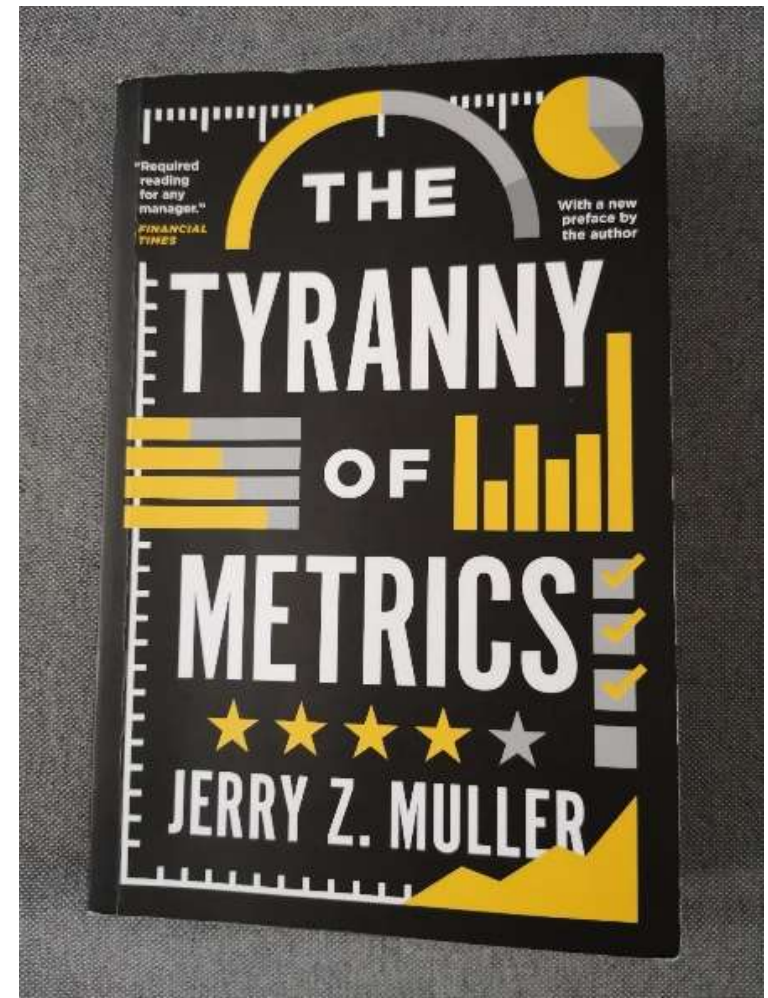




J. Z. Muller, The tyranny of metrics. Princeton University Press , 2018.

Metric fixation, or the irresistible pressure to measure performance

A wealth of case studies from education to war to medicine to foreign aid..

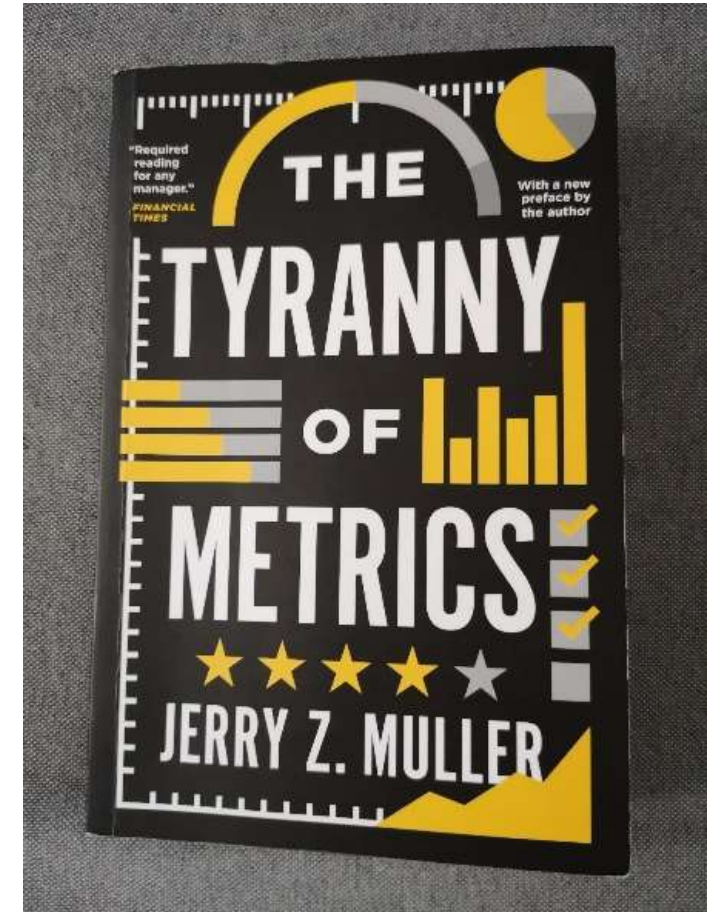




# Critiques of metrics

From the left: metric fixation promotes deskilling

From the right (Friedrich Hayek): metric fixation reproduces features of the soviet system

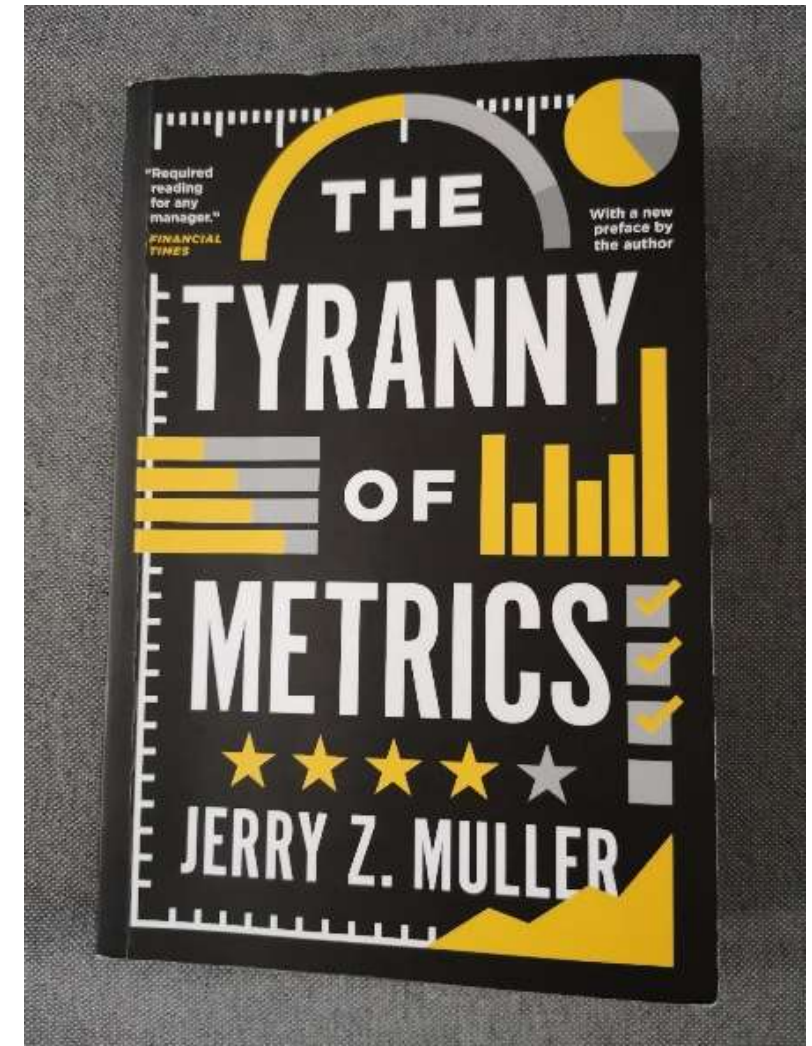




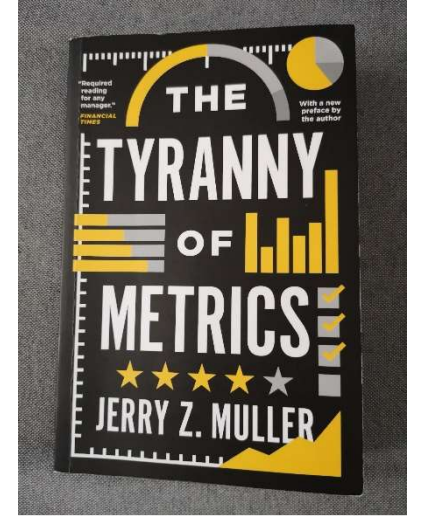
# Critiques of metrics

An epistemological critique:  
metrics privilege abstract and  
formulaic knowledge against  
practical and tacit knowledge

(Greek concept of metis)



# Unintended consequences: a litany



- Goal displacement
- Short termism
- Diminishing utility
- Rule cascade
- Discouraging risk taking
- Discouraging innovation
- Rewarding luck
- Discouraging cooperation and common purpose
- Degrading work
- Time waste
- Loss of productivity



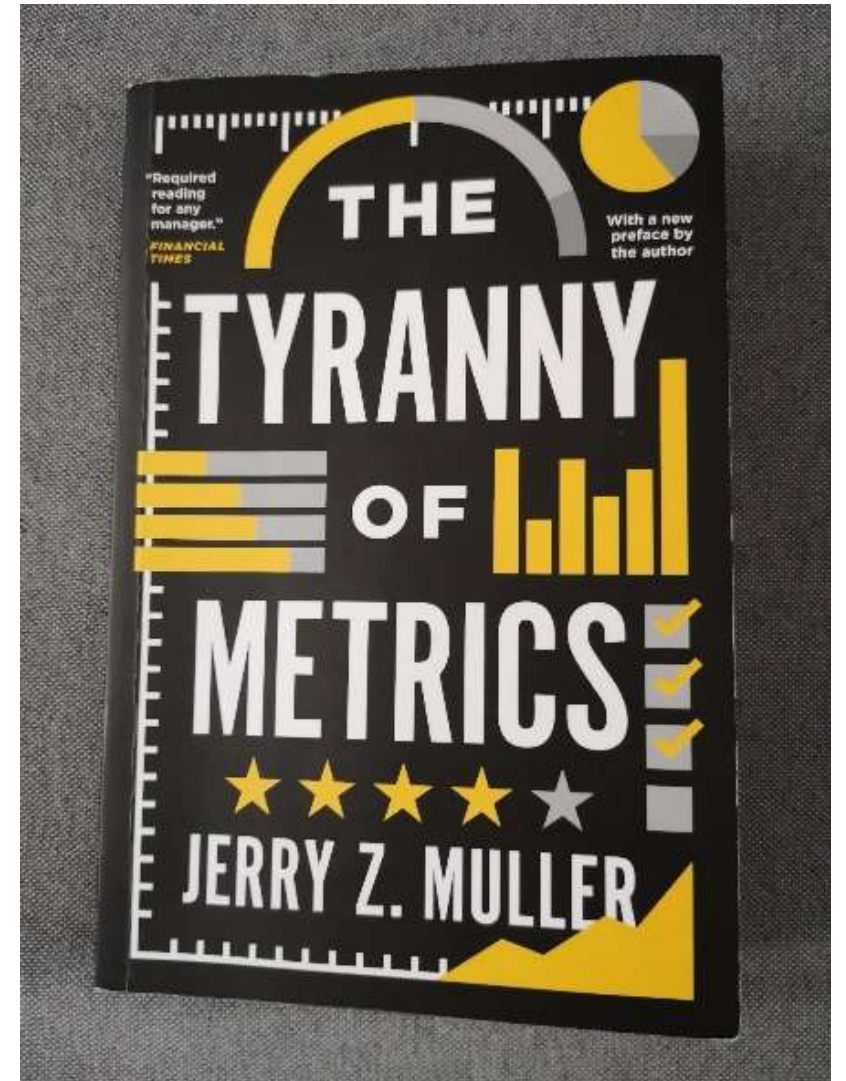
Charles Goodhart

p. 44 “Any ... measures necessarily involve a loss of information ... [and distorts behavior]” (Porter, 1995)

Goodhart’s law, from Charles Goodhart.  
"When a measure becomes a target, it ceases to be a good measure."

