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Philosophy of Scientific Advice to Policymakers

:: Luana Poliseli

Abstract

In this essay I offer philosophical reflections on the emerging theme of the philosophy of scientific advice. I discuss some of the challenges of science-based policymaking, underscoring how philosophy of science can contribute to more robust policy development. The piece concludes by introducing new imaginaries that can support more reflective and just approaches to policymaking, one of the aims of our project within the ISR (UKRI) Interdisciplinary Systematic Review: mechanistic evidence and epistemic justice.

How to Cite

Luana Poliseli. *Philosophy of Scientific Advice to Policymakers*. THE REASONER 20(1) 2026. https://doi.org/10.54103/1757-0522/30067

As global challenges such as climate change, health crises, and technological transformation demand immediate informed decisions, the ability to effectively embed scientific knowledge into governance structures becomes critical. Scientific advice is a crucial tool in enabling guidance on scientific matters to inform and assist policy decisions facing the recent polycrises (e.g. COVID-19, biodiversity loss, AI governance, etc.). However, the integration of scientific advice into policymaking processes is increasingly complex and has been frequently contested as technocratic (Strassheim & Kettunen 2014). For instance, the neglect of other relevant world views of legitimate stakeholders in deciding policy-relevant facts are the result of an intensive and complex struggle for political and epistemic authority (ibid.) which sometimes can result in flawed policy prescriptions (Saltelli & Giampietro 2017).

In addressing these and other concerns, in July 2025, the Finnish Academy of Sci-

ence and Letters together with the Scientific Advice Mechanism to the European Commission hosted a Workshop titled Philosophy of Science Advice Mechanism[1]. This informal working meeting brought together international scholars and practitioners engaged in the philosophy of science advice. This essay is inspired partly by discussions that took place during this workshop and goes further, it outlines three core challenges of science advice to policy making (i.e. epistemic, normative, and institutional) and explores innovative imaginaries to overcoming these barriers.

The Challenges of Integrating Scientific Advice into Policy Making

In the *Honest Broker*, Roger A. Pielke Jr. offers two models and four roles of scientists in policy advice.

The Linear Model assumes the position that knowledge is always a prerequisite for action and should sometimes compel policy - scientists would take the role of pure scientists (aligning with a traditional positivist philosophy of science which posits that scientific knowledge can be entirely separate from values and political contexts) or science arbiters (akin to certain standards of empirical engagement, aligned with pragmatism or logical empiricism).

The Stakeholder Model maintains that policy-relevant science should not be considered value-free and that user and use considerations should have a bearing on the production of knowledge for policy - scientists would take the role of issues advocates (reflects an overly normative or activist philosophical stance, linked to critical theory or value-laden pragmatism) or honest brokers of policy alternatives (integrates expertise with democratic pluralism, similar to aspects of deliberative democracy or value-aware post-positivism).

Regardless of possible advantages to his model, Pielke's framework has been criticized as poorly representing the STS scholarly debate and of being too simplistic (see Jasanoff 2006). It is hard not to argue that policy advisers should act as honest brokers of scientific alternatives - disclosing the limits of their information and the extent of their uncertainty in a spirit of professional humility. However, whenever these are not met, decision-making might run the risk of having ambiguities concealed behind monolithic claims of scientific certainty (ibid.)

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[1]https://scientificadvice.eu/events/philosophy-of-science-advice-workshop/

Scientific advice in policymaking is not merely a technical exercise of using scientific information but a complex negotiation of knowledge, values, and institutional arrangements. Thus, whenever addressing complex socioenvironmental problems, science advice faces at least three core challenges: epistemic, institutional and normative. These challenges shape the relationship between science, policy and society and will be addressed below. If scientific advice is to drive meaningful and fair policy outcomes, it must not only navigate these adversities but actively work to dismantle them.

Epistemic challenges: what counts as knowledge and evidence?

Intrinsically to scientific advice is the epistemic challenge of determining which knowledge is relevant and reliable to count as evidence for policymaking. In this paper, knowledge refers broadly to the diverse epistemic resources available to inform division-making including scientific theories, models, experiential insights, and tacit or local know-how, whereas evidence denotes the subset of those resources that are selected, justified, and mobilized to support concrete policy recommendations. This distinction matters because not all available knowledge is automatically treated as evidence in policy contexts, particularly under conditions of uncertainty, constestantion, and urgency. For instance, in many cases, scientific fields are themselves divided, making it difficult to establish what should count as truth or evidence (Greenhalgh & Engebretsen 2022). Beyond formal science, experiential and tacit knowledge from citizens, practitioners, and stakeholders also plays an essential role. Effective policymaking therefore requires the integration of both systematic scientific evidence and context-specific experiential insights, without reducing one knowledge system to the other (Poliseli 2025). This pluralistic approach demands evidence that values diverse forms of knowledge and navigate contested epistemic terrains.

However, existing philosophical accounts of evidence in public health and sustainability research are not adequate to deal with the kind of evidence generated and used to support interventions (Caniglia & Russo 2024). As Susan Haack (2001) argues, evidence should not be understood as a rigid hierarchy or as a mere aggregation of data points, but rather a network of clues that gain credibility through mutual support and coherence. In contrast to hierarchical models commonly used in policy contexts, which privilege specific methodologies such as randomized controlled trials, Haack's network model allows diverse evidential sources to contribute to justification without being reduced to a single evidential standard. Evidential reasoning, on this view, involves both empirical grounding and inferential coherence, so that diverse sources of evidence (statistical models, qualitative narratives, experiential and participatory knowledge) can jointly constitute to the

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overarching evidence complex without being forced into a single methodological standard. These 'clues for action' (Caniglia & Russo 2024), allows to deal with the messy, pluralistic epistemic ecology of public-health and sustainability interventions, enabling judgments under complexity and uncertainty while preserving critical standards of justification.

Institutional Challenges: Who advises whom?

The institutional dimension concerns who provide scientific evidence advice, and how such advice is structured and communicated. There is growing concern about fragmentation and underrepresentation of certain scientific perspectives (Conti et al 2025). Moreover, institutional models must also create space for stakeholder and citizen involvement, ensuring legitimacy and inclusivity in decision-making processes. This requires robust institutional design that bridges science, policy, and society. This might also require thinking on to *whom* are these policies made for? Recent debates have argued that decision-making should be no longer made through a top-down approach but a bottom-up approach. The earlier emphasizes hierarchical control and clear policy design, while the latter focuses on local actors' practices, motivations and interactions in shaping policies outcomes.

