Work in Progress

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The Politics of Modelling

Numbers Between Science and Policy

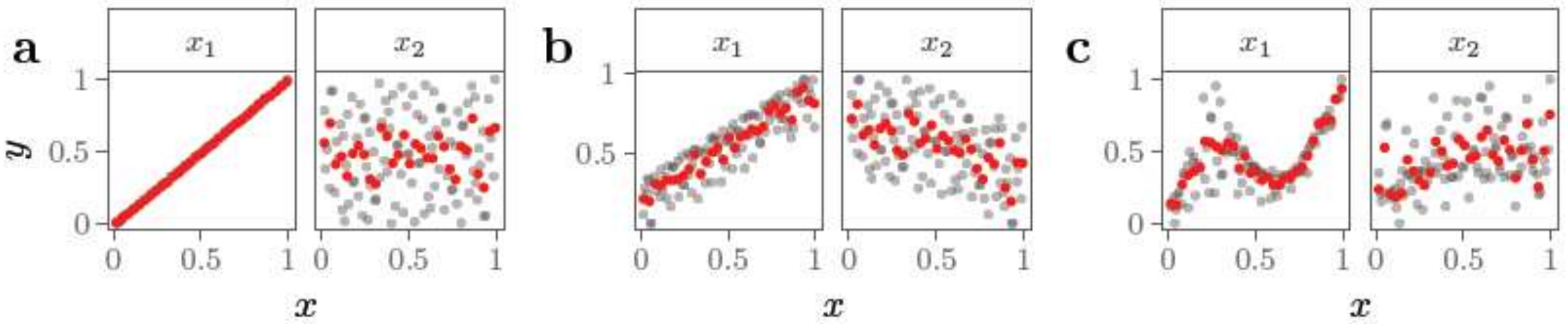
Andrea Saltelli and Monica Di Fiore

"*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

Open access paper

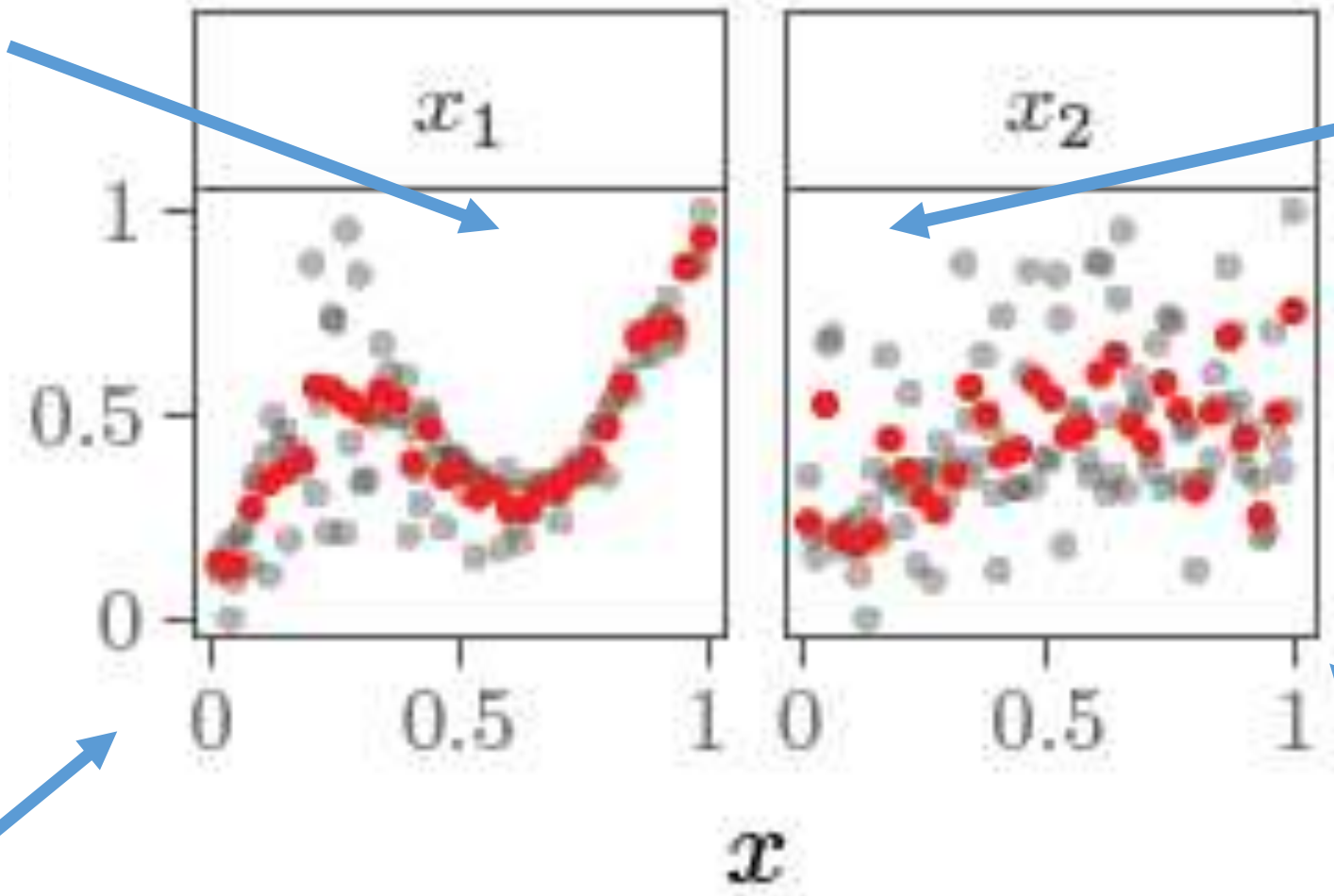
Do we need to compute indices? Can we do without statistics and calculus using the histograms we have met already?