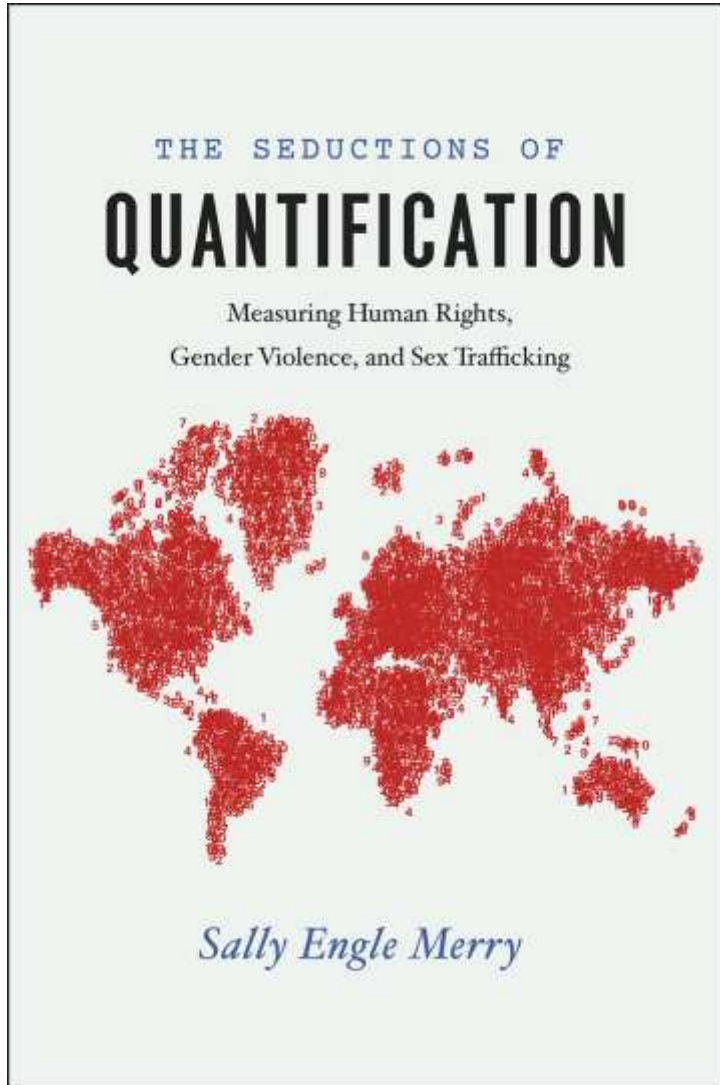
Also known as Campbell's law (1976);  
[https://en.wikipedia.org/wiki/Goodhart%27s\\_law](https://en.wikipedia.org/wiki/Goodhart%27s_law)

Considering all of the above  
keep in mind at every step  
that “the best use of metrics  
may be not to use it at all”



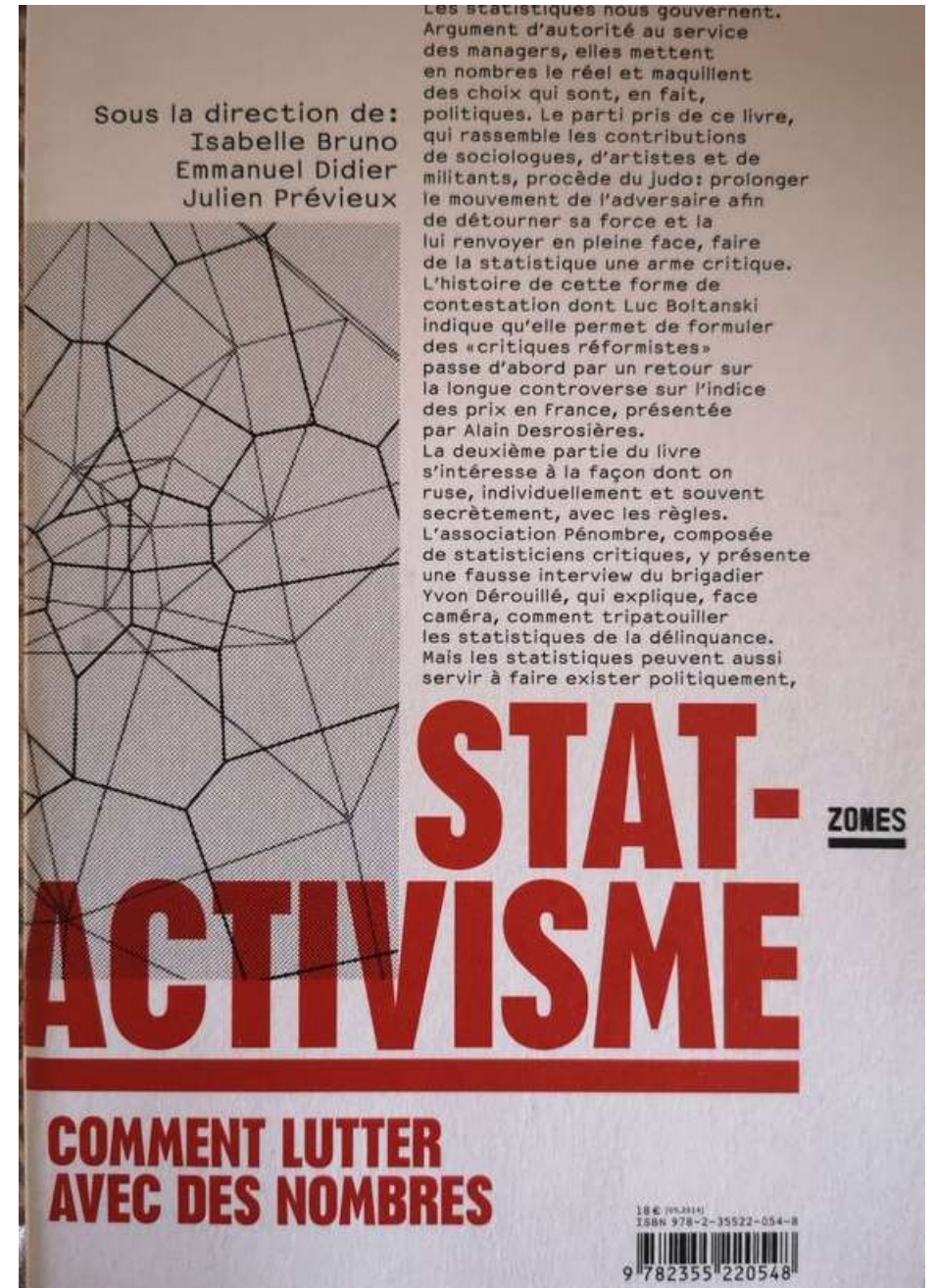


“...those who create indicators aspire to measure the world but, in practice, create the world they are measuring”



# Do we need a movement of resistance?

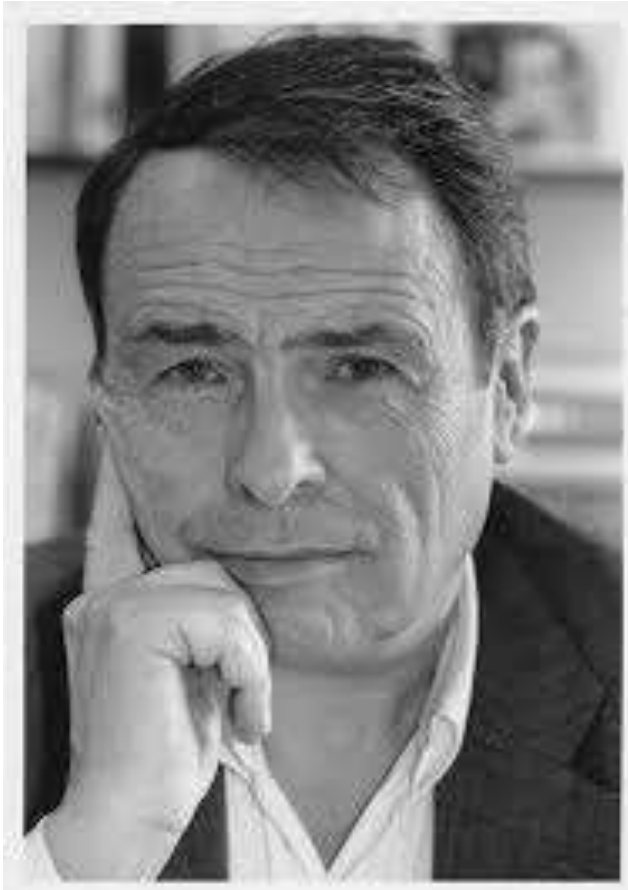
I. Bruno, E. Didier, and J. Prévieux, Stat-activisme. Comment lutter avec des nombres. Paris: Zones, La Découverte, 2014





