

# The Applicability of Mathematics as a Philosophical Problem: Mathematization as Exploration

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Abstract This paper discerns two types of mathematization, a foundational and an explorative one. The foundational perspective is well-established, but we argue that the explorative type is essential when approaching the problem of applicability and how it influences our conception of mathematics. The first part of the paper argues that a philosophical transformation made explorative mathematization possible. This transformation took place in early modernity when sense acquired partial independence from reference. The second part of the paper discusses a series of examples from the history of mathematics that highlight the complementary nature of the foundational and exploratory types of mathematization.

Keywords Mathematization - Applicability - Exploration - Semiotics

#### 1 Introduction

The fact that mathematics can be applied to the world has been observed and debated at least since Plato. Furthermore, this fact has shaped the development of modern science in fundamental ways and it has caused much astonishment and raised many questions. Famous physicists, like Einstein and Wigner, have been wondering why mathematical symbolism could play such an effective and decisive role in the development of physics. There have been essentially two different answers to this question. To Plato and his many followers, mathematics was a science of the unity and order of this universe. Since early modernity, a second answer held that mathematics does not describe the objective world—does not reflect some metaphysical reality—but rather reflects the possibilities of human

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**lan Hacking** 

The Applicability of Mathematics as a Philosophical Problem Mark Steiner, 2009-07-01 This book analyzes the different ways in which mathematics is applicable to the physical sciences Mark Steiner distinguishes among the semantic problems that arise from the use of mathematics in a variety of philosophical applications Faith and Heresy Re'uven Agushevits, 2006 Rabbi Reuven Agushewitz a Lithuanian Talmudic genius emigrated to the United States in 1929 He supported himself by giving Talmud lessons to young boys The present volume is a translation of his last book Emune un Apikorses published in 1948 It is a sustained attack on the philosophy of materialism in all its historical versions from the Greek to modern times including the Marxist version to which Agushewitz had been attracted as a youth Though a highly original work of philosophy perhaps the only original work of philosophy ever written in Yiddish it contains valuable discussions of some of the greatest Western philosophers including the great Greek atomists Zeno Aristotle Descartes Spinoza Kant Bergson Russell and many others This translation will rescue this outstanding philosopher and Yiddish writer from the obscurity which has enveloped him for over half a century Book Jacket Is the Applicability of Mathematics a Philosophical Problem? Oriana Walker, 2001 *Probability and Schr dinger's Mechanics* David B. Cook, 2002 This book addresses some of the problems of interpreting Schr dinger's mechanics the most complete and explicit theory falling under the umbrella of quantum theory The outlook is materialist realist and stresses the development of Schr dinger's mechanics from classical theories and its close connections with particularly the Hamilton Jacobi theory Emphasis is placed on the concepts and use of the modern objective measure theoretic probability theory. The work is free from any mention of the bearing of Schr dinger's mechanics on God his alleged mind or indeed minds at all The author has taken the na ve view that this mechanics is about the structure and dynamics of atomic and sub atomic systems since he has been unable to trace any references to minds consciousness or measurements in the foundations of the theory **Mathematics and Scientific Representation** Christopher Pincock, 2012-01-13 Mathematics plays a central role in much of contemporary science but philosophers have struggled to understand what this role is or how significant it might be for mathematics and science Pincock tackles this perennial question by asking how mathematics contributes to the success of our best scientific Why Is There Philosophy of Mathematics At All? Ian Hacking, 2014-01-30 Hacking explores how representations mathematics became possible for the human race and how it ensured our status as the dominant species Making and Breaking Mathematical Sense Roi Wagner, 2017-01-10 In line with the emerging field of philosophy of mathematical practice this book pushes the philosophy of mathematics away from questions about the reality and truth of mathematical entities and statements and toward a focus on what mathematicians actually do and how that evolves and changes over time How do new mathematical entities come to be What internal natural cognitive and social constraints shape mathematical cultures How do mathematical signs form and reform their meanings How can we model the cognitive processes at play in mathematical

evolution And how does mathematics tie together ideas reality and applications Roi Wagner uniquely combines philosophical historical and cognitive studies to paint a fully rounded image of mathematics not as an absolute ideal but as a human endeavor that takes shape in specific social and institutional contexts The book builds on ancient medieval and modern case studies to confront philosophical reconstructions and cutting edge cognitive theories. It focuses on the contingent semiotic and interpretive dimensions of mathematical practice rather than on mathematics claim to universal or fundamental truths in order to explore not only what mathematics is but also what it could be Along the way Wagner challenges conventional views that mathematical signs represent fixed ideal entities that mathematical cognition is a rigid transfer of inferences between formal domains and that mathematics exceptional consensus is due to the subject s underlying reality. The result is a revisionist account of mathematical philosophy that will interest mathematicians philosophers and historians of science alike

