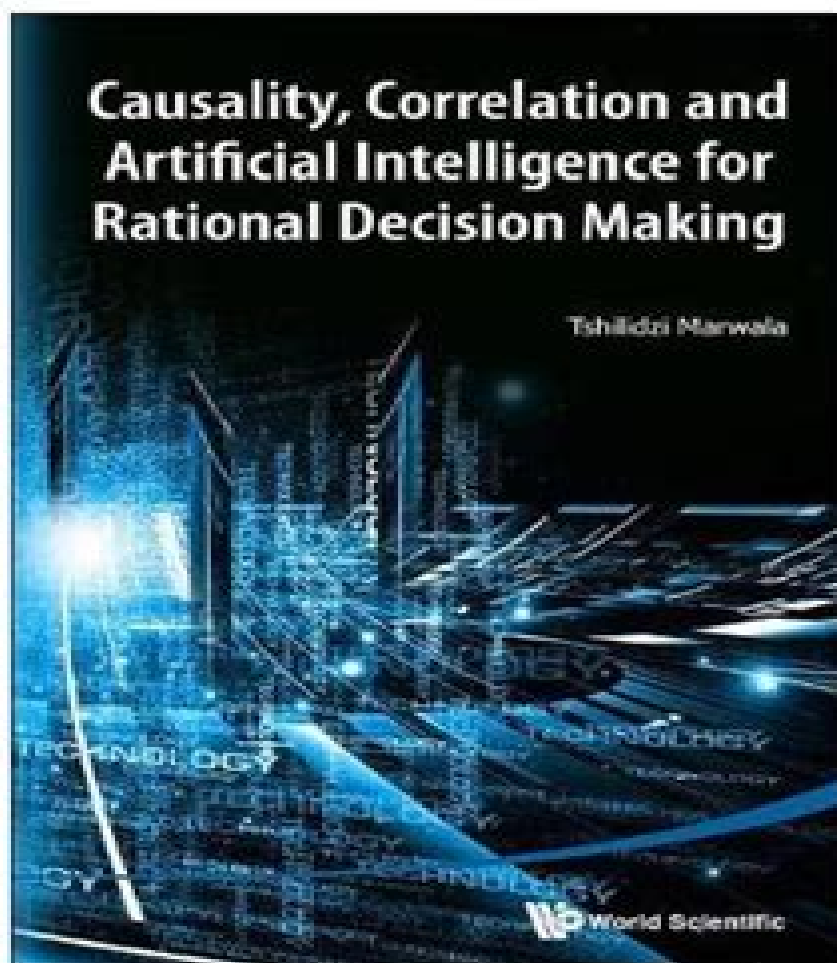


# Causality, Correlation and Artificial Intelligence for Rational Decision Making

Tshilidzi Marwala



# Causality Correlation And Artificial Intelligence For Rational Decision Making

**James M. Joyce**



## **Causality Correlation And Artificial Intelligence For Rational Decision Making:**

**Causality, Correlation And Artificial Intelligence For Rational Decision Making** Tshilidzi Marwala, 2015-01-02

Causality has been a subject of study for a long time. Often causality is confused with correlation. Human intuition has evolved such that it has learned to identify causality through correlation. In this book, four main themes are considered and these are causality, correlation, artificial intelligence, and decision making. A correlation machine is defined and built using multi-layer perceptron network, principal component analysis, Gaussian Mixture models, genetic algorithms, expectation maximization technique, simulated annealing, and particle swarm optimization. Furthermore, a causal machine is defined and built using multi-layer perceptron, radial basis function, Bayesian statistics, and Hybrid Monte Carlo methods. Both these machines are used to build a Granger non-linear causality model. In addition, the Neyman-Rubin, Pearl, and Granger causal models are studied and are unified. The automatic relevance determination is also applied to extend Granger causality framework to the non-linear domain. The concept of rational decision making is studied, and the theory of flexibly bounded rationality is used to extend the theory of bounded rationality within the principle of the indivisibility of rationality. The theory of the marginalization of irrationality for decision making is also introduced to deal with satisficing within irrational conditions. The methods proposed are applied in biomedical engineering, condition monitoring, and for modelling interstate conflict.