# How to be a "statactiviste"?

1. Deconstruct existing metrics, including using irony (Pierre Bourdieu, *Les héritiers*).



La sociologie,  
ça doit être  
rigolo

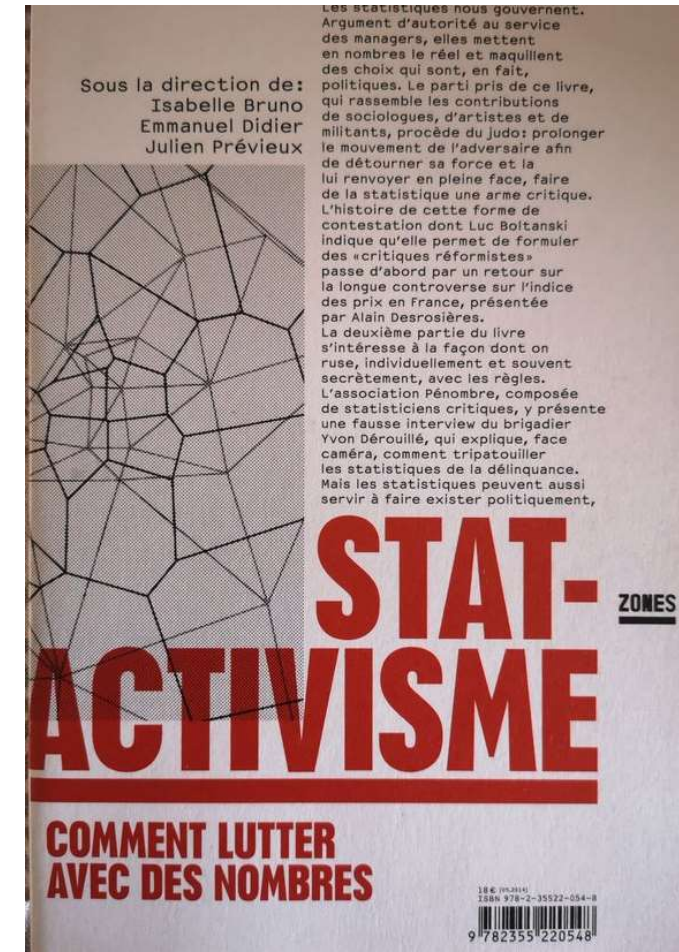
(Sociology must be fun)



# How to be a "statactiviste"?

2. Gaming metrics (statistical judo) – use Goodhart's law to your advantage – or make the ruse public.

- Police statistics in NY





# How to be a "statactiviste"?

3. Bring to the surface what is hidden / unsaid/ excluded – new social classes, marginalization, minorities:

- ‘Creative class’ or ‘precarious intellectuals’?



# How to be a "statactiviste"?

## 4. Measure something different.

- Suicides at France Telecom;
- BIP 40, a new French measure of poverty/inequality



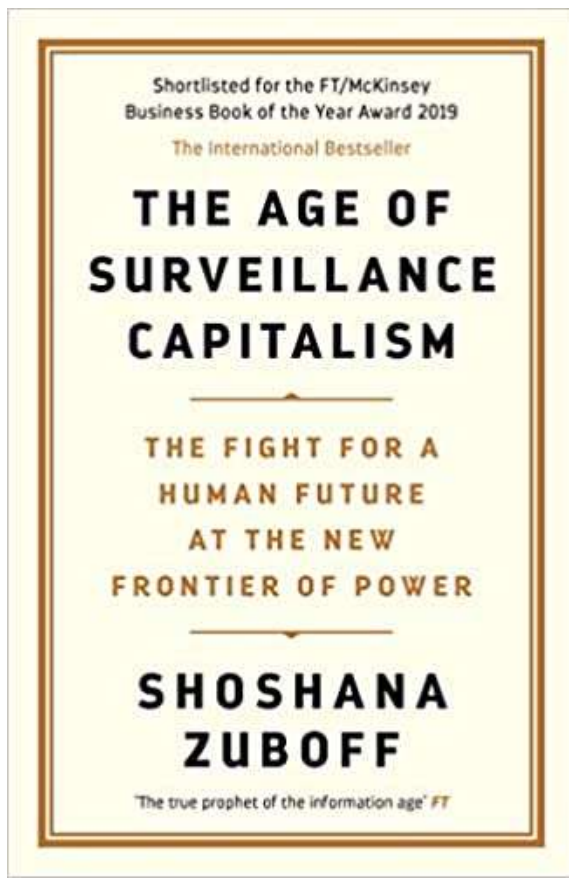
# Important:

“Quantification should not be abandoned to the advantage of exalting qualities, singularities, and the incommensurable. Such an abandon would be a tactical error”



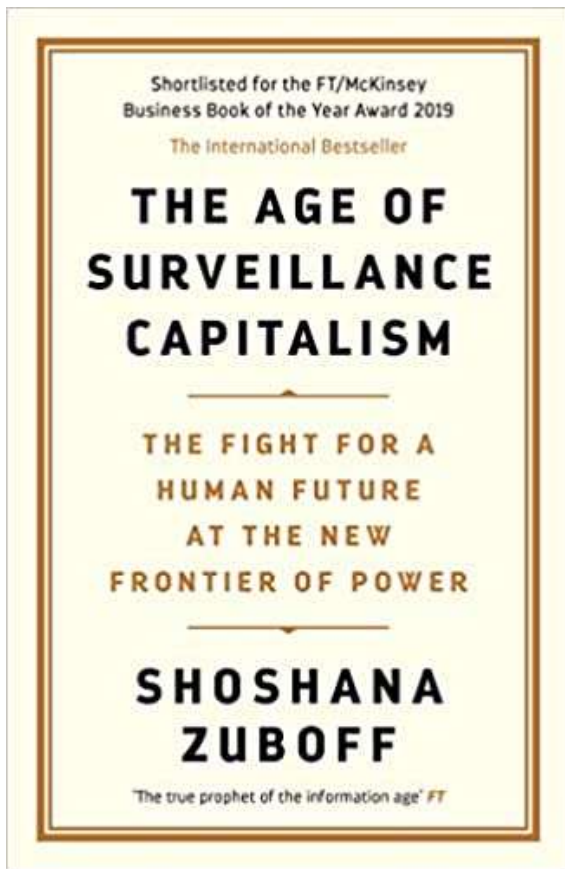


A project of domination of consumers and voters is made possible by artificial intelligence, big data & cognitive psychology



Inequality, power asymmetries and the world of surveillance capitalism





Chapters 11 & 12

Instrumentarian  
power



Chapter 10

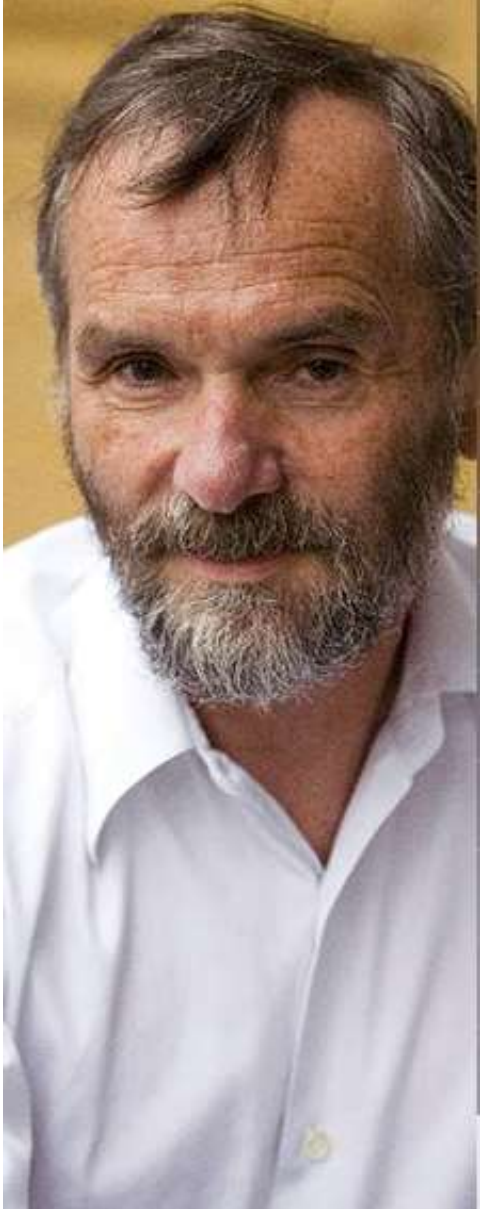
Néorationalism d'  
importation

*La trollisation de  
l'espace public*

Cognitive psychology  
and evolutionary  
psychology

A project of domination?

# Alain Supiot

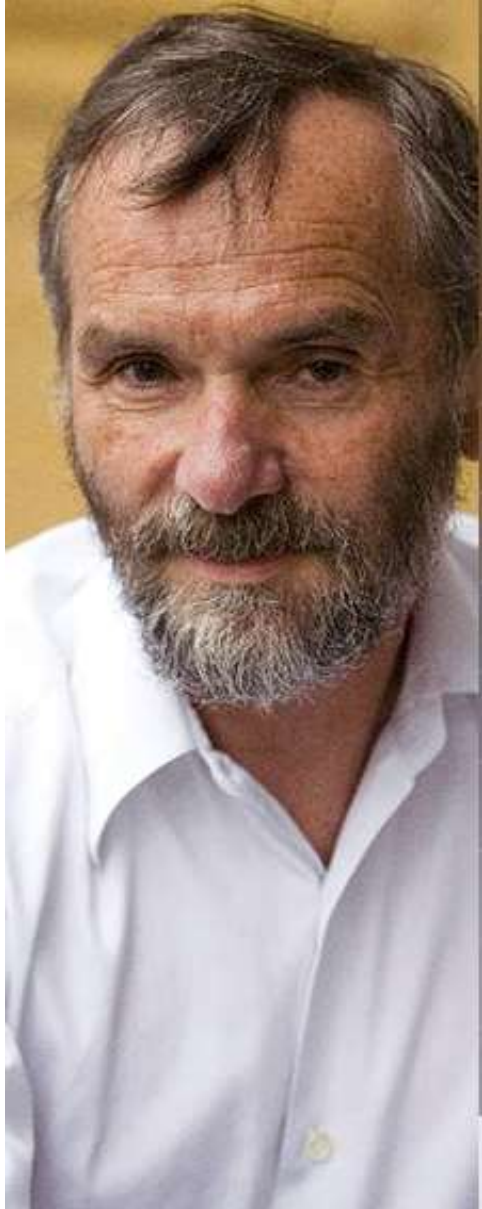


An indictment of the  
Total Market and the  
normative uses of  
economic quantification

<https://www.college-de-france.fr/site/en-alain-supiot/Governance-by-Numbers-Introduction.htm>