Notably, the contrast between top-down and bottom-up approaches mirrors the epistemic tension between hierarchical and network-based models of evidence. Just as pluralistic evidential networks resist rigid methodological hierarchies, non-hierarchical institutional arrangements may allow for more adaptive, reflexive, and context-sensitive forms of scientific advice. While this paper does not propose a fully developed institutional model, the analogy suggests that institutional pluralism, distributed across advisory bodies, stakeholders, and levels of governance, may better accommodate the epistemic complexity of contemporary policy problems.

Normative challenges: ethics and consequences

Scientific knowledge alone cannot dictate political decisions. Policymakers must weigh the likely consequences of different policy options against their ethical implications, a process that extends beyond forecasting impacts to navigating value pluralism and contested notions of fairness. Policy disputes often arise not because of disagreement over empirical projections, but because stakeholders hold divergent views about responsibility, acceptable risk, distribution of burdens, and procedural justice. This normative dimension requires an understanding not only of what *can* be done, but what *should* be done. For example, in climate policy, scientific models can predict emissions outcomes, but decisions about fairness, responsibility, and sacrifice are ethical judgments. The increasing complexity of pol-

icy environments, shaped by overlapping crises and stakeholders' interests, makes identifying universally "correct" solutions increasingly elusive.

Reimagining the role of Science in Policy

To address these challenges, science must assume multiple roles. It should seek fundamental understanding; provide knowledge to achieve policy aims; and help shape inclusive and reflexive decision-making processes. These latter suggest a need for interdisciplinary and transdisciplinary approaches that transcend traditional academic boundaries.

Innovative models: the Interdisciplinary Systematic Review (UKRI)

Dealing with the challenges discussed, the project *Interdisciplinary Systematic Review: mechanistic evidence and epistemic justice* (UKRI 2025-2027) stands out as a promising framework for reaching expert consensus in complex policy domains, overall, in public health. Traditional evidence-based evaluation methods rely heavily on specific types of studies, especially randomized controlled trials, while often overlooking other valuable forms of evidence, such as mechanistic research and stakeholder perspectives. The ISR-UKRI project, by adopting two approaches to review, the Evidential Pluralism Review and the Mechanism-Informed Narrative Synthesis, *both in development*, adopts a structured, interactive format for causal enquiry, to create a more comprehensive and systematic approach to evidence review. By integrating diverse forms of evidence across disciplines, the project aims to deliver more informed and inclusive evaluations. These methods are being tested through a new review of the effectiveness of face-mask efficacy, mandates and use during the COVID-19 pandemics. It is expected that this framework will allow experts and stakeholders to refine their views and converge on informed recommendations, consensus and guidance on specific issues. Furthermore, it is also expected that these review methods will promote transparency, trust, and shared ownership for policy decisions.

Seen through the lens of the three challenges outlined earlier, the Interdisciplinary Systematic Review framework can be understood as addressing epistemic, institutional, and normative dimensions simultaneously. Epistemically, it operationalizes systematic review by integrating mechanistic, quantitative, qualitative, and experiential sources without imposing a rigid hierarchy. Institutionally, its iterative and participatory review structure creates spaces for interdisciplinary collaboration and stakeholder engagement, thereby, mitigating fragmentation and exclusion. Normatively, by making value assumptions, uncertainties, and trade-offs explicit, the

framework supports more transparent deliberation about biases, fairness, responsibility, and acceptable risk in policy recommendations.

Conclusion

The study and practice of science in policymaking have developed significantly in recent years, yet their philosophical underpinnings remain somewhat under-examined. Scientific advice in policymaking is not merely a technical exercise but a complex negotiation of knowledge, values, and institutional arrangements. Robust philosophical scrutiny from a variety of normative and epistemic perspectives helps to ensure that the theoretical foundations of the discipline are robust. Addressing epistemic, normative, and institutional challenges requires adaptive, inclusive, and collaborative approaches. Methods such as the UKRI SR+NR+ initiatives, combined with sustained reflection on the role of science in society, can help build more effective and legitimate pathways for integrating complex knowledge into public decision-making. However, we should continually ask whether policymaking is truly about diagnosing pre-existing social problems and applying evidence-based scientific solutions, or whether it is, instead, a contest over how problems are defined and framed. Competing framings determine not only what counts as a problem but also who is held responsible and what kinds of scientific interventions are deemed appropriate.

Declaration of generative AI and AI-assisted technologies   To increase the readability and language of this paper, generative artificial intelligence and AI-assisted tools were used to review this text and increase its intelligibility.

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What De Finetti Really Meant When He Said *"PROBABILITY DOES NOT EXIST"*: A Comment on Spiegelhalter's Interpretation

∷ **Tommaso Costa**

Abstract

Few sentences in the philosophy of probability have generated more confusion than Bruno de Finetti's famous claim that "probability does not exist". The line is routinely interpreted as a denial of probability itself, while de Finetti intended only to reject the idea that probability is an objective property of the world. A recent essay by David Spiegelhalter in Nature has reintroduced this ambiguity through an instrumentalist "as-if" formulation. This short note clarifies the distinction between de Finetti's anti-metaphysical stance, Spiegelhalter's pragmatic instrumentalism, and E. T. Jaynes's conception of probability as a form of epistemic objectivity. Recognising these differences helps avoid persistent misunderstandings about what 'non-existence' means in probabilistic contexts.

How to Cite

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Few sentences in the philosophy of probability have generated more confusion than Bruno de Finetti's striking declaration that "probability does not exist". The line appears at the opening of his Theory of Probability (1974: Theory of Probability, Wiley, Preface) and has since travelled far beyond its original context. Detached from the explanation that immediately follows, the phrase is often read as a radical rejection of probability itself.

De Finetti's own presentation makes the intended meaning unmistakable. In the Preface of Theory of Probability he writes, in block capitals as in the original:

PROBABILITY DOES NOT EXIST.

He immediately adds: "My thesis, paradoxically, and a little provocatively, is simply this: PROBABILITY DOES NOT EXIST. The abandonment of superstitious beliefs about the existence of 'objective' probabilities is absolutely essential."

Seen in its full context, the slogan is not a rejection of probability itself, but of the metaphysical belief that probabilities are real properties of the world.

De Finetti makes this explicit in *Lezioni di Calcolo delle Probabilità* (1970, Einaudi, pp. 3–5), where he writes that probability is "not an objective property of things, but a subjective way of expressing our degree of confidence". The point is repeated in *Probabilità, Induzione e Statistica* (1972: Einaudi, Ch. 1). His view is simply that nature does not contain "real probabilities" in the way it contains masses or temperatures. Probability exists only as coherent degrees of belief.