'Stupid' histograms in the x_i, y plane, both in **[0,1]**, for different $y = f(x_i)$

Bigger ‘holes’

Smaller ‘holes’



=more important

=less important

Research Article

Mathematical models: a state of exception

Andrea Saltelli, Arnald Puy & Monica Di Fiore

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ABSTRACT

Models live in a state of exception. Their versatility, the variety of their methods, the impossibility of their falsification and their epistemic authority allow mathematical models to escape, better than other cases 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 both underexplored and overinterpreted. While retaining a firm grip on policy, they reinforce the entrenched culture of transforming political issues into technical ones, possibly decreasing citizens' agency and thus favouring anti-democratic policies. To combat this state of exception, one should question the reproducibility of models, foster complexity of interpretation rather than complexity of construction, and encourage forms of activism aimed at achieving a reciprocal domestication between models and society. To breach the solitude of modellers, more actors should engage in practices such as assumption hunting, modelling of the modelling process, and sensitivity analysis and auditing.

2.2. An Ersatz Discrepancy

The discrepancies presented in (5)–(11) are state-of-the-art measures used in the design of computer experiments, requiring statistical training to understand. They are also computationally complex due to their reliance on column-wise and row-wise loops, which limits their scalability for larger sample sizes and higher-dimensional settings. Here, we propose an ersatz discrepancy (S-ersatz hereafter) that addresses these issues and leverages the link between scatterplots, discrepancy, and sensitivity discussed in Section 2.1.

We suggest to split the $\boldsymbol{x}_k, \boldsymbol{y}$ plane into a uniform grid formed by $\lceil\sqrt{N_s}\rceil \times \lceil\sqrt{N_s}\rceil$ cells, where $\lceil . \rceil$ stands for the ceiling function, and calculate the ratio between the number of cells with points (N_P) and the total number of cells (N_T). Mathematically, this translates into