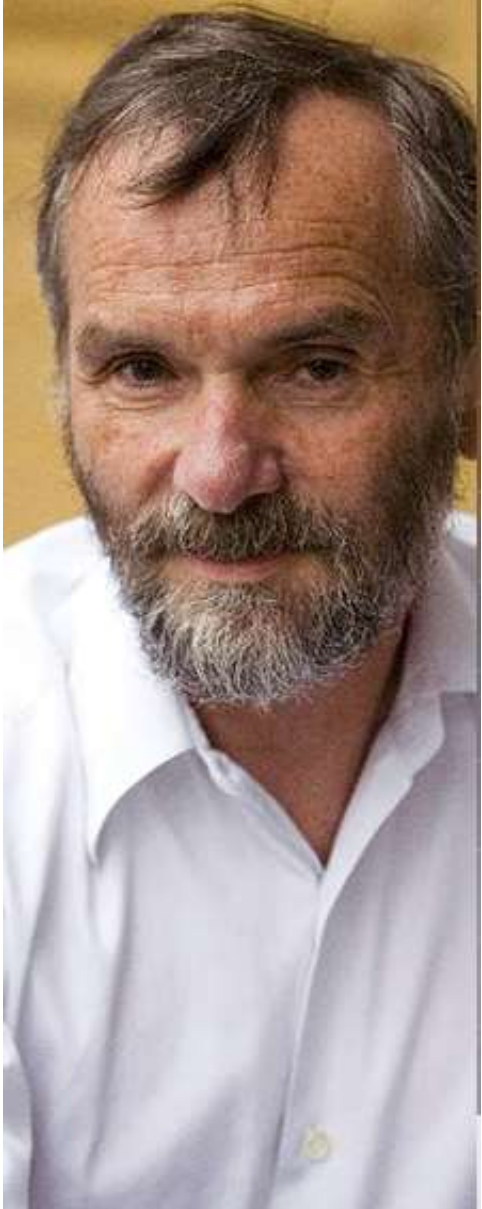
# Alain Supiot



...we have entered the era of the cybernetic imaginary, which revives the West's age-old dream of grounding social harmony in calculations.

Repudiating the goal of governing by just laws, this new discourse advocates in its stead the attainment of measurable objectives efficiently

# Alain Supiot

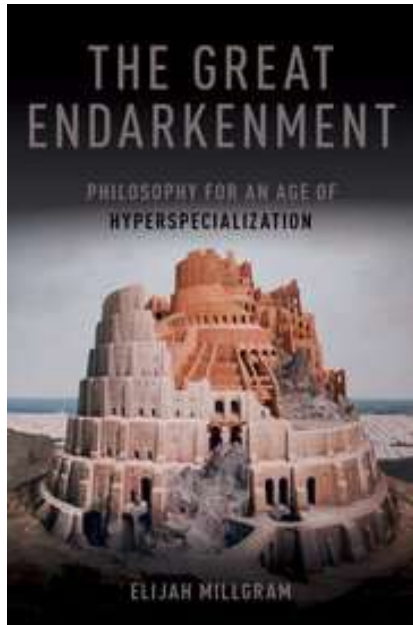


... This leaves no option open to populations or countries than to ride roughshod over social legislation, and pledge allegiance to those stronger than they are



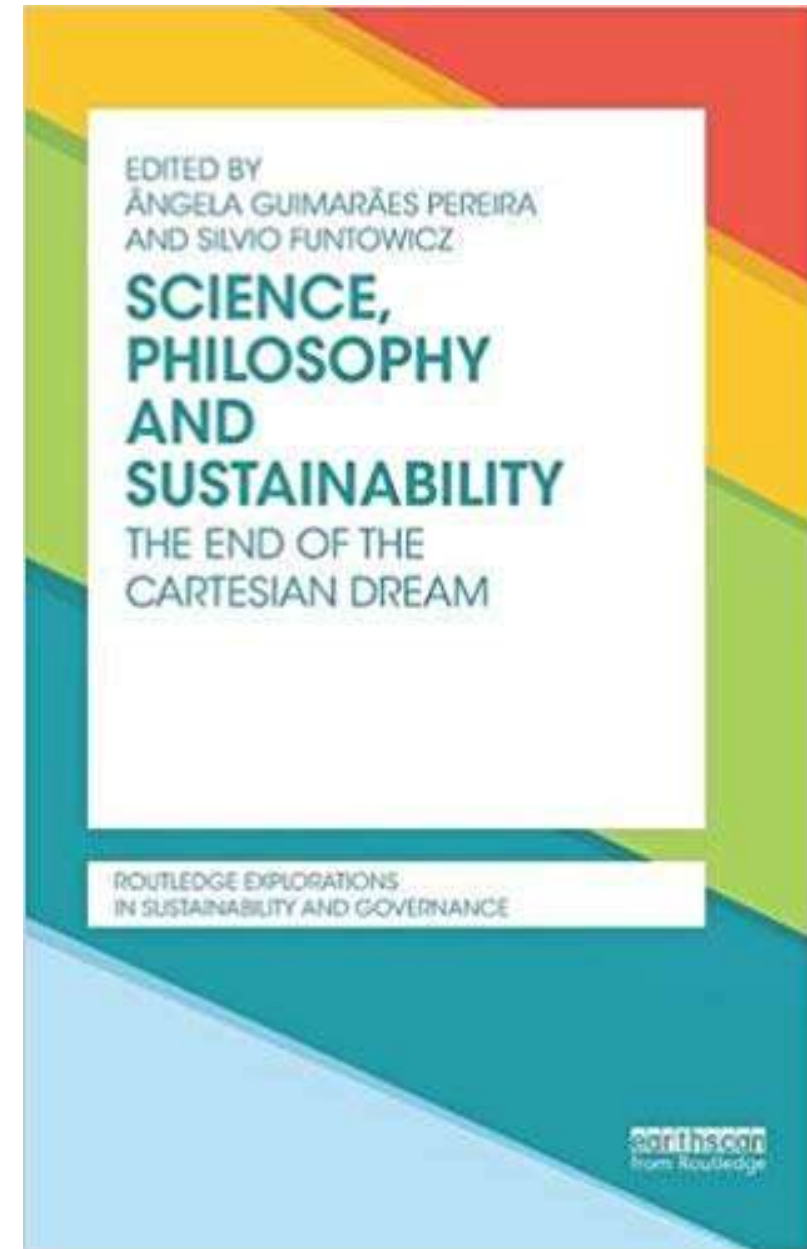
Cartesian anxiety:

Numbers, uncertainty,  
modernity



Elijah Millgram: warns against “procedural utopia”, a machinery to take the right decision based on a set of logical rules and methods.

A Cartesian dream?  
Cartesian anxiety

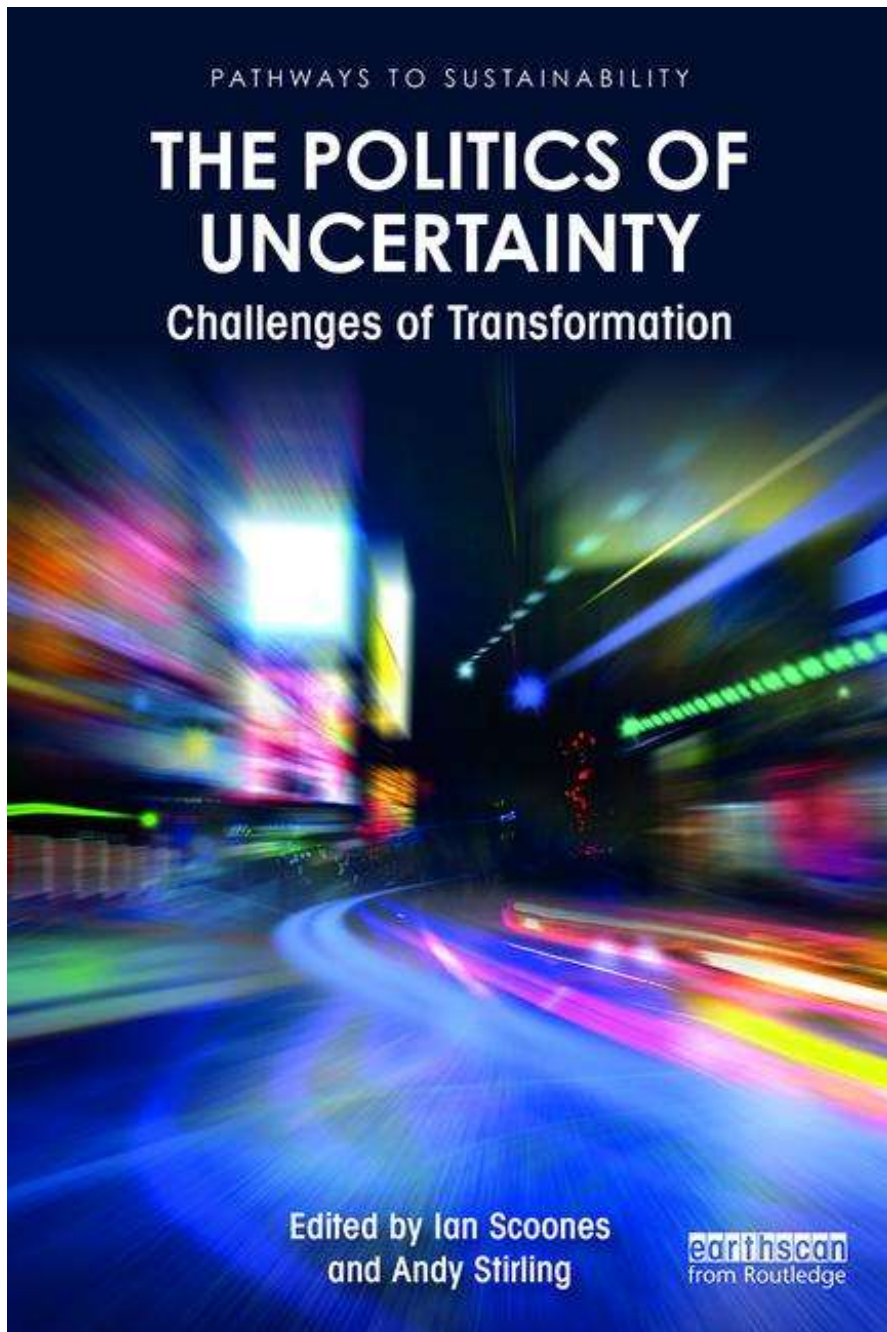


This dream started with Condorcet's  
Mathématique sociale; Bentham's  
utilitarianism

‘Decisionism’ – the idea that  
decisions can always systematically  
arrived at, given a modicum of  
computation