A recent essay has revived this ambiguity. Spiegelhalter (2024: Does probability exist?, *Nature*, 560–563) argues that numerical probabilities are not objective features of the world, but constructions based on judgement — a view that is close to de Finetti's and entirely correct. Yet the essay ends with the claim that "probability probably does not exist — but it is useful to act as if it does." This introduces a form of pragmatic instrumentalism: probability becomes a convenient fiction rather than a logical norm.

This is not de Finetti's view. For de Finetti, probability is not a fiction; it is the logic of coherent belief. Jaynes makes this point in *Probability Theory: The Logic of Science* (2003: Cambridge University Press, pp. 4–6). For Jaynes, probability is "a property of our state of knowledge", meaning that if two rational agents share the same information, they should—at least ideally—assign the same probabilities.

Once this distinction is clear, the problem with "acting as if probability existed" becomes visible. The instrumentalist stance frames probability as merely useful rather than logically necessary. Under de Finetti's and Jaynes's views, the probability calculus is not optional: it is the unique system of rules that rational agents must follow to avoid incoherence.

Recognising this distinction can help clarify ongoing discussions about uncertainty, modelling, and the epistemic foundations of scientific inference. This short comment is meant to disentangle these positions, not to criticise them.

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On the Soundness of S5

:: **Alex Blum**

Abstract

We prove that the characteristic axiom of modal system S5 under the assumption that the modal operators are logical operators is sound.

How to Cite

Alex Blum. *On the Soundness of S5*. THE REASONER 20(1) 2026. https://doi.org/10.54103/1757-0522/29438

The characteristic formula of system S5, the system commonly accepted as the logic of metaphysical modalities is:

$$(S5) \text{ Pos } P > \text{ Nec Pos } P,$$

where 'Pos' stands for 'Possible' and 'Nec' for 'Necessary'.

We intend to show that if 'Nec' and 'Pos' are thought of as 'logical necessity' and 'logical possibility' then the characteristic S5 formula is clearly necessarily true.

We first transpose and get (S5)'s logical equivalent:

$$(S5') \text{ Pos Nec } P > \text{ Nec } P,$$

For if it is possible that P is necessarily true, then it is possible that P is implied by every sentence, that is by $\neg P$ as well. But no contingent proposition can be implied by its negation e.g., Nec $(\neg P > P) >$ Nec P. Hence P cannot be contingent. And since P is possible, P cannot be a contradiction. Hence (S5') and thus (S5).

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Prime Lattices and the Structure of Arithmetic: A Conceptual Note

:: Joshua Sanctus

Abstract

This paper gives a clear account of how prime numbers form the basic structure of arithmetic. Using the Fundamental Theorem of Arithmetic, I show that every natural number can be written as a product of primes and that this makes it possible to picture numbers as points in a lattice, each one defined by its prime factors. In this way, arithmetic is not built from isolated numbers but from the network of relations among primes. What is real, on this view, is not the numbers themselves but the structure that connects them.

How to Cite

Joshua Sanctus. *Prime Lattices and the Structure of Arithmetic: A Conceptual Note*. The Reasoner 20(1) 2026. https://doi.org/10.54103/1757-0522/29911

Introduction

Philosophers of mathematics have long asked what kind of things numbers are. Platonists think numbers exist independently of us, nominalists deny that they exist at all, and structuralists hold that what matters are not objects themselves but the places they occupy within a structure [1, 2].

Most discussions focus on sets, functions, or abstract patterns. Yet one part of arithmetic has received little attention in this debate: prime numbers. By the **Fundamental Theorem of Arithmetic**, every natural number greater than one can be written in one and only one way as a product of primes [7]. Primes are therefore

the basic building blocks or the *'atoms'* of arithmetic. If mathematics is understood structurally, then primes are natural candidates for the most basic elements of that structure. They can be seen not as isolated objects but as coordinates in a network of relations. This paper develops that idea. First, it shows how prime factorization represents each number as a point in an infinite-dimensional lattice. Second, it describes this lattice in set-theoretic terms, where numbers correspond to finitely supported functions from primes to natural exponents. Finally, it draws the philosophical conclusion: numbers are not self-standing things but positions within a lattice of prime relations.

This note extends structural realism by giving it a precise mathematical instance: the structure it describes is not hypothetical or abstract, but one required by the arithmetic facts themselves.

Primes as Structural Units

The most natural place to begin is with the Fundamental Theorem of Arithmetic. This theorem states that every natural number greater than one can be expressed uniquely as a product of prime powers [7]:

$$\forall n \in \mathbb{N}, \ n > 1 \implies n = \prod_{i=1}^{k} p_i^{a_i},$$

where each p_i is prime and each $a_i \in \mathbb{N} \cup \{0\}$. This result shows that primes act as the irreducible "atoms" of arithmetic. All natural numbers are built out of them, and no number greater than one escapes this structural dependence. From this point of view, each natural number can be represented not only as a product, but also as a vector of exponents across the primes:

$$n \mapsto (a_1, a_2, a_3, \dots).$$

For instance, numbers such as 12 and 30 can be represented in this way, with each coordinate recording the exponent of a prime.[2] The natural numbers can therefore be embedded into an infinite-dimensional lattice of prime exponents, with each axis corresponding to a distinct prime. This provides a structural representation of arithmetic in terms of coordinates rather than isolated objects. We can make

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[2]For example, $12 = 2^2 \cdot 3^1$ corresponds to $(2, 1, 0, 0, \dots)$, while $30 = 2^1 \cdot 3^1 \cdot 5^1$ corresponds to $(1, 1, 1, 0, \dots)$.

this more precise in terms of set theory. Let $\mathbb{P}$ be the set of all primes. Define a mapping:

$$f : \mathbb{N}_{>1} \to \mathbb{N}^{(\mathbb{P})}, \quad f(n)(p) = a_p,$$

where $\mathbb{N}^{(\mathbb{P})}$ denotes the set of finitely-supported functions from $\mathbb{P}$ to $\mathbb{N}$. In this framework, each number is a finite function that assigns exponents to primes.

The philosophical consequence is clear. While this note focuses on multiplication and its inverse, it is important to acknowledge that addition and subtraction occupy an equally fundamental place in arithmetic, from informal counting practices to formal Peano systems. Prime-lattice representations are indeed less natural for additive operations; addition does not preserve the coordinate structure given by exponents. This limitation, however, does not undermine the structural point being made. The prime lattice isolates the multiplicative backbone of the integers—the structure determined by the Fundamental Theorem of Arithmetic—and structuralist ontology does not require a representation to capture all operations at once. The aim of this note is therefore more modest: to show that the multiplicative relations alone already supply a rich and necessary structural framework.