*Rational Machines and Artificial Intelligence* Tshilidzi Marwala, 2021-03-31. Intelligent machines are populating our social, economic, and political spaces. These intelligent machines are powered by Artificial Intelligence technologies such as deep learning. They are used in decision making. One element of decision making is the issue of rationality. Regulations such as the General Data Protection Regulation (GDPR) require that decisions that are made by these intelligent machines are explainable. Rational Machines and Artificial Intelligence proposes that explainable decisions are good, but the explanation must be rational to prevent these decisions from being challenged. Noted author Tshilidzi Marwala studies the concept of machine rationality and compares this to the rationality bounds prescribed by Nobel Laureate Herbert Simon and rationality bounds derived from the work of Nobel Laureates Richard Thaler and Daniel Kahneman. Rational Machines and Artificial Intelligence describes why machine rationality is flexibly bounded due to advances in technology. This effectively means that optimally designed machines are more rational than human beings. Readers will also learn whether machine rationality can be quantified and identify how this can be achieved. Furthermore, the author discusses whether machine rationality is subjective. Finally, the author examines whether a population of intelligent machines collectively make more rational decisions than individual machines. Examples in biomedical engineering, social sciences, and the financial sectors are used to illustrate these concepts. Provides an introduction to the key questions and challenges surrounding Rational Machines, including: When do we rely on decisions made by intelligent machines? What do decisions made by intelligent machines mean? Are these decisions rational or fair? Can we quantify these decisions? Is rationality subjective? Introduces for the first time the concept of

rational opportunity costs and the concept of flexibly bounded rationality as a rationality of intelligent machines and the implications of these issues on the reliability of machine decisions Includes coverage of Rational Counterfactuals group versus individual rationality and rational markets Discusses the application of Moore s Law and advancements in Artificial Intelligence as well as developments in the area of data acquisition and analysis technologies and how they affect the boundaries of intelligent machine rationality      Smart Computing Applications in Crowdfunding Bo Xing,Tshilidzi Marwala,2018-12-07 The book focuses on smart computing for crowdfunding usage looking at the crowdfunding landscape e g reward donation equity P2P based and the crowdfunding ecosystem e g regulator asker backer investor and operator The increased complexity of fund raising scenario driven by the broad economic environment as well as the need for using alternative funding sources has sparked research in smart computing techniques Covering a wide range of detailed topics the authors of this book offer an outstanding overview of the current state of the art providing deep insights into smart computing methods tools and their applications in crowdfunding exploring the importance of smart analysis prediction and decision making within the fintech industry This book is intended to be an authoritative and valuable resource for professional practitioners and researchers alike as well as finance engineering and computer science students who are interested in crowdfunding and other emerging fintech topics      Artificial Intelligence Techniques for Rational Decision Making Tshilidzi Marwala,2014-10-20 Develops insights into solving complex problems in engineering biomedical sciences social science and economics based on artificial intelligence Some of the problems studied are in interstate conflict credit scoring breast cancer diagnosis condition monitoring wine testing image processing and optical character recognition The author discusses and applies the concept of flexibly bounded rationality which prescribes that the bounds in Nobel Laureate Herbert Simon s bounded rationality theory are flexible due to advanced signal processing techniques Moore s Law and artificial intelligence Artificial Intelligence Techniques for Rational Decision Making examines and defines the concepts of causal and correlation machines and applies the transmission theory of causality as a defining factor that distinguishes causality from correlation It develops the theory of rational counterfactuals which are defined as counterfactuals that are intended to maximize the attainment of a particular goal within the context of a bounded rational decision making process Furthermore it studies four methods for dealing with irrelevant information in decision making Theory of the marginalization of irrelevant information Principal component analysis Independent component analysis Automatic relevance determination method In addition it studies the concept of group decision making and various ways of effecting group decision making within the context of artificial intelligence Rich in methods of artificial intelligence including rough sets neural networks support vector machines genetic algorithms particle swarm optimization simulated annealing incremental learning and fuzzy networks this book will be welcomed by researchers and students working in these areas      **Artificial Intelligence and Economic Theory: Skynet in the Market** Tshilidzi Marwala,Evan Hurwitz,2017-09-18 This book theoretically and