EVIDENCE,  
ARGUMENT, &  
PERSUASION IN  
THE POLICY  
PROCESS  
GIANDOMENICO  
MAJONE



Ian Scoones

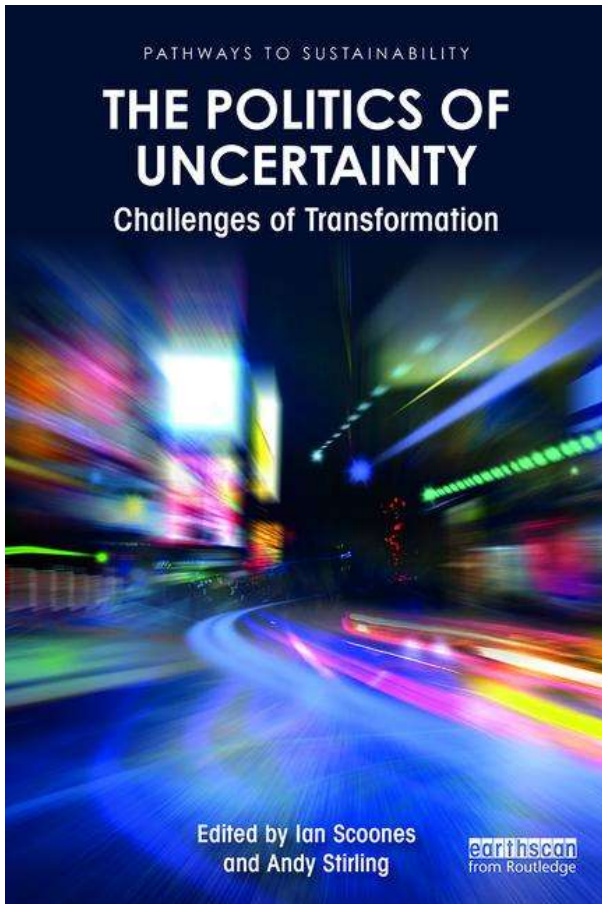


Andy Stirling

Free download  
<https://www.taylorfrancis.com/books/e/9781003023845>



A refutation of technological determinism, “modernity and progress as a hard-wired ‘one-track’ ‘race to the future’”



… modernity tends to ‘close down’ towards risk pretending to reduce uncertainties and ambiguities to (Knightian) risk

… the colonization of time, whereby the future becomes the present and an occasion of profit

See also: George F. De Martino, Ilene Grabel, Helga Nowotny, Andrea Saltelli and Brian Wynne: responses to "Control in Crisis: A DISCUSSION OF COVID-19 and the Futility of Control in the Modern World", by Andrew Stirling, Ian Scoones, Issues in Science and Technology, Vol. XXXVII, No. 1, Fall 2020.  
<https://issues.org/control-in-crisis-scoones-stirling-forum/>

“Is COVID-19 a gentle reminder of our ‘reckless modernity’?”

Of course, no computation can tell us that”



See <https://issues.org/control-in-crisis-scoones-stirling-forum/>

The critique of Andrew Stirling:

“[...] rhetoric clamour [surrounds] ‘expected utility’, ‘decision theory’, ‘life cycle assessment’, ‘ecosystem services’ ‘sound scientific decisions’ and ‘evidence-based policy’

[...] Each technique routinely delivers its answers with formidable levels of precision. Yet the resulting impression of accuracy is deeply misplaced”

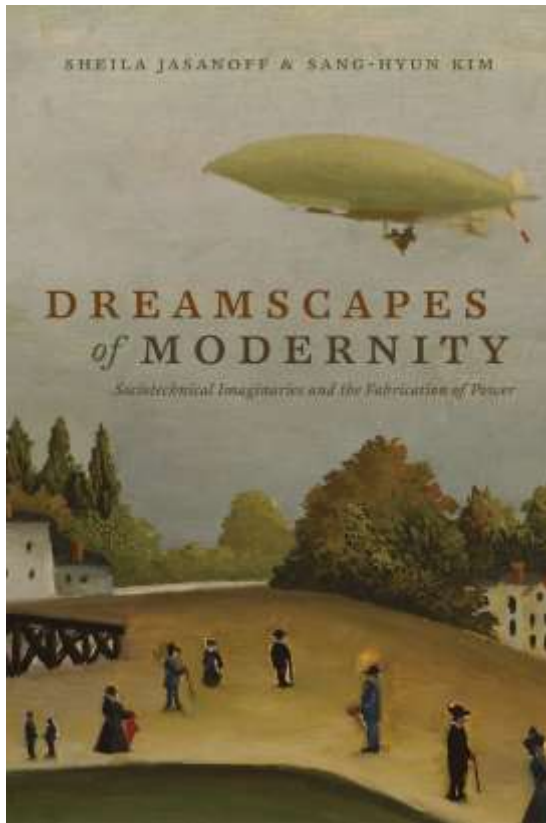


Andrew Stirling

And yet ... which is the  
prevailing sociotechnical  
imaginary?



How visions of scientific and technological progress carry with them implicit ideas about public purposes, collective futures, and the common good



Sheila Jasanoff

# ‘Decisionism’ is mainstream

Cass Sunstein, winner of  
the 2018 Holberg Prize



“In a series of books (The Cost Benefit State, 2002, Risk and Reason, 2002, and The Laws of Fear, 2004), Sunstein shows the ways in which cost benefit analysis can discipline regulatory agencies”

<https://www.holbergprisen.no/en/holberg-prize/prize-winners/cass-r-sunstein>

# Can technocracy be saved? An interview with Cass Sunstein.

Obama's regulation czar makes the case that "the issues that most divide us are fundamentally about facts rather than values."

By Dylan Matthews | @dylanmatt | dylan@vox.com | Oct 22, 2018, 9:00am EDT

<https://www.vox.com/future-perfect/2018/10/22/18001014/cass-sunstein-cost-benefit-analysis-technocracy-liberalism>



“Often, immersion  
in the facts often  
makes value  
disagreements feel  
much less  
relevant”  
(C. Sunstein)



<https://www.vox.com/future-perfect/2018/10/22/18001014/cass-sunstein-cost-benefit-analysis-technocracy-liberalism>



# Statistical and mathematical modelling

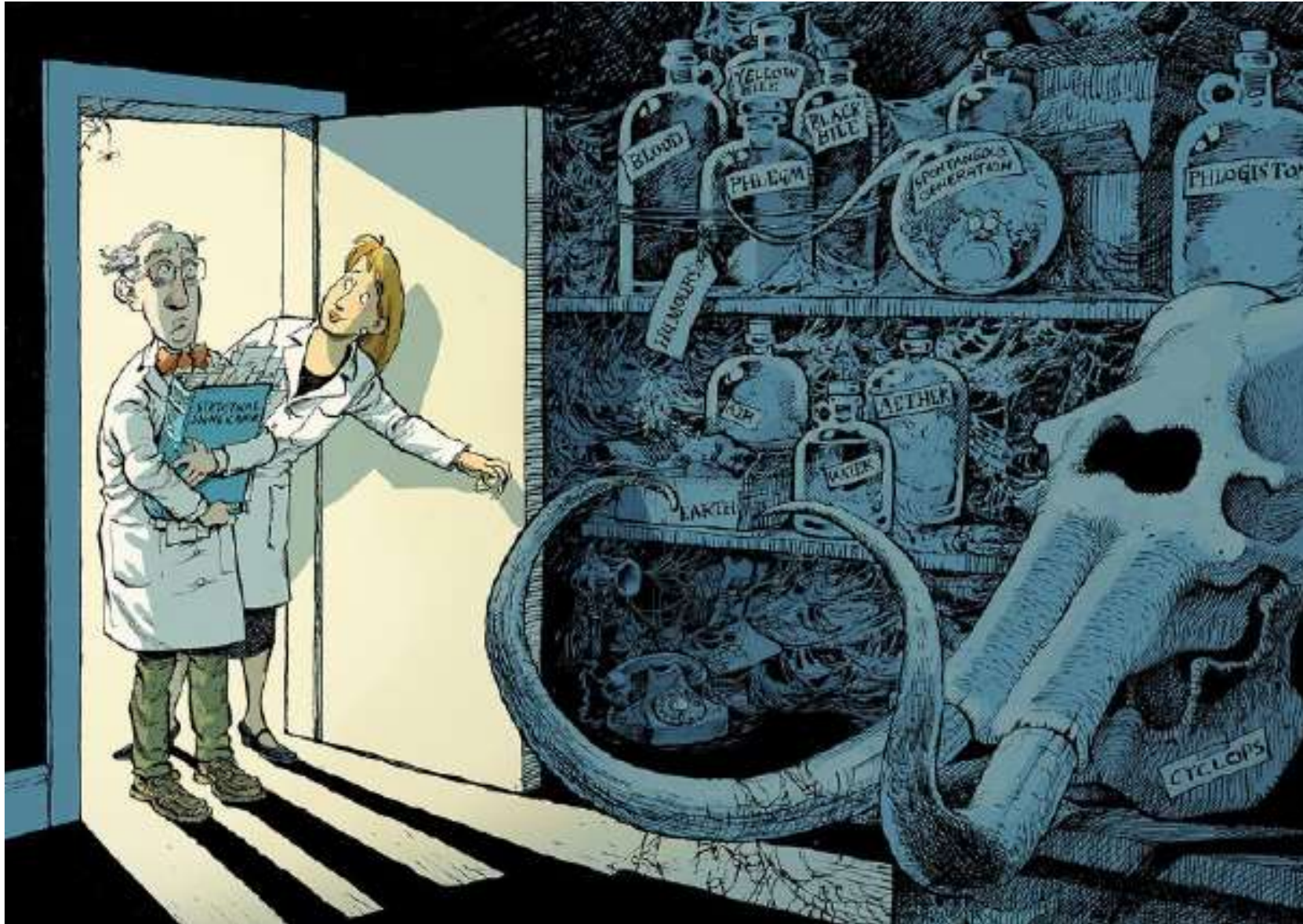


# Crisis in statistics?

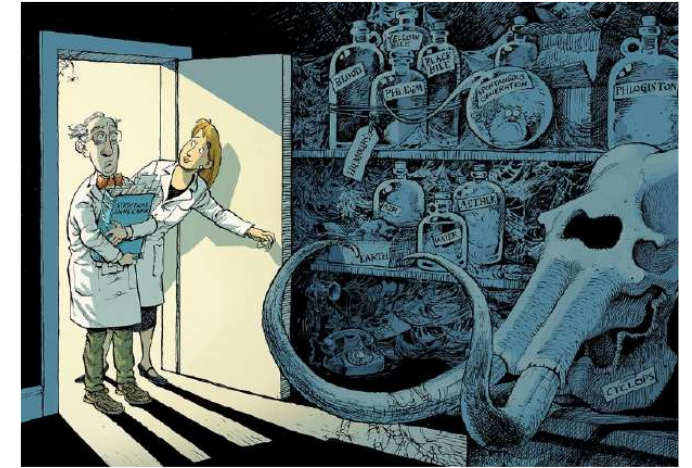


**nature**  
International journal of science





Throw away  
the concept of  
statistical  
significance?