If structuralism in mathematics is correct, then the ontological role of numbers is not that of independent entities but of positions within a relational system [1, 2]. On the prime-lattice view, this relational system is generated specifically by the distribution of primes. The primes themselves serve as basis vectors, and the integers emerge as coordinates in this prime-defined structure. This suggests that what truly exists are the *relations of prime structure*, not numbers as individual objects.

Computation and Structure

The structure defined by primes is not only mathematical but also computational. In computation, primes play a key role in algorithms for encryption, random number generation, and complexity analysis. The same properties that define integers in the prime lattice also shape how information is processed and secured.

Public-key cryptography provides the clearest example. The security of systems such as RSA depends on the fact that multiplying two large primes is easy, while factoring their product is extremely hard. This asymmetry reflects a structural feature of arithmetic itself: moving "forward" through multiplication is simple, but moving "backward" through factorization is costly. The lattice of primes there-

fore captures not only numerical identity but also the limits and possibilities of computation [9, 10].

These ideas suggest that the complexity of algorithms is rooted in the same relations that define numbers. If numbers are determined by their position within the lattice, then computational difficulty expresses the geometry of that structure. The prime lattice thus connects arithmetic and computation: numbers act as structural nodes, and algorithms trace the paths between them. In this sense, the prime lattice shows how a simple mathematical principle can give rise to both the organization of numbers and the constraints of computation. It illustrates how mathematical structure can shape what can be computed, making arithmetic not only a theory of numbers but a framework for information itself.

Philosophical Payoff and Objections

The prime lattice view offers a clear philosophical result. If the identity of numbers comes from their relations to primes, then the ontology of mathematics is not based on independent objects but on structure itself. This matches the structuralist idea that mathematical entities exist only through the relations they take within a system [1, 2]. In this picture, primes act as the basic directions of that system, and integers are the coordinates they define. Numbers are not separate things, but positions in a web of prime relations.

This has consequences for realism in mathematics. Platonism treats numbers as timeless objects, and nominalism denies them altogether. Structuralism stands between these views, holding that what exists is the structure, not the objects [3, 4]. The prime lattice makes this idea precise. It replaces general talk of "patterns" with a definite mathematical construction grounded in the Fundamental Theorem of Arithmetic [7]. The structure is not invented but required by arithmetic itself. One objection is that the lattice might seem only a metaphor. But every number greater than one fits uniquely into this system, so the representation is not arbitrary but necessary. It shows, rather than assumes, that numbers are defined by their relations. A second objection is that primes themselves remain abstract. If they are part of the structure, what makes them real? The answer follows the line of structural realism in science [5, 6]: what matters is not the nature of the basic units, but the roles they play in maintaining the structure. Primes exist only through the relations that define them. A final concern is that not every structure deserves ontological status. But the prime lattice is special: it follows from a theorem that holds in all consistent versions of arithmetic. It is therefore a natural, not a chosen,

structure [8, 10]. A related question is whether a similar structural interpretation could be developed using p-adic numbers. In one sense, the answer is yes: each p-adic valuation isolates a prime and encodes numerical behaviour along that single direction. However, p-adics provide a local completion of the integers relative to a fixed prime, whereas the prime lattice introduced here is global: it records the exponents of all primes simultaneously. The structuralist claim advanced in this note depends precisely on this global coordination, since integers are defined by their full profile across the prime system, not by their behaviour under any single p-adic metric. The two perspectives are therefore complementary rather than interchangeable.

Together, these points show that the prime lattice gives a concrete example of structural realism in mathematics. It links number theory and ontology by showing that arithmetic depends on relations rather than objects. Primes are not marginal curiosities, but the simplest expression of mathematical structure itself.

Relational Invariants and Ramanujan Structure

The prime lattice is not only a static arrangement but also a pattern of repeating relations. Congruences show that arithmetic structure has internal symmetry: numbers that differ by a multiple of a modulus share the same relational form. These repeating patterns act as *relational invariants*-features of arithmetic that remain constant even as numbers change.

Ramanujan's sums express this idea in a different way[12]. They reveal hidden periodicity in the arithmetic world: apparent randomness in the primes still gives rise to rhythmic order. The lattice therefore has a harmonic aspect, where structure repeats in cycles of relation rather than in fixed positions. This combination of invariance and harmony shows that arithmetic structure is both stable and dynamic. The same relations that define numerical identity also generate recurring patterns, making the prime lattice not just a framework of positions but a living geometry of relations.

Conclusion

This paper has shown that prime numbers reveal a deep structural order within arithmetic. By the Fundamental Theorem of Arithmetic, every number can be seen as a point in a lattice defined by its prime factors. Numbers are not independent

objects but positions in this lattice of relations.

The prime lattice gives a simple and precise example of how mathematical reality can be understood structurally. It turns the idea of "structure" from a metaphor into a clear construction, one that arises from arithmetic itself rather than from interpretation. Through congruence and periodicity, the lattice also shows a hidden harmony, echoing the rhythmic order that Ramanujan found in number patterns. The result is not a new mathematics but a clearer way of seeing what mathematics already contains. If structural realism is right, then the prime lattice stands as one of its clearest examples: a necessary structure that gives arithmetic its form, order, and quiet symmetry.

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S. Barocas, M. Hardt and A. Narayanan. *Fairness and Machine Learning: Limitations and Opportunities. MIT Press, 2023*

:: **Leonardo De Pin**

Abstract

This review discusses Fairness and Machine Learning by Barocas, Hardt, and Narayanan, highlighting its comprehensive and interdisciplinary treatment of fairness in algorithmic decision-making. The book is accessible, open access, and enriched by insights from ethics, law, and the social sciences.

Automated decision-making systems based on machine learning are increasingly deployed in high-stakes areas such as criminal justice (risk assessments), hiring (automated résumé screening), healthcare (predictive diagnostics), and others. These developments raise questions about their legitimacy, advantages, and limitations regarding fairness and discrimination—these are precisely the issues tackled by Barocas, Hardt, and Narayanan in *Fairness and Machine Learning: Limitations and Opportunities*.