$$S_{\text{ersatz}} = \frac{N_P}{N_T}\,. \tag{12}$$

For

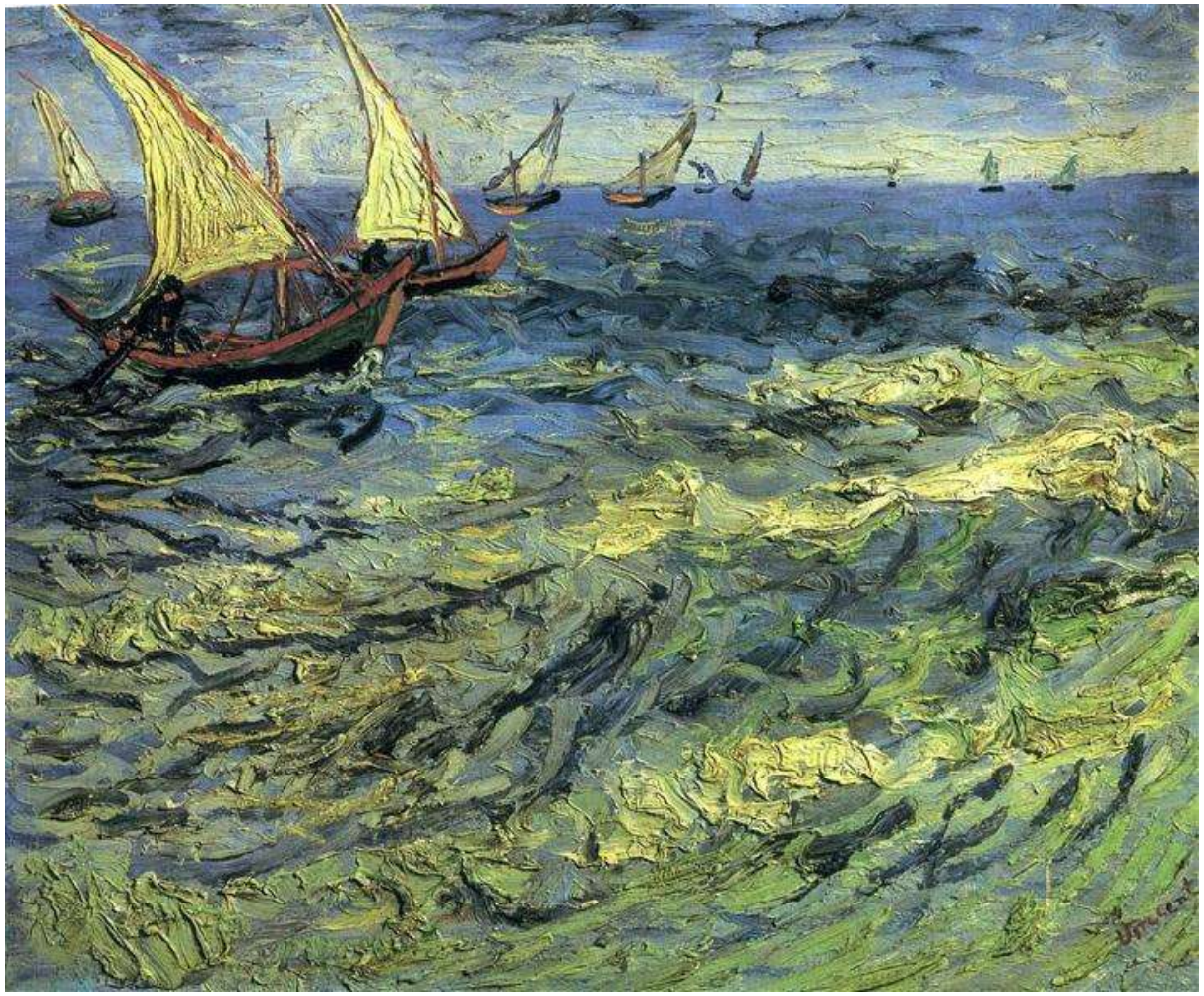
QMS S_ersatz ~→ 1
MC S_ersatz → 0.63

Solutions to resolve the state of exception

Sensitivity analysis and sensitivity auditing

But the real strength of the models, in my mind at least, were in sensitivity analysis (where one could examine the response of the model to parameters or structures that were not known with precision (i.e., sensitivity analysis), and in the examination of the behavior of the model components relative to that of the real system in question (i.e., validation). By undertaking sensitivity analysis and validation, a great deal can be learned about the real system, including what you do not know. (Hall, 2020)