COMMENT • 20 MARCH 2019

# Scientists rise up against statistical significance

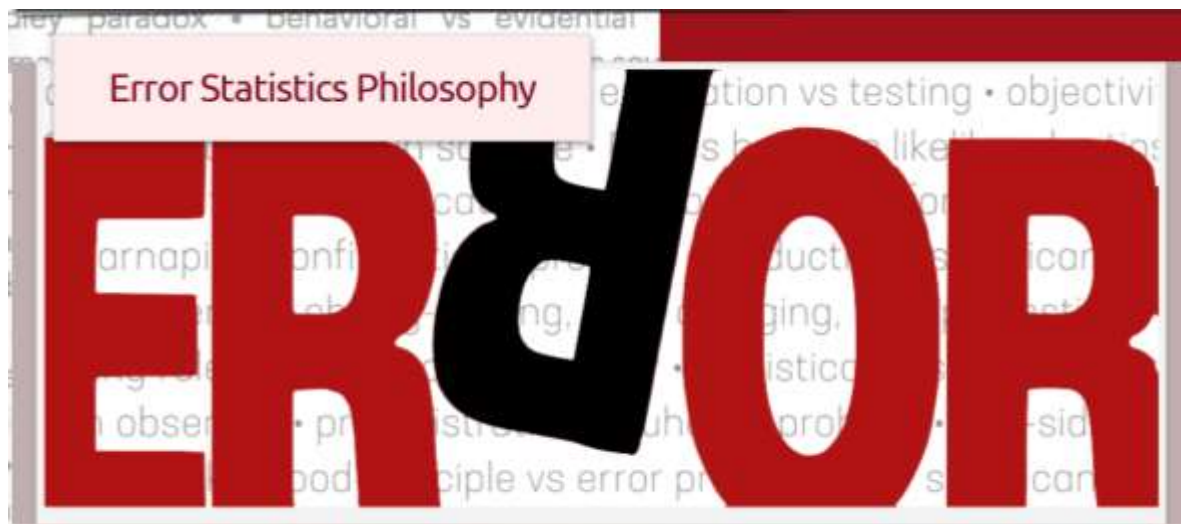
Valentin Amrhein, Sander Greenland, Blake McShane and more than 800 signatories call for an end to hyped claims and the dismissal of possibly crucial effects.

Valentin Amrhein , Sander Greenland & Blake McShane

↑  
A petition scientific  
about methodology?

See the discussion on the blog of Andrew Gelman <https://statmodeling.stat.columbia.edu/>





## A. Saltelli (Guest post): What can we learn from the debate on statistical significance?

Posted on November 22, 2019 by Mayo



**Professor Andrea Saltelli**

Centre for the Study of the Sciences and the Humanities (SVT), University of Bergen (UIB, Norway),  
&  
Open Evidence Research, Universitat Oberta de Catalunya (UOC), Barcelona

*What can we learn from the debate on statistical significance?*



## Cargo-cult statistics and scientific crisis

Written by Philip B. Stark and Andrea Saltelli on 05 July 2018. Posted in [Science](#)



“We can help fight power asymmetries in the use of evidence. We can stand up for the responsible use of statistics”

# Statistical wars?

# Is mathematical modelling affected?



[Comment](#)

[Open Access](#)

[Published: 27 August 2019](#)

## A short comment on statistical versus mathematical modelling

Andrea Saltelli 

Unlike statistics, modelling  
is not a discipline ...

... mathematical modelling cannot do this:



**AMERICAN STATISTICAL ASSOCIATION RELEASES STATEMENT ON  
STATISTICAL SIGNIFICANCE AND *P*-VALUES**

*Provides Principles to Improve the Conduct and Interpretation of Quantitative  
Science*

March 7, 2016

Wasserstein, R.L. and Lazar, N.A., 2016. 'The ASA's statement on p-values: context, process, and purpose', *The American Statistician*, Volume 70, 2016 – Issue 2, Pages 129–133.



# Five ways to ensure that models serve society: a manifesto

Pandemic politics highlight how predictions need to be transparent and humble to invite insight, not blame.

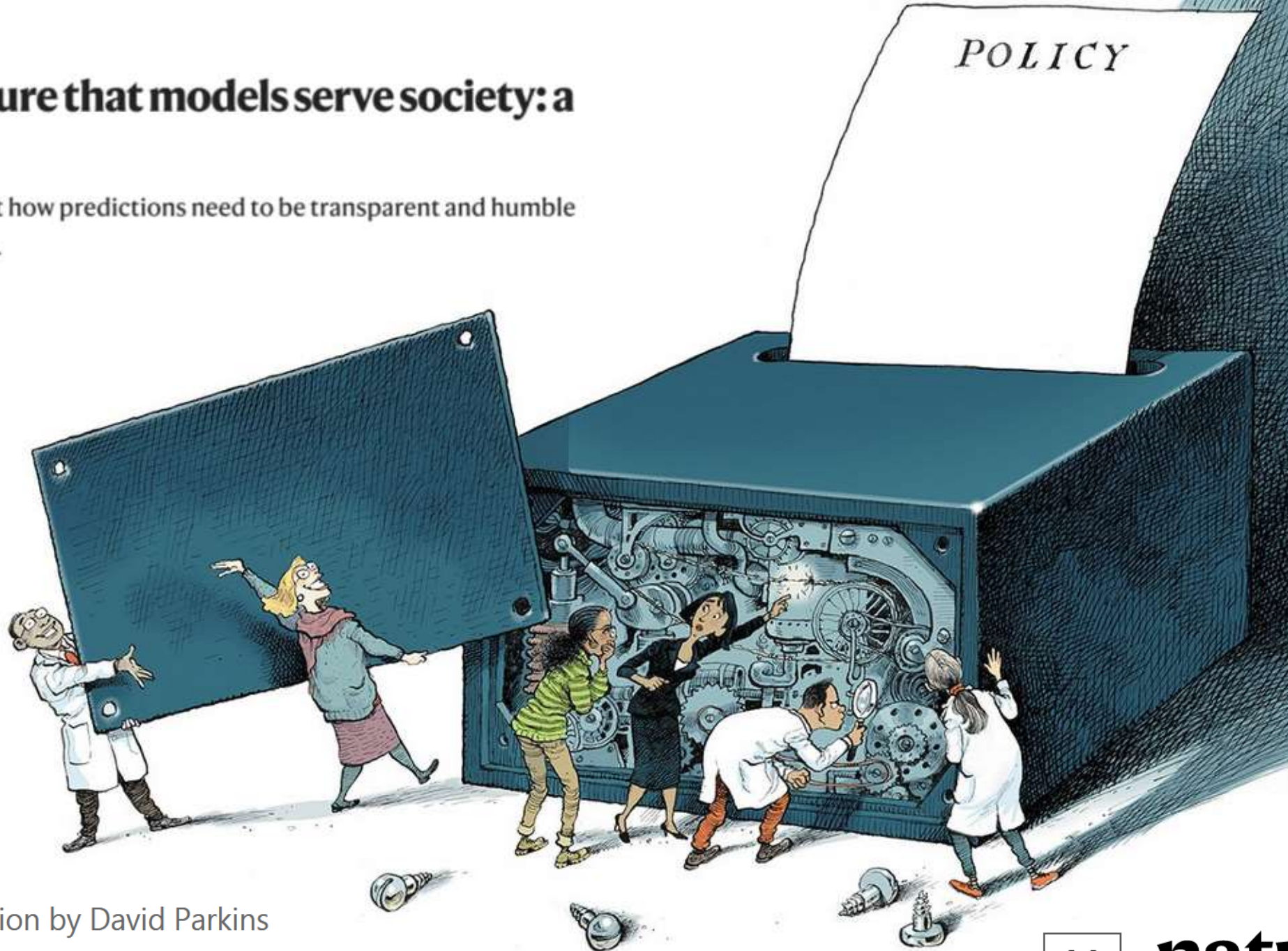


Illustration by David Parkins



**nature**

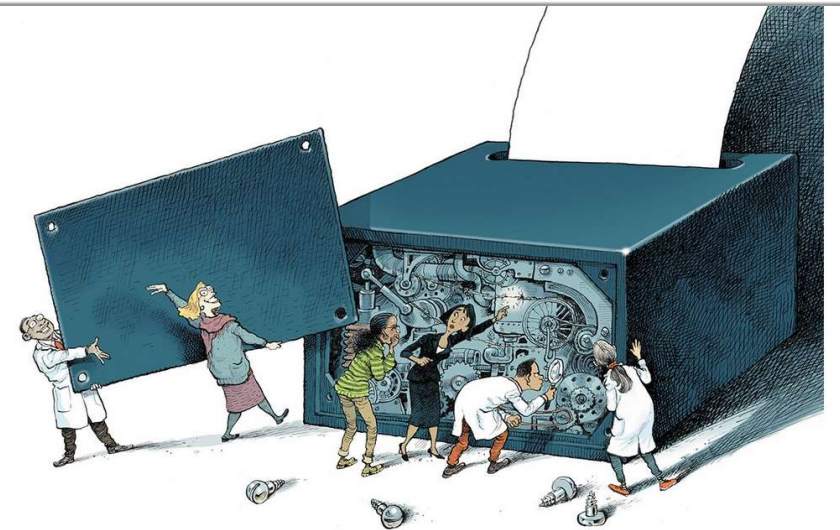


# Five ways to ensure that models serve society: a

Andrea Saltelli , Gabriele Bammer, Isabelle Bruno, Erica Charters, Monica Di Fiore, Emmanuel Didier, Wendy Nelson Espeland, John Kay,

Samuele Lo Piano, Deborah Mayo, Roger Pielke Jr, Tommaso Portaluri, Theodore M. Porter, Arnald Puy, Ismael Rafols, Jerome R. Ravetz, Erik Reinert,

Daniel Sarewitz, Philip B. Stark, Andrew Stirling, Jeroen van der Sluijs & Paolo Vineis