The appeal of automating decision-making lies in the promise of more accurate and efficient outcomes. Such systems can follow rules, learn from past decisions, and detect new patterns in data. For example, résumé-screening tools predict job performance and reduce arbitrariness in hiring. Yet they may also perpetuate inequalities encoded in training data or introduce new biases through model design—such as penalizing equally qualified women if historical gender bias is present. Even seemingly relevant predictors like education can raise concerns, since they

reflect structural factors such as family income. In sensitive domains like criminal sentencing, the very legitimacy of delegating decisions to machines is open to question.

Often, these concerns are addressed through technical solutions or formal definitions of fairness, which are frequently very abstract. However, these issues go beyond technical features of the system and involve moral, legal, and domain-specific considerations. Each context has different discrimination mechanisms, penalized categories and objectives. The authors capture this complexity effectively, offering a comprehensive treatment of fairness: problems, risks, formal criteria, connections to moral and legal concepts, analyses of discrimination mechanisms, and more.

The book structure is straightforward, with chapters grouped into four main themes: the first two provide the motivation and an overview of fairness issues; Chapters 3-5 develop the technical background; Chapters 6-7 adopt a more practical stance, illustrating how fairness is addressed in law and tested; the last two chapters offer broader reflections on discrimination and datasets.

The opening chapters introduce the debate by showing why fairness in machine learning is important and outlining the decision-making contexts where fairness concerns arise.

Chapter 1 presents the book's central concern: the impact on group disparities when decision-making is delegated to machine learning. To better explain how demographic disparities can propagate, the authors introduce the "machine learning loop", a conceptual model with four stages: measuring the state of the world in data, learning to turn data into a model, acting on the model's predictions, and feeding back the results, to alter the world. Biases can arise at any stage, and understanding these dynamics and mitigating them is complex.

Chapter 2 examines the legitimacy of automated decision-making systems, asking whether their use is fair. The authors argue that machine learning is used to automate bureaucratic processes designed to limit arbitrariness through formal procedures. They focus on concerns posed by predictive optimization—a particular form of automation where decision rules are learned directly from data— illustrating cases in which the legitimacy of automated decision making can be questioned.

Chapters 3–5 provide technical foundations, presenting measures, definitions, and models of fairness and their trade-offs.

Chapter 3 focuses on classification, the task of predicting which category an input belongs to, based on patterns learned from labeled data. The authors formally characterize classification and introduce three statistical fairness criteria: independence (group membership is independent of the classification's outcome), separation (error rates are the same across groups), and sufficiency (the outcome is independent of group membership given the prediction). These criteria are then shown to be incompatible: satisfying one often means violating the others. The chapter ends with a discussion of the inherent limitations of statistical criteria, one being that they do not reveal the causal mechanisms through which disparities are created.

Chapter 4 explores the moral landscape behind fairness and discrimination, discussing why discrimination is wrong and illustrating three views of equality of opportunity, often conceived as the foundation of fairness. The three views—narrow, middle and broad—are assessed by highlighting the tensions between them, their strengths and implications. Most importantly, the chapter considers whether statistical notions of fairness can be normatively justified by connecting them to views of equality of opportunity. While some alignment is possible, the correspondence is loose: moral notions require a causal understanding of disparities, something statistical approaches lack.

Chapter 5 addresses these limitations by introducing causal reasoning tools. Using structural causal models, the authors describe interventions, control for confounders, and address counterfactual questions such as "Would the applicant have been rejected had she been of a different race?" These tools are used to analyze causal and counterfactual questions about discrimination and to introduce counterfactual fairness criteria. The chapter concludes with an assessment of causal modeling's validity, noting its advantages and limitations.

Chapter 6 reviews the main anti-discrimination laws and doctrines, such as disparate treatment and disparate impact, outlining their history, uses, and limitations. It shows how these frameworks can inform the regulation of machine learning but argues that they are insufficient, suggesting that privacy and consumer protection law should also play a role.

Chapter 7 surveys traditional methods for testing discrimination, from audit studies to regression analyses, and shows their application to machine learning in different domains: natural language processing, computer vision, and online platforms. These examples illustrate that unfairness arises in subtle, context-dependent ways, reinforcing the idea that there is no single fairness test and its choice must follow moral and domain-specific considerations.

Chapter 8 broadens the scope by analyzing discrimination at three levels––structural, organizational, and interpersonal. It highlights how laws, policies, and education shape structural inequalities, which can be reinforced by machine learning systems. The authors propose interventions at both structural and organizational levels, stressing the need to move beyond narrow views of fairness that focus only on minimizing numerical disparities.

Chapter 9 turns to datasets, describing some widely used examples and the multiple roles they play in machine learning. The authors examine the "benchmark approach" in building and using datasets, noting its benefits but also its risks, and emphasize that problems stem not only from data but also from the cultural and normative practices surrounding them. The chapter closes with proposals for more responsible dataset practices.

After reviewing the main contents of the book, several strengths stand out. First, it offers a broad and comprehensive account of fairness in machine learning. The authors not only define fairness and explain its technical implementation, but also raise deeper questions: Why is discrimination wrong? What effects does it have? What moral justifications support competing definitions of fairness, and how should we choose among them?

Second, the authors emphasize the importance of context in fairness interventions. A fairness criterion applied through a technical adjustment or validated by a test does not guarantee that a system is fair. Discrimination is deeply rooted in culture and society, and fairness interventions can generate feedback effects––for instance, adjusting thresholds in credit scoring may reshape lending patterns, resulting in new data used for future models. Fairness is thus not a static property of a model but requires continuous monitoring and long-term evaluation. Meaningful interventions must be context-sensitive, guided by moral reasoning and domain-specific considerations.

No single book can exhaust the topic, and as noted by Cohen, J. and Liu, L.(2025:

The Reach of Fairness, *ACM J. Responsib. Comput.* 10.1145/3718989), the discussion could be extended. Barocas, Hardt, and Narayanan focus mainly on organizational decision-making, devoting less attention to structural interventions. Cohen and Liu also argue that fairness should not be reduced to equality of opportunity, the notion on which the book primarily focuses, but should be understood more broadly.

Beyond these limitations, two further strengths deserve emphasis. First, the book is multidisciplinary, drawing on ethics, law, the social sciences, and computer science. This breadth makes it appealing to a wide audience and situates the technical material in its normative and institutional context. Second, it is open access, ensuring that its insights are freely available to researchers, practitioners, and policymakers alike.

Overall, the book is accessible without oversimplifying. The authors guide the reader step by step, though some chapters—particularly 3 and 5—are more technically demanding, and non-experts may need to approach them slowly. Yet the combination of an introductory style, interdisciplinary reach, and open-access availability makes it a valuable resource for a wide audience and strongly recommended to anyone interested in the ethical challenges of machine learning.