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



Solutions to resolve the state of exception

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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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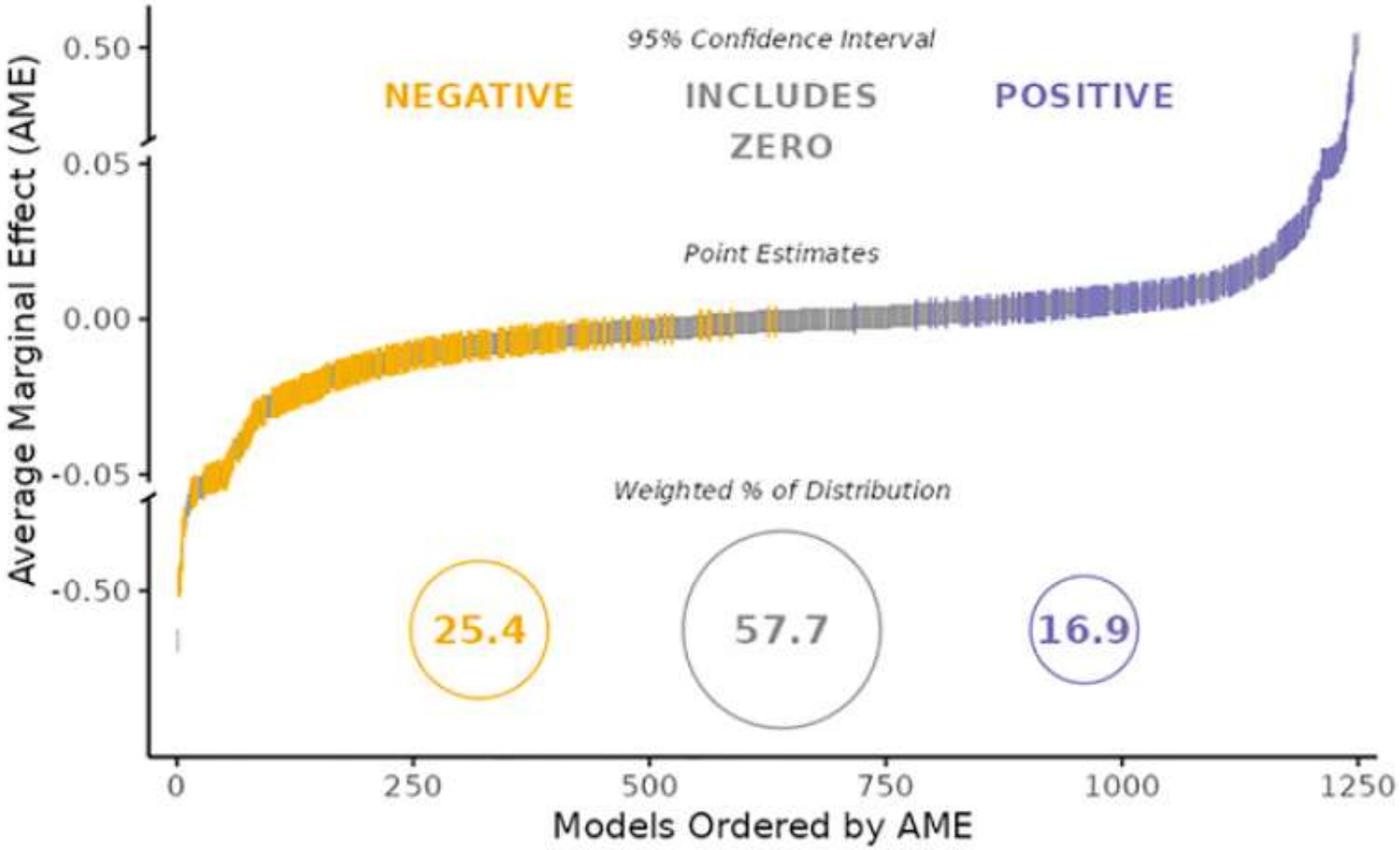
Why this matters?

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)

END

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