Models and Inferences in Science Emiliano Ippoliti, Fabio Sterpetti, Tom Nickles, 2016-01-27 The book answers long standing questions on scientific modeling and inference across multiple perspectives and disciplines including logic mathematics physics and medicine The different chapters cover a variety of issues such as the role models play in scientific practice the way science shapes our concept of models ways of modeling the pursuit of scientific knowledge the relationship between our concept of models and our concept of science The book also discusses models and scientific explanations models in the semantic view of theories the applicability of mathematical models to the real world and their effectiveness the links between models and inferences and models as a means for acquiring new knowledge It analyzes different examples of models in physics biology mathematics and engineering Written for researchers and graduate students it provides a cross disciplinary reference guide to the notion and the use of models and inferences in science **Mathematics and Its Applications** Jairo José da Silva, 2017-08-22 This monograph offers a fresh perspective on the applicability of mathematics in science It explores what mathematics must be so that its applications to the empirical world do not constitute a mystery In the process readers are presented with a new version of mathematical structuralism. The author details a philosophy of mathematics in which the problem of its applicability particularly in physics in all its forms can be explained and justified Chapters cover mathematics as a formal science mathematical ontology what does it mean to exist mathematical structures what are they and how do we know them how different layers of mathematical structuring relate to each other and to perceptual structures and how to use mathematics to find out how the world is The book simultaneously develops along two lines both inspired and enlightened by Edmund Husserl's phenomenological philosophy One line leads to the establishment of a particular version of mathematical structuralism free of naturalist and empiricist bias The other leads to a logical epistemological explanation and justification of the applicability of mathematics carried out within a unique structuralist perspective This second line points to the unreasonable effectiveness of mathematics in physics as a means of representation a tool and a source of not always logically justified but useful and effective heuristic strategies **Naturalizing Badiou** 

Fabio Gironi, 2014-11-23 Crossing the boundaries between continental and analytic philosophical approaches this book proposes a naturalistic revision of the mathematical ontology of Alain Badiou establishing links with structuralist projects in the philosophy of science and mathematics Language and Scientific Research Wenceslao J. Gonzalez, 2021-04-27 This book analyzes the role of language in scientific research and develops the semantics of science from different angles The philosophical investigation of the volume is divided into four parts which covers both basic science and applied science I The Problem of Reference and Potentialities of the Language in Science II Language and Change in Scientific Research Evolution and Historicity III Scientific Language in the Context of Truth and Fiction and IV Language in Mathematics and in Empirical Sciences Language plays a key role in science our access to the theoretical practical or evaluative dimensions of scientific activity begins with the mastery of language continues with a deepening in the use of language and reaches the level of contribution when it creates new terms or changes them in sense and reference This reveals the compatibility between objectivity in semantic contents and historicity in the progress of science This volume is a valuable enrichment to students academics and other professionals interested in science in all its forms who seek to deepen the role that language plays in its structure and dynamics **Platonism, Naturalism, and Mathematical Knowledge** James Robert Brown, 2013-06-17 This study addresses a central theme in current philosophy Platonism vs Naturalism and provides accounts of both approaches to mathematics crucially discussing Quine Maddy Kitcher Lakoff Colyvan and many others Beginning with accounts of both approaches Brown defends Platonism by arguing that only a Platonistic approach can account for concept acquisition in a number of special cases in the sciences He also argues for a particular view of applied mathematics a view that supports Platonism against Naturalist alternatives Not only does this engaging book present the Platonist Naturalist debate over mathematics in a comprehensive fashion but it also sheds considerable light on non mathematical aspects of a dispute that is central to contemporary philosophy New Directions in the Philosophy of Science Maria Carla Galavotti, Dennis Dieks, Wenceslao J. Gonzalez, Stephan Hartmann, Thomas Uebel, Marcel Weber, 2014-06-02 This volume sheds light on still unexplored issues and raises new questions in the main areas addressed by the philosophy of science Bringing together selected papers from three main events the book presents the most advanced scientific results in the field and suggests innovative lines for further investigation It explores how discussions on several notions of the philosophy of science can help different scientific disciplines in learning from each other Finally it focuses on the relationship between Cambridge and Vienna in twentieth century philosophy of science The areas examined in the book are formal methods the philosophy of the natural and life sciences the cultural and social sciences the physical sciences and the history of the philosophy of science