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Jacob Stegenga: Medical Nihilism. Oxford: Oxford University Press, 2018, xiv + 227, ISBN 978-0–19–874704–8.

∷ Giovanni Sanavio

Abstract

This review critically assesses the main claim and argument of Jacob Stegenga's book Medical Nihilism, published in 2018 by Oxford University Press. It considers some problematic aspects of the application of Bayes' theorem in support of the author's thesis, and it discusses a brief selection of unclear consequences.

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In his book *Medical Nihilism*, published in 2018 by Oxford University Press, Jacob Stegenga aims to defend the claim that "our confidence in the effectiveness of medical interventions ought to be low" (Stegenga, 2018 *Medical Nihilism*, Oxford University Press, p.11). This work is part of a wider line of research in clinical epistemology criticizing the unwarranted trust that ordinary people, patients, and healthcare professionals seem to place in the effectiveness of many clinical practices. This skeptical stance radically questions the optimism of evidence-based medicine (EBM), which assesses the quality of clinical evidence through fixed hierarchies of reliability, celebrating the use of randomized control trials (RCTs) and metaanalyses while downplaying mechanistic reasoning (see Devanesan, 2020: *Medical nihilism: the limits of a decontextualized critique of medicine*, Studies in History and Philosophy of Biological and Biomedical Sciences, 79, DOI: 10.1016/j.shpsc.2019.101189).

Through an extensive list of examples, Stegenga observes that the use and prescrip-

tion of several medical interventions, including treatments associated with severe side effects, seems to rely on unpersuasive evidence-bases. His critique targets the very core of clinical medicine, claiming that the effectiveness of medical interventions is poorly assessed whenever it is not clearly and readily appreciable, thus motivating distrust. However, it is fundamental to emphasize that his argument is neither simplistic nor anti-scientific. The author does not in fact deny the existence of some unquestionably effective medical interventions, specific for certain diseases, nor that well-conducted medical scientific research can produce beneficial results.

Stegenga acknowledges that different classes of medical interventions are associated with different degrees of effectiveness: some interventions are highly effective, others moderately effective, minimally effective, or not effective at all (Stegenga, 2018: p.184). The primary target of Stegenga's critique are thus the classes of interventions ranging from moderately effective to wholly ineffective, later identified with pharmacological interventions (i.e. administration of drugs) and related testing methodologies. This focus on drugs is plausibly motivated by the author's hybrid conception of health and disease, according to which a disease is a causally determined physical state that is also negatively valued, typically in terms of harm or discomfort. On this view, a medical intervention qualifies as effective only if it targets the causal basis of a disease or mitigates its associated discomfort. Pharmacological interventions fit this conception particularly well, as they are readily amenable to evaluation through RCTs. This is especially salient given Stegenga's insistence that assessments of effectiveness should also account for the potential harms (in the form of side effects) that can be caused by such interventions.

Measuring the effectiveness of pharmacological interventions is an operation susceptible to many biases at the level of the design of RCTs'. Stegenga proceeds identifying different stages of clinical testing which in his view may be permeable to such biases, including the selection of outcome measures, the analysis and comparison of results, and the determination of statistical procedures generalizing these results beyond the tested population (*ivi*: p.114). More broadly, he argues that trials designed to assess the effectiveness of drugs exhibit malleability, a characteristic defined by the extent to which their execution depends on discretionary decisions potentially influenced by idiosyncratic and subjective factors. Malleability is then an undesirable feature of clinical trials, as it compromises their objectivity and replicability.

Structure of the "master argument"

Towards the end of the book, Stegenga develops an argument, which he calls the
"master argument", to conclude that there are no adequate epistemic grounds to
support the effectiveness of most medical (i.e. pharmacological) interventions.
To make his position more formally explicit, he introduces H as the hypothesis
that a certain medical intervention, call it I, is effective. The probability $P(H)$ is
therefore the probability that I is effective, which he interprets as a degree of belief
based on all the relevant available evidence. Stegenga then introduces E as the
available evidence regarding I and $P(E)$ as the degree of belief in the evidence of
the effectiveness of I (*ivi*: p.168).

Motivated by the high malleability of commonly published clinical analyses, Ste-
genga assumes that, for most of them, the value of $P(E)$ is high while $P(H)$ is low.
This means that it is generally admissible that the effectiveness of I is evident, even
though it is not very plausible that I is truly effective. However, even when limiting
the scope of investigation to pharmacological interventions, it cannot be taken for
granted that the evidence E supporting H has a uniform and precise meaning.

The author's insistence on the pervasiveness of biases in RCTs' design stages seem
to force an interpretation of E as evidence of correlation, since this is the only
type of evidence that lends itself to be manipulated by personal idiosyncrasies and
flawed statistical analyses. The case becomes considerably more complicated if E
is interpreted as evidence of mechanism, given that RCTs motivated by this type
of evidence tends to test research hypotheses on more carefully selected groups
of subjects – this is to avoid excessive dilution of the observed effect on subjects
who may not respond adequately to the therapy. In such cases, it is plausible to
admit a low value of $P(E)$, especially if it is not known a priori on which subjects
the intervention will be effective. For the low value of $P(H)$, Stegenga follows
the pessimistic argument that, given that many therapies considered very effective
in the past have proved useless or harmful over time, the probability that a new
therapy will prove to be definitively very effective is low (here, the notions of
"evidence of correlation" and "evidence of mechanism" are meant according to
the account presented in Shan and Williamson, 2023: *Evidential Pluralism in the
Social Sciences*, Routledge, pp. 3-30).

From these assumptions about $P(E)$ and $P(H)$ Stegenga derives that the value of
the conditional probability $P(E|H)$ must also be low. This means attributing little
value to the belief that the supposed truth of H contributes to make E more prob-
able. To ensure the arithmetic consistency of this assumption, the author is forced
to further clarify the meaning of E, stating that this is evidence of "a poor effec-

tiveness of I" (Stegenga, 2018: p.176). Setting aside the legitimacy of this move, it is nevertheless possible to comply with the author and ensure that the assumption on the high value of $P(E)$ remains unchanged. At this point, it is intuitive that the conditional probability $P(H|E)$, which Stegenga calculates via Bayes' theorem, can only represent the low support of H given by E, thus formally motivating his main claim. Applying the formula:

$$P(H|E) = \frac{P(H) \cdot P(E|H)}{P(E)}$$

it is clear that the value of $P(H|E)$ must be low for elementary arithmetic reasons. In fact, it is the result of the product of two small numbers, both smaller than 1, divided by a number that is also smaller than 1 but greater than both. This is the conclusion of the "master argument".