# Mind the assumptions

Assess uncertainty and sensitivity

## Mind the hubris

Complexity can be the enemy of relevance

## Mind the framing

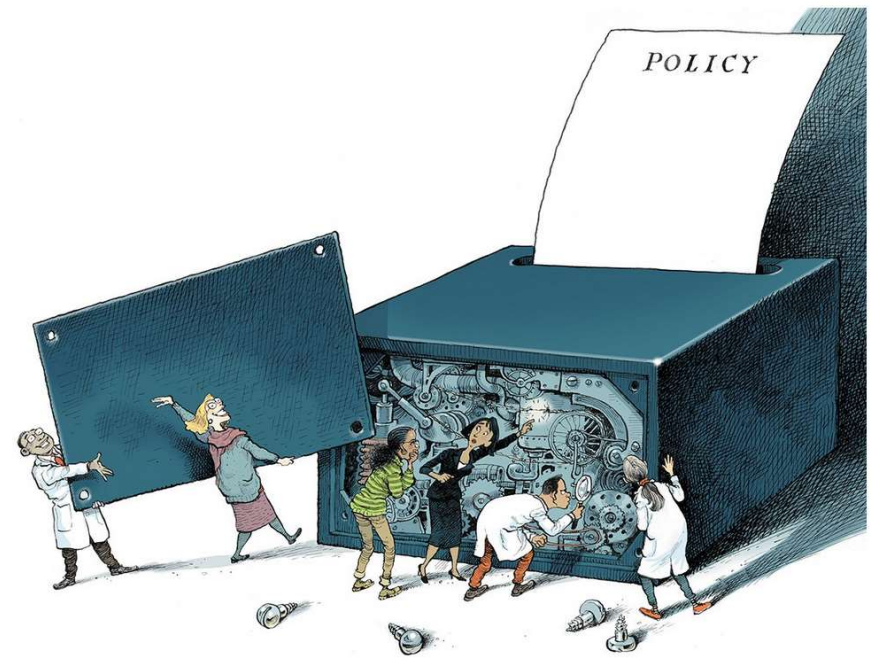
Match purpose and context

## Mind the consequences

Quantification can backfire.

## Mind the unknowns

Acknowledge ignorance

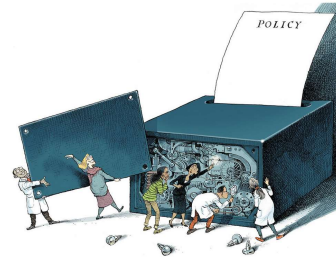


SUPPLEMENTARY INFORMATION

1. Additional information and references

>260 references

COVID-19 policies dictated by  
'science' with two digits precision  
in the presence of fundamental  
uncertainties



Undocumented research code used  
as a policy tool (chameleon models)



Pfleiderer, P. Chameleons: The Misuse of Theoretical Models in Finance and Economics. *Economica* 87, 81–107 (2020).



# *Behind the Virus Report That Jarred the U.S. and the U.K. to Action*

It wasn't so much the numbers themselves, frightening though they were, as who reported them: Imperial College London.



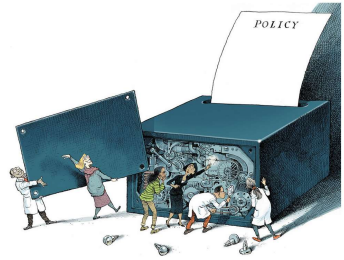
By Mark Landler and Stephen Castle

Published March 17, 2020 Updated April 2, 2020

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## The New York Times





ROGER PIELKE JR.

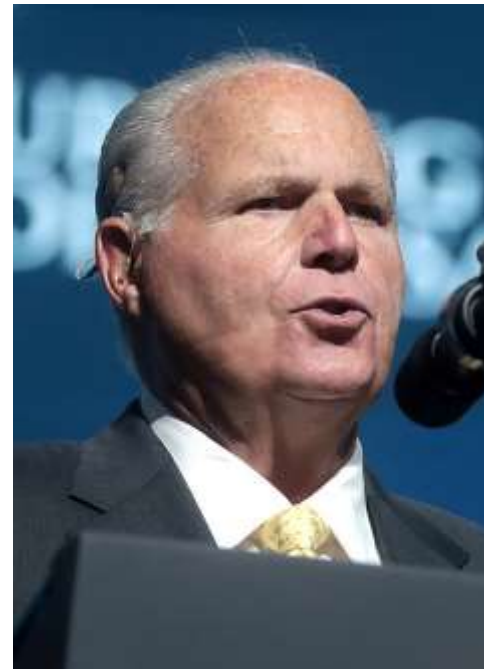
IDEAS 04.22.2020 08:00 AM

# The Mudfight Over ‘Wild-Ass’ Covid Numbers Is Pathological

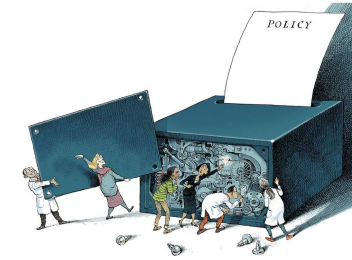
How did epidemiological modeling get so politicized?

Models in the limelight, and under attack:

“Wild ass numbers”  
(Rush Limbaugh)

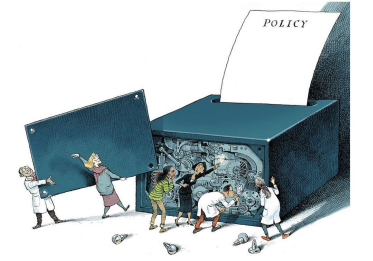


“There is no number-answer to your question”



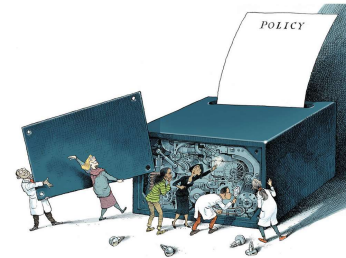
Anthony Fauci

March 12, 2020, Anthony Fauci before the House Oversight and Reform Committee  
[https://archive.org/details/CSPAN\\_20200314\\_141500\\_Dr.\\_Redfield\\_Dr.\\_Fauci\\_\\_Others\\_Testify\\_on\\_Coronavirus\\_Response\\_Part\\_1](https://archive.org/details/CSPAN_20200314_141500_Dr._Redfield_Dr._Fauci__Others_Testify_on_Coronavirus_Response_Part_1)



“Modellers must not be permitted to project more certainty than their models deserve; and politicians must not be allowed to offload accountability to models of their choosing”





... value of a statistical life ... might have a place in choosing the best public-health policy, it can produce a questionable appearance of rigour and so disguise political decisions as technical ones



The rules of the manifesto match the checklist of sensitivity auditing, a tool recommended by SAPEA (2019)



Saltelli, A., Guimarães Pereira, Â., Van der Sluijs, J.P. and Funtowicz, S., 2013, 'What do I make of your latinorum? **Sensitivity auditing of mathematical modelling**', Int. J. Foresight and Innovation Policy, (9), 2/3/4, 213–234.

At times of changing  
paradigm

The crises of science, technology and policy are entangled with one another

An expanding media system accelerates this entanglement

Human addiction to communication and technology makes the crisis unavoidable

Battles are fought where science, ideology and special interests collide



Paul-Marie Boulanger

Andrea Saltelli and Paul-Marie Boulanger, Technoscience, policy and the new media. Nexus or vortex?, Futures, 2020, <https://doi.org/10.1016/j.futures.2019.102491>



If rankings, scoreboards, indicators, statistical & mathematical models, share common problems,  
do we need an ethics of  
quantification?



Futures

Volume 116, February 2020, 102509



Essays

# Ethics of quantification or quantification of ethics?

Andrea Saltelli

[Show more](#)

<https://doi.org/10.1016/j.futures.2019.102509>

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Humanities & Social Sciences  
Communications

Article | [Open Access](#) | Published: 19 August 2020

## From sociology of quantification to ethics of quantification

Andrea Saltelli [✉](#) & Monica Di Fiore [✉](#)



*Humanities and Social Sciences Communications* **7**, Article number: 69 (2020) | [Cite this article](#)

**852** Accesses | **25** Altmetric | [Metrics](#)

Tools and practices to:

- tame modelling hubris,
- contrast knowledge asymmetry
- open the box of quantification
- ask for context & purpose-specific
- numbers as tools not as masters

# Quantification

Issues

Strategies of contrast

Neutrality

Plurality

Facts and values separation (reductionism)

Condivision of facts and values

Universality

Specificity of context and purpose



# Quantification

Issues

Strategies of contrast

Trust

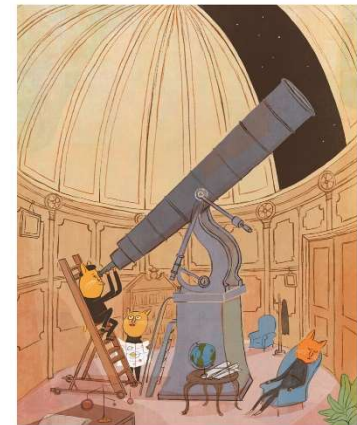
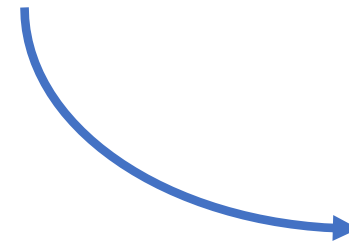
Licence not to quantify

Hubris

Humility

Abuse/Asymmetry

Disciplinary and societal oversight





# An observatory to do what?

As a pilot to run cases such as

- Ratings of higher education
- Public investments
- Evaluation of research and researchers
- Responsible inference
- Numbers of COVID-19
- ...

# The End



@andreasaltelli

# Poor quantifications: an example





EARTH  
OVERSHOOT  
DAY

[ABOUT](#)

[BLOG](#)

[SOLUTIONS](#)

[STEPS TO #MOVETHEDATE](#)

[NEWSROOM](#)

[FOR KIDS & TEACHERS](#)

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# EARTH OVERSHOOT DAY WAS JULY 29

*On That Day, Humanity Exhausted The Biological Resources Our Planet Can Renew This Whole Year. Check Out Solutions Below So We Stop Increasing The Global Ecological Deficit.*



At 8.00 am?

We use 1.75 planets  
Or 17.5? 175? 1,750? ...Infinity?

How many plastic bottles are we  
allowed to throw in the sea in a  
year?

Try replacing plastic bottles with extinction of a species, or collapse of a  
fishery, or a Fukushima,...





Move the date  
forward 5 days  
every years  
suggests Mathis  
Wackernagel

The Ecological Footprint suggests compressing sustainability to a single metric (acres of equivalent land). CO<sub>2</sub> emissions from energy demand dominate the output.