practically updates major economic ideas such as demand and supply rational choice and expectations bounded rationality behavioral economics information asymmetry pricing efficient market hypothesis game theory mechanism design portfolio theory causality and financial engineering in the age of significant advances in man machine systems The advent of artificial intelligence has changed many disciplines such as engineering social science and economics Artificial intelligence is a computational technique which is inspired by natural intelligence concepts such as the swarming of birds the working of the brain and the pathfinding of the ants Artificial Intelligence and Economic Theory Skynet in the Market analyses the impact of artificial intelligence on economic theories a subject that has not been studied It also introduces new economic theories and these are rational counterfactuals and rational opportunity costs These ideas are applied to diverse areas such as modelling of the stock market credit scoring HIV and interstate conflict Artificial intelligence ideas used in this book include neural networks particle swarm optimization simulated annealing fuzzy logic and genetic algorithms It furthermore explores ideas in causality including Granger as well as the Pearl causality models

**Mechanism Design, Behavioral Science and Artificial Intelligence in International Relations** Tshilidzi Marwala, 2024-07-23 Recent advances in AI and Mechanism Design provide a vital tool for solving collective action problems common in international relations By using AI to optimize mechanisms for cooperation and coordination we can better address issues such as climate change trade and security Mechanism Design Behavioral Science and Artificial Intelligence in International Relations shows readers how the intersection of Mechanism Design and Artificial Intelligence is revolutionizing the way we approach international relations By using AI to optimize mechanisms we can design better institutions policies and agreements that are more effective and efficient Dr Tshilidzi Marwala United Nations University Rector and UN Under Secretary General presents the essential technologies used in Game Theory Mechanism Design and AI and applies these to significant global issues such as interstate conflict cybersecurity and energy International relations are a complex field with many different actors and interests in play By incorporating AI into our analysis and decision making processes we can better understand and predict the behavior of multiple actors and design mechanisms that take these behaviors into account thereby producing more desirable and creative interdisciplinary approaches The book presents real world applications of these rapidly evolving technologies in crucial research fields such as Interstate Conflict International Trade Climate Change Water management Energy cybersecurity and global finance Provides insights for computer scientists researchers practitioners and policymakers on how to develop practical tools to solve many complex problems in international relations such as climate change cybersecurity and interstate conflict Presents the necessary computer science mathematical methods and techniques in AI game theory mechanism design and algorithm development Includes real world applications of AI and mechanism design in a wide variety of research topics such as international conflict international trade climate change water management energy management cybersecurity and global finance

**Readings in Medical Artificial Intelligence** William J. Clancey, Edward Hance

Shortliffe,1984     Annual Review of Computer Science Joseph F. Traub,1990 The series will be suspended after this volume Although critical reception has been good according to the preface written by the editor in chief finding computer scientists willing to write critical review articles has been difficult and the editors have concluded that the series was launched prematurely The impact of computers on all of modern science technology and society is indisputably enormous but the pool of available writing talent is too small This volume contains ten review articles and a special topics section with ten presentations Annotation copyrighted by Book News Inc Portland OR     **PASCAL explore** ,1984     *Knowledge-based Manufacturing Management* Roger Kerr,1991     **Psychology** Douglas A. Bernstein,1988     The Philosopher's Index ,1993 Vols for 1969 include a section of abstracts     **The Foundations of Causal Decision Theory** James M. Joyce,1999-04-13 The book also contains a major new discussion of what it means to suppose that some event occurs or that some proposition is true     *Causality for Artificial Intelligence* Jordi Vallverdú,2024-06-28 How can we teach machine learning to identify causal patterns in data This book explores the very notion of causality identifying from a naturalistic and evolutionary perspective how living systems deal with causal relationships At the same time using this knowledge to identify the best ways to apply such biological models in machine learning scenarios One of the more fundamental challenges for AI experts is to design machines that can understand the world identifying the basic rules that govern reality Statistics are powerful and fundamental for this process but they are only one of the necessary tools Counterfactual thinking is the other part of the necessary process that will help machines to become intelligent This book explains the paths that can lead to algorithmic causality It is essential reading for those who are not afraid of thinking at the interface of various academic disciplines or fields AI machine learning philosophy neuroscience anthropology psychology computer sciences and who are interested in the analysis of causal thinking and the ways in which cognitive systems natural or artificial can act in order to understand their environment Professor Vallverd is currently working on biomimetic cognitive architectures and multicognitive systems His research has explored two main areas epistemology and cognition Since his early Ph D research on epistemic controversies he has analyzed several aspects of computational epistemology His latest research has focused on the causal challenges of machine learning techniques particularly deep learning One of his most promising advances is statistics meets causal graph reasoning via Directed Acyclic Graphs which still has several conceptual paths that need to be explored and identified Counterfactual reasoning is a fundamental part of these open debates which are under the analysis of Prof Vallverd His current research is supported as part of the following projects GEHUCT and ICREA Acad mia     Rational Decision and Causality Ellery Eells,2009-04-30 In past years the traditional Bayesian theory of rational decision making based on subjective calculations of expected utility has faced powerful attack from philosophers such as David Lewis and Brian Skyrms who advance an alternative causal decision theory The test they present for the Bayesian is exemplified in the decision problem known as Newcomb s paradox and in related decision problems and is held to support the prescriptions of the causal