What is promised and what is delivered

The application of Bayes' theorem seems to justify the lack of support that E provides to H. It therefore seems surprising that, given the formal clarity with which the "master argument" is set out and the arithmetic necessity of the conclusion, the nihilistic thesis is not incontrovertibly accepted by everyone. The problem emerges clearly considering the conditions under which this operation results in a low posterior probability $P(H|E)$, such as to rationally motivate distrust in the effectiveness of I. Appropriate and intuitive requirements are that effectiveness must be adequately measured, and it must be evident that the subjects included in the trial exhibit the symptoms of the disease to be treated. Failures to apply Stegenga's argument depend on the fact that the assumptions on which it is based are not always valid, and that the interpretations of the probabilities involved are not always consistent (a similar point is considered in Gillies, 2018: *Should we distrust medical interventions?* Metascience, 28, DOI: 10.1007/s11016-019-00396-z, pp. 273-276).

Given the reasons leading the author to question the effectiveness of pharmacological interventions, it is obvious that such evidence cannot support any hypothesis of effectiveness. The application of Bayes' theorem merely confirms this fact. Stegenga's point could therefore be that, limited to the classes of medical interventions he considers, the evidence reported in support of their effectiveness is in fact probabilistically greater than that of their actual effectiveness. The conclusion that the high effectiveness of I is not adequately represented by the reported evidence is obvious and there is no need of justifying it using Bayes' theorem. On the contrary, the application of the theorem results unclear.

One further limitation of Stegenga's analysis is that it fails to consider the relevance of moderately effective medical interventions and interventions that are considered to be effective even without proper assessment. In fact, although the argument is not so naive as to reduce all existing therapies to either very effective or completely ineffective, it is still possible to find counterexamples and borderline situations challenging the overall analysis. An interesting case in this sense is the evaluation of effectiveness of oncological treatments: it is difficult to define a notion of effectiveness for therapies aiming to help patients live along with chronic conditions in the absence of definitive cures. A further complication is that the conception of side effects as negative effectiveness values can contribute to underestimate the effectiveness measures of certain containment therapies. Noticeably, chemotherapy is often a potential cause of pain and physical dysfunction for patients due to its duration and intensity, but on these bases it seems irrational to conclude that it is less effective in curing cancer.

With respect to the problematic interpretation of E as evidence of mechanism, it is sufficient to observe that the quality of clinical decisions cannot obviously depend solely on statistical factors. The act of evaluating the effectiveness of a medical intervention is in many cases a complex process in which eminently clinical motivations are combined with statistical and experimental results. These considerations should be carefully considered by those who wish to endorse medical nihilism.

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Bayesian Epistemology in the Age of Disinformation, Bologna, 4–5 December

:: **Lorenzo Casini**

Abstract

This article reports the content of the talks given at the workshop "Bayesian Epistemology in the Age of Disinformation", which was held at the University of Bologna on 4–5 December 2025.

The workshop "Bayesian Epistemology in the Age of Disinformation", organized by Lorenzo Casini at the University of Bologna, brought together cognitive scientists and formal epistemologists to examine how Bayesian epistemology can illuminate the mechanisms of belief formation, polarization, and susceptibility to disinformation in imperfect information environments.

In the opening talk, *Identity, Dependence, and Polarization: A Bayesian Study*, Jürgen Landes (LMU) examined the influence of perceived dependencies among information sources on polarization between groups. Building on and generalizing recent formal results, Landes demonstrated analytically and through simulations that disagreements about in-group and out-group dependencies are sufficient, even without any difference in group reliability, to produce polarization across a wide range of parameter settings, such as numbers of agents and their reliability.

The second talk, *A Bayesian Analysis of Witness Reliability*, was given by Paolo Garbolino (IUAV), who presented a structured Bayesian network that models witness credibility by disentangling perceptual sensitivity, cognitive belief formation, and ideological sincerity. He argued that this layered approach allows for

a more precise assessment of evidential weight in legal and epistemic contexts, and showed how the same framework can be extended beyond human witnesses to assess the reliability of online opinions and outputs generated by artificial intelligence systems.

Next, in *How Industry Influence on Science Interacts with Assertion Practices*, Klee Schöppl (Groningen) explored how strategic industry interventions can undermine collective inquiry within scientific communities. Using agent-based simulations grounded in the NormAN framework, Schöppl showed that both obfuscating strategies that redirect inquiry and misleading strategies that selectively communicate evidence can significantly increase polarization and error, with their epistemic impact being strongly mediated by the norms governing what scientists choose to assert and share.

In the talk *Rational or Biased? Examining Belief Updating in Politically Charged Context Using Bayesian Networks*, Greta Sanna (UCL) reported experimental results that challenge prevailing pessimism about reasoning in politically polarized environments. Through studies with U.S. partisan participants, they showed that belief updating in response to corrective evidence often closely tracks Bayesian predictions, suggesting that apparent resistance to correction is better explained by the strength of prior beliefs than by identity-driven irrationality.

The final talk, *Bayes, Bias, and Bots: (Ir)rational Updating on Expert Advice*, given by Piero Avitabile (IMT), investigated how people update their beliefs when confronted with expert testimony from different kinds of sources. Presenting results from a pilot study, Avitabile showed how participants' posterior beliefs deviated from Bayesian norms and how these deviations varied depending on whether the expert was described as a human or a large language model, shedding light on people's heuristics when using expert knowledge.

The event was very successful. Overall, the talks highlighted the dual role of Bayesian epistemology as both a normative ideal and an explanatory framework for diagnosing epistemic failures. By combining formal modeling, simulations, and experimental evidence, the workshop advanced our understanding of how cognitive limitations, social identity, and information structures interact to shape belief formation, trust in expertise, and the dynamics of polarization in scientific, legal, and public discourse.

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A Seminar Series on the History of Logic, and beyond

:: **Francesco Montesi, Antonio Piccolomini d'Aragona, Francesco Pisano**

Abstract

We present the Seminar Series on the History of Logic, held (at the Department of Humanities of the Federico II University of Naples) since September 2024, and a number of side-activities, such as the 1st Naples Workshop on the History of Logic, held (at the same Department as above) on October 28–29 2025.

Since September 2024, a Seminar Series on the History of Logic has been regularly held at the Department of Humanities of the Federico II University of Naples. Organised by the authors, the Series consists of talks delivered monthly, either on-line or in person.