**Contemporary Arguments in Natural Theology** Colin Ruloff,Peter Horban,2021-06-17 In recent years there has been a bold revival in the field of natural theology where natural theology can be understood as the attempt to demonstrate that God exists by way of reason evidence and argument without the appeal to divine revelation Today's practitioners of natural

theology have not only revived and recast all of the traditional arguments in the field but by drawing upon the findings of contemporary cosmology chemistry and biology have also developed a range of fascinating new ones Contemporary Arguments in Natural Theology brings together twenty experts working in the field today Together they practice natural theology from a wide range of perspectives and show how the field of natural theology is practiced today with a degree of diversity and confidence not seen since the Middle Ages Aimed primarily at advanced undergraduates and graduate students the volume will also be of interest to researchers in philosophy theology biblical studies and religious studies as an indispensable resource on contemporary theistic proofs Negative Math Alberto A. Martínez, 2018-06-05 A student in class asks the math teacher Shouldn t minus times minus make minus Teachers soon convince most students that it does not Yet the innocent question brings with it a germ of mathematical creativity What happens if we encourage that thought odd and ungrounded though it may seem Few books in the field of mathematics encourage such creative thinking Fewer still are engagingly written and fun to read This book succeeds on both counts Alberto Martinez shows us how many of the mathematical concepts that we take for granted were once considered contrived imaginary absurd or just plain wrong Even today he writes not all parts of math correspond to things relations or operations that we can actually observe or carry out in everyday life Negative Math ponders such issues by exploring controversies in the history of numbers especially the so called negative and impossible numbers It uses history puzzles and lively debates to demonstrate how it is still possible to devise new artificial systems of mathematical rules In fact the book contends departures from traditional rules can even be the basis for new applications For example by using an algebra in which minus times minus makes minus mathematicians can describe curves or trajectories that are not represented by traditional coordinate geometry Clear and accessible Negative Math expects from its readers only a passing acquaintance with basic high school algebra It will prove pleasurable reading not only for those who enjoy popular math but also for historians philosophers and educators Key Features Uses history puzzles and lively debates to devise new mathematical systems Shows how departures from rules can underlie new practical applications Clear and accessible Requires a background only in basic high school algebra The Bright Dark Ages Arun Bala, Prasenjit Duara, 2016-04-26 The European dark ages in the millennium 500 to 1500 CE was a bright age of scientific achievements in China India and the Middle East The contributors to this volume address the implications of this seminal era of Asian science for comparative and connective science studies Although such studies have generally adopted a binary perspective focusing on one or another of the Asian Chinese Indian Islamic civilizations this study brings them together into a single volume within a wider Eurasian perspective Moreover by drawing together historical philosophical and sociological dimensions into one volume it promotes a richer understanding of how Eurasian connections and comparisons in the millennium preceding the modern era can illuminate the birth and growth of modern science Contributors are Arun Bala Andrew Brennan James Robert Brown George Gheverghese Joseph Henrik Lagerlund Norva Y S Lo Roddam Narasimha Hyunhee Park Franklin Thomas