Contents lists available at [ScienceDirect](#)

## Ecological Indicators

journal homepage: [www.elsevier.com/locate/ecolind](http://www.elsevier.com/locate/ecolind)



## Footprints to nowhere

Mario Giampietro<sup>a,c</sup>, Andrea Saltelli<sup>b,\*</sup>



<sup>a</sup> Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain

<sup>b</sup> Institute for the Protection and Security of the Citizen (IPSC), The European Commission, Joint Research Centre, TP 361, 21027 Ispra, VA, Italy

<sup>c</sup> Catalan Institution for Research and Advanced Studies (ICREA), Passeig Lluís Companys, 23, 08010 Barcelona, Spain

Giampietro, M., and Saltelli, A., 2014, Footprints to nowhere, Ecological Indicators, 46, 610–621.

Goldfinger, S., Wackernagel, M., Galli, A., Lazarus, E., Lin, D., 2014, Footprint facts and fallacies: A response to Giampietro and Saltelli (2014) “Footprints to Nowhere”, 46, 622–632.

Giampietro, M., and Saltelli, A., 2014, Footworking in Circles, Ecological Indicators, 46 (2014) 260–263.

Alessandro Galli , Mario Giampietro , Steve Goldfinger, Elias Lazarus, David Lin, Andrea Saltelli , Matthis Wackernagel , Felix Müller, 2016, Questioning the ecological footprint , Ecological Indicators, 69, 224–232.

All the story...

Andrea  
Saltelli

HOME ABOUT ME

CAETERIS ARE  
NEVER PARIBUS



## Futures

Volume 91, August 2017, Pages 5-11



# What is science's crisis really about?

Andrea Saltelli <sup>a, b</sup>  , Silvio Funtowicz <sup>a</sup>



## Futures

Volume 104, December 2018, Pages 85-90



# Why science's crisis should not become a political battling ground

Andrea, Saltelli 



Silvio Funtowicz

Failed replications, entire subfields going bad,  
fraudulent peer reviews, predatory publishers,  
perverse metrics, statistics on trial ...




Brow

 OPEN ACCESS

ESSAY

June 21, 2017

Why Most Clinical Research Is Not Useful

John P. A. Ioannidis 

Published: June 21, 2016 • <https://doi.org/10.1371/journal.pmed.1002049>

THE  
ECONOMIC  
JOURNAL



*The Economic Journal*, 127 (October), F236–F265. Doi: 10.1111/eoj.12461 © 2017 Royal Economic Society. Published by John Wiley & Sons, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

THE POWER OF BIAS IN ECONOMICS RESEARCH\*

*John P. A. Ioannidis, T. D. Stanley and Hristos Doucouliagos*

October 27, 2017



... misleading science advice, institutions on denial, a new breed of science wars

## **Opinion: Is science really facing a reproducibility crisis, and do we need it to?**

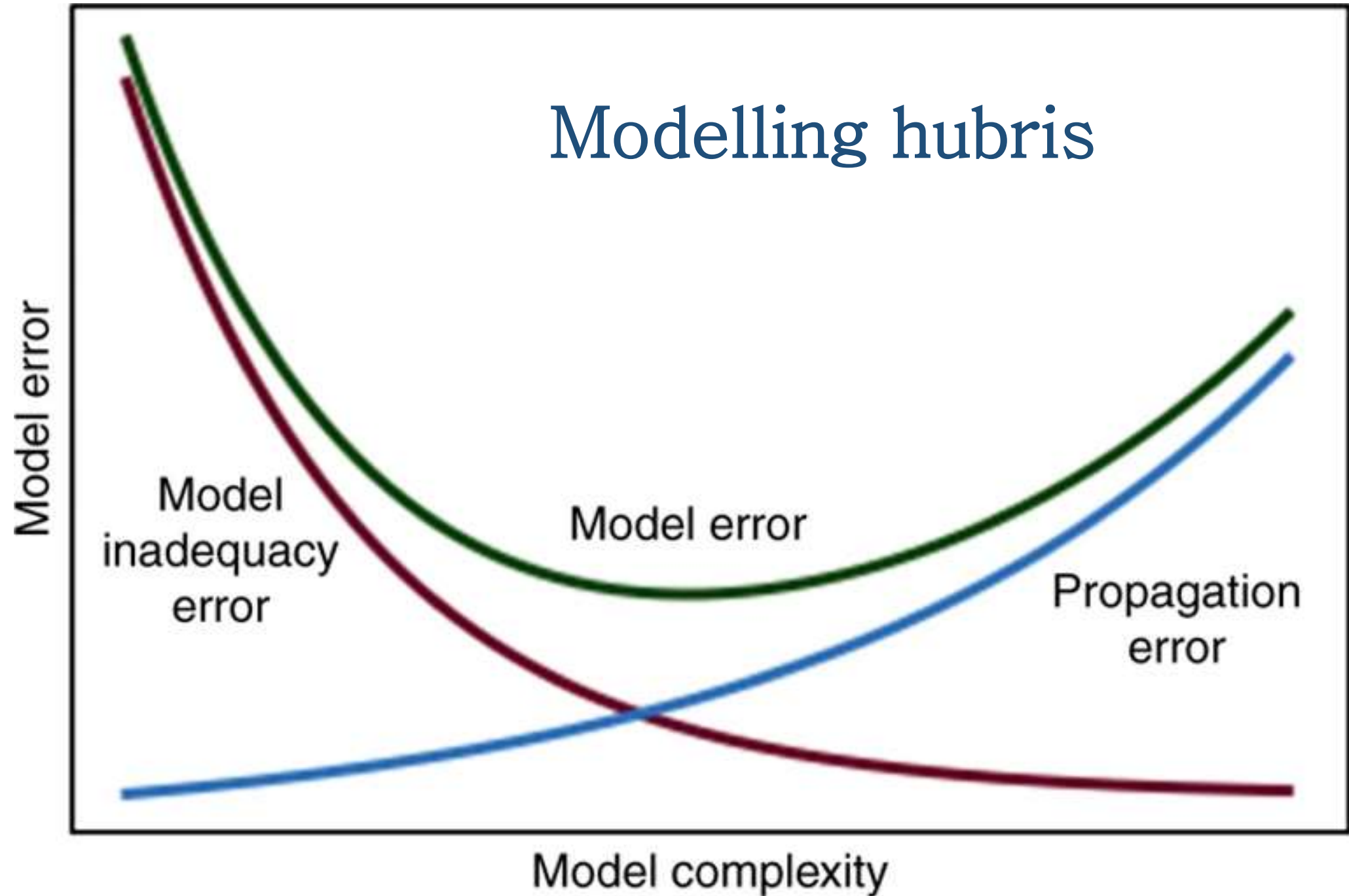
Daniele Fanelli

PNAS March 12, 2018. 201708272; published ahead of print March 12, 2018. <https://doi.org/10.1073/pnas.1708272114>



“The new “science is in crisis” narrative is not only empirically unsupported, but also quite obviously counterproductive”

# Modelling hubris





nature

ANDREA SALTELLI

Save science  
from itself

COMMENT • 21 MAY 2019

## Views from a continent in flux

*Nature* asked nine leading Europeans to pick their top priority for science at this pivotal point. Love, money, and trust got most votes.

Carlos Moedas, Isabelle Vernos , Stephan Kuster , Helga Nowotny , Andrea Saltelli , Alina Mungiu-Pippidi ,  
Jan Wouter Vasbinder , Daniel R. Brooks & Patrick Cunningham 

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ANDREA SALTELLI

**Save science  
from itself**

All that matters operates  
simultaneously in science, technology,  
economics, law and policy

Battles are fought where science,  
ideology and special interests collide

Social media imprint unprecedented  
reach and acceleration



---

**ANDREA SALTELLI**  
**Save science  
from itself**

Science to inform policy decisions  
versus science lending a veil of  
rationality to the same decisions

Science as a source of emancipation  
versus science as the currency of  
lobbies

Prudent science and technology are at  
odds with their use for corporate or  
military interests.

NUSAP

Numeral, Unit, Spread

+

Assessment (qualitative judgement on quantification)

Pedigree (qualitative assessment of mode of production and anticipated use)

THEORY AND DECISION LIBRARY

SERIES A: PHILOSOPHY AND METHODOLOGY  
OF THE SOCIAL SCIENCES

SILVIO O. FUNTOWICZ AND JEROME R. RAVETZ

UNCERTAINTY AND QUALITY  
IN  
SCIENCE FOR POLICY

KLUWER ACADEMIC PUBLISHERS



Jeroen  
van der Sluijs

## Example Pedigree matrix parameter strength

| Code | Proxy               | Empirical                            | Theoretical basis                               | Method   | Validation  |
|------|---------------------|--------------------------------------|---|--|---|
| 4    | Exact measure       | Large sample direct mmts             | Well established theory                         | Best available practice                            | Compared with indep. mmts of same variable            |
| 3    | Good fit or measure | Small sample direct mmts             | Accepted theory partial in nature               | Reliable method commonly accepted                  | Compared with indep. mmts of closely related variable |
| 2    | Well correlated     | Modeled/derived data                 | Partial theory limited consensus on reliability | Acceptable method limited consensus on reliability | Compared with mmts not independent                    |
| 1    | Weak correlation    | Educated guesses / rule of thumb est | Preliminary theory                              | Preliminary methods unknown reliability            | Weak / indirect validation                            |
| 0    | Not clearly related | Crude speculation                    | Crude speculation                               | No discernible rigour                              | No validation   |

<http://www.nusap.net/>





# Sensitivity Auditing

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## **What do I make of your latinorum? Sensitivity auditing of mathematical modelling**

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Saltelli, A., Guimarães Pereira, Â.,  
Van der Sluijs, J.P. and Funtowicz, S.



Ângela Guimarães Pereira

# The rules of sensitivity auditing

1. Check against rhetorical use of mathematical modelling;
2. Adopt an “assumption hunting” attitude; focus on unearthing possibly implicit assumptions;
3. Check if uncertainty been instrumentally inflated or deflated.

4. Find sensitive assumptions before these find you; do your SA before publishing;
5. Aim for transparency; Show all the data;
6. Do the right sums, not just the sums right;
7. Perform a proper global sensitivity analysis.



Numbers, visible and invisible, increasingly permeate all aspects of life. Fields as different as artificial intelligence and algorithms, use of metrics and indicators, statistical inference and mathematical models condition our life, for best or worse. Model generated numbers concerning –for example, the ongoing pandemic populate the news, and importantly affect – or determine, our perceptions and resulting policies. Scholars look at this fast changing numerical landscape, variously hailing an incoming utopia or lamenting an impending dystopia – a world of aplenty or the end of a well ruled society. The talk will review these visions, what relations these have with different disciplines, and how these universes of quantification feed into policy and society. Any quantification is a social activity, but can society cope with the present rate of change? Some examples will be offered of possible strategies for responsible quantification. The talk may be propaedeutic to a course entitled ‘Numbers for Policy’ to be arranged at a later time.