The core idea of the seminar series is that historical knowledge is a powerful tool for understanding and advancing in all fields of science, including formal sciences. It has been argued that logic has no history, because it is meant to reflect conceptual, linguistic or ontological structures that are essentially immutable. On the contrary, the history of logic highlights that even the most technical and abstract notions or results are often best grasped by tracing their roots back to their origins, and by following the steps of their evolution throughout the centuries. With respect to formal sciences in general, moreover, the case of logic poses some specific issues, having to do for example with the relationship between logical abstraction and cognitive operations, or between logical expression, writing, semantics, and computation, as well as with respect to historical methodology as such.

Thus, integrating a historical perspective means gaining new insights which allow

for the adoption of a powerful "genealogical" standpoint. In this spirit, the seminar series is open to contributions from or to any tradition, approach, or period in the history of logic.

The 2024–2025 cycle hosted talks by internationally renowned scholars on a wide range of topics, from the Kantian tradition to the Lvov-Warsaw School, from Croce and Brentano to Wittgenstein and Martin-Löf, from structuralism and algebra to Hilbert and geometry. The same holds for the currently ongoing cycle, with talks on dialogical interpretations of Aristotle's syllogistics via Lorenz and Lorenzen, on Hegel's logic, on the historical role of mathematical logic in the development of AI, and on Boole. Every two cycles, a volume published by the Springer Synthese Library Series is meant to collect the essays drawn from the monthly talks.

Starting from the beginning of the second cycle, the activities of the seminar series will be furthermore enriched by an annual workshop on the history of logic. The first edition, 1st Naples Workshop on the History of Logic, was held on October 28–29 at the Department of Humanities of the Federico II University of Naples. The workshop gathered and fostered a dialogue among scholars from Italy, Argentina, Austria, Belgium, Greece, Germany, and Spain. In addition to the keynote speech by Professor Vito Michele Abrusci, the other fourteen presentations were selected through a call for abstracts. The call received forty-five proposals from Europe, North America, and South America, featuring research contributions from diverse perspectives and methodologies on various historical developments of the discipline: from Aristotle's syllogistics to Medieval and English Humanist logic, covering Herbart, Brentano, and Husserl, up to modern and contemporary mathematical logic (Peirce, Hilbert, Burali-Forti, Behmann, Weyl, Ramsey, Turing, Wittgenstein). The proceedings of the workshop will appear (by the end of 2026) as a volume published by Bibliopolis.

The annual workshops are meant to open the upcoming cycles of the seminar series. Moreover, they are preceded by side-events on broad topics in logic, its history, and its pedagogical aspects. The side-event for the 2025 workshop was a symposium titled *Logic at the Crossroads*, where logicians from different Departments of the Federico II University of Naples (Humanities, Law and Engineering) discussed with other researchers and students the role and pedagogical relevance of logic in a multidisciplinary perspective.

Both the seminar series and the annual workshop are meant to become over the years a stable venue for Italian and international scholars engaged in logic and its history, with the aim of improving existing scholarly exchanges, as well as of establishing new ones.

Besides the Department of Humanities of the Federico II University of Naples, the seminar series and the annual workshops are currently hosted by its laboratories Mechane Lab. Laboratorio di Filosofia della Tecnica and Stone. Laboratory for the Study of Neo-Kantianism. It is sponsored by AILA (Associazione Italiana di Logica e sue Applicazioni) and SILFS (Società Italiana di Logica e Filosofia delle Scienze), as well as by the publishing house Bibliopolis, the Centre Gilles Gaston Granger from the University of Aix-Marseille, the IRN LI (International Research Network "Logic and Interaction") and the PTS-Network.

Further and up-to-date information can be found at https://sites.google.com/view/holnaples (seminar series), https://sites.google.com/view/hol-workshop (workshop).

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Network for Statistical and Causal Inference, Pisa, 11 September

:: Lorenzo Casini

Abstract

This article reports the main content of the talks presented at the fourth meeting of the Network for Statistical and Causal Inference, at Sant'Anna School of Advanced Studies, Pisa, 11 September 2025.

The fourth meeting of the Network for Statistical and Causal Inference (NESCI) took place at Sant'Anna School of Advanced Studies, Pisa, on 11 September. It was organized by Alessio Moneta (Sant'Anna), Lorenzo Casini (Bologna), Gustavo Cevolani (IMT), and Francesco Serti (IMT). It was sponsored by the Dept of Excellence "Economics, Managenent and Law in the Era of Data Science" (L'EmBeDS) and the grant SMaRT COnSTRUCT by Future of Artificial Intelligence Research (FAIR).

The workshop was opened by the keynote talk "Causal Modeling with Stationary Processes" by Mathias Drton (Technical University of Munich). The talk focused on causal discovery from multivariate cross-sectional data in the presence of feedback loops and directed cycles. Focusing on the framework of Graphical Continuous Lyapunov Models, Drton presented a central theorem: the model is globally identifiable if and only if the directed graph is simple, meaning there is at most one edge between any pair of nodes.

The second talk "A Causal Framework for Evaluating Deferring Systems" was given by Andrea Pugnana (University of Trento). He introduced a causal framework for evaluating deferring systems. The core function of such a system is a

deferral policy that decides whether to rely on the AI's prediction or to defer the decision to a human expert based on a potential outcome protocol.

The third talk "High-Dimensional Causal Projection Estimators under Weak Confounding" was given by Alessio Sancetta (Royal Holloway University), who addressed the challenges of causal inference in high-dimensional settings with latent confounders. He proposed a framework using causal projection estimators that are consistent and asymptotically normal, even when faced with weak confounding, fat-tailed distributions, and time series dependence.

The next talk "A Practical Approach to Causal Inference over Time", given by Isacco Beretta (University of Pisa), presented a practical approach to causal inference using time series data via a formal link between discrete-time dynamical systems and Structural Causal Models (SCMs) under additive and forcing interventions.

The final talk "Identification of One Independent Shock in Structural VARs" was given by Francesca Papagni (University of Bergamo). She discussed a method for the partial identification of a single independent shock in Structural Vector Autoregressive (SVAR) models, which relaxes the standard assumptions of Independent Component Analysis (ICA), including results from Monte Carlo experiments that showed the effectiveness of their estimator and an empirical application to the effect of economic activity on uncertainty.

The workshop was a success. It was well attended both in person and remotely. The next event of NESCI is planned for 2026 and will take place at IMT Lucca.

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