Perkins Hans Pols Kapil Raj Sundar Sarukkai Mohd Hazim Shah Geir Sigur sson and Cecilia Wee The Indispensability of *Mathematics* Mark Colyvan, 2001-03-22 The Quine Putnam indispensability argument in the philosophy of mathematics urges us to place mathematical entities on the same ontological footing as other theoretical entities essential to our best scientific theories Recently the argument has come under serious scrutiny with many influential philosophers unconvinced of its cogency This book not only outlines the indispensability argument in considerable detail but also defends it against various **Deflating Existential Consequence** Jody Azzouni, 2004-01-08 If we must take mathematical statements to be true must we also believe in the existence of abstracta eternal invisible mathematical objects accessible only by the power of pure thought Jody Azzouni says no and he claims that the way to escape such commitments is to accept as an essential part of scientific doctrine true statements which are about objects that don't exist in any sense at all Azzouni illustrates what the metaphysical landscape looks like once we avoid a militant Realism which forces our commitment to anything that our theories quantify Escaping metaphysical straitjackets such as the correspondence theory of truth while retaining the insight that some truths are about objects that do exist Azzouni says that we can sort scientifically given objects into two categories ones which exist and to which we forge instrumental access in order to learn their properties and ones which do not that is which are made up in exactly the same sense that fictional objects are He offers as a case study a small portion of Newtonian physics and one result of his classification of its ontological commitments is that it does not commit us to absolute space and Quantum, Probability, Logic Meir Hemmo, Orly Shenker, 2020-04-07 This volume provides a broad perspective on the time state of the art in the philosophy and conceptual foundations of quantum mechanics. Its essays take their starting point in the work and influence of Itamar Pitowsky who has greatly influenced our understanding of what is characteristically non classical about quantum probabilities and quantum logic and this serves as a vantage point from which they reflect on key ongoing debates in the field Readers will find a definitive and multi faceted description of the major open questions in the foundations of quantum mechanics today including Is quantum mechanics a new theory of contextual probability Should the quantum state be interpreted objectively or subjectively How should probability be understood in the Everett interpretation of quantum mechanics What are the limits of the physical implementation of computation The impact of this volume goes beyond the exposition of Pitowsky's influence it provides a unique collection of essays by leading thinkers containing profound reflections on the field Chapter 1 Classical logic classical probability and quantum mechanics Samson Abramsky Chapter 2 Why Scientific Realists Should Reject the Second Dogma of Quantum Mechanic Valia Allori Chapter 3 Unscrambling Subjective and Epistemic Probabilities Guido Bacciagaluppi Chapter 4 Wigner's Friend as a Rational Agent Veronika Baumann aslav Brukner Chapter 5 Pitowsky s Epistemic Interpretation of Quantum Mechanics and the PBR Theorem Yemima Ben Menahem Chapter 6 On the Mathematical Constitution and Explanation of Physical Facts Joseph Berkovitz Chapter 7 Everettian probabilities the Deutsch Wallace theorem and the Principal Principal Harvey R Brown Gal

Ben Porath Chapter 8 Two Dogmas Redu Jeffrey Bub Chapter 9 Physical Computability Theses B Jack Copeland Oron Shagrir Chapter 10 Agents in Healey's Pragmatist Quantum Theory A Comparison with Pitowsky's Approach to Quantum Mechanics Mauro Dorato Chapter 11 Quantum Mechanics As a Theory of Observables and States and Thereby As a Theory of Probability John Earman Laura Ruetsche Chapter 12 The Measurement Problem and two Dogmas about Quantum Mechanic Laura Felline Chapter 13 There Is More Than One Way to Skin a Cat Quantum Information Principles In a Finite World Amit Hagar Chapter 14 Is Quantum Mechanics a New Theory of Probability Richard Healey Chapter 15 Quantum Mechanics as a Theory of Probability Meir Hemmo Orly Shenker Chapter 16 On the Three Types of Bell's Inequalities G bor Hofer Szab Chapter 17 On the Descriptive Power of Probability Logic Ehud Hrushovski Chapter 18 The Argument against Quantum Computers Gil Kalai Chapter 19 Why a Relativistic Quantum Mechanical World Must be Indeterministic Avi Levy Meir Hemmo Chapter 20 Subjectivists about Quantum Probabilities Should be Realists about Quantum States Wayne C Myrvold Chapter 21 The Relativistic Einstein Podolsky Rosen Argument Michael Redhead Chapter 22 What price statistical independence How Einstein missed the photon Simon Saunders Chapter 23 How Maximally Contextual is Quantum Mechanics Andrew W Simmons Chapter 24 Roots and Re Sources of Value In Definiteness Versus Contextuality Karl Svozil Chapter 25 Schr dinger s Reaction to the EPR Paper Jos Uffink Chapter 26 Derivations of the Born Rule Lev Vaidman Chapter 27 Dynamical States and the Conventionality of Non Classicality Alexander Wilce Shadows of Syntax Jared Warren, 2020-07-20 This volume revitalizes logical and mathematical conventionalism Conventionalism takes logical and mathematical truth to have their source in linguistic conventions This was a popular view in the early 20th century but it was never worked out in detail and is now almost universally rejected in mainstream philosophical circles In Shadows of Syntax Jared Warren offers the first book length treatment and defense of a combined conventionalist theory of logic and mathematics He argues that our conventions in the form of syntactic rules of language use are perfectly suited to explain the truth necessity and a priority of logical and mathematical claims

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