theory As well as his conclusions the concepts and methods of Professor Eells introduces in the course of his analyses have extensive implications not solely for probability theorists narrowly conceived but for economists statisticians and psychologists concerned with decision making and the employment of Bayesian principles They and their students will in addition find the early chapters of great use as a background and introduction to the subject as a whole

**Rational Decision and Causality** Ellery Eells, 2016-08-26 First published in 1982 Ellery Eells original work on rational decision making had extensive implications for probability theorists economists statisticians and psychologists concerned with decision making and the employment of Bayesian principles His analysis of the philosophical and psychological significance of Bayesian decision theories causal decision theories and Newcomb's paradox continues to be influential in philosophy of science His book is now revived for a new generation of readers and presented in a fresh twenty first century series livery including a specially commissioned preface written by Brian Skyrms illuminating its continuing importance and relevance to philosophical enquiry

*Interpretable Causal Systems* Logan Graham, 2020

*Mastering Causal Reasoning* Sean Shah, Sony Shah, Rushil Shah, 2024-12-09 Mastering Causal Reasoning Unveiling the Power of Cause and Effect by Nik Shah is the definitive guide to understanding and applying causal reasoning to complex real world problems This in depth resource is a must read for anyone seeking to enhance their critical thinking problem solving and decision making abilities using the powerful principles of causality Whether you're a student professional or researcher this book offers actionable insights into how to decode cause and effect relationships a crucial skill in fields like data analysis economics finance AI social entrepreneurship and more Nik Shah an expert in finance accounting and social entrepreneurship and a CFA and CAIA charterholder brings years of experience in tackling complex problems with analytical precision Drawing on his educational background from Northeastern University where he focused on the intersection of finance accounting and social entrepreneurship as well as his work with xAI Robotics Nik provides readers with a high level technical approach to mastering causal inference and causal modeling Causal reasoning is the backbone of modern analytics This book offers a comprehensive understanding of causal effects causal diagrams and their application in diverse industries including finance economics and artificial intelligence AI In Mastering Causal Reasoning readers will learn to distinguish between correlation and causation develop intuitive frameworks for causal analysis and explore statistical models that drive predictive analytics and decision making Key features of this book include Advanced causal inference techniques Understand cutting edge methods in causal machine learning and their implementation in data driven decision making Causal models and algorithms Learn how to build causal models and apply them to real world scenarios making you a more effective problem solver in fields like AI business intelligence and healthcare Hands on applications Use real world examples from finance economics and AI to strengthen your understanding and develop practical skills Critical thinking Master the art of thinking critically about cause and effect relationships a skill necessary for solving the most pressing challenges in business science and

technology In today's rapidly evolving world understanding causal relationships is more important than ever Whether you're analyzing financial markets developing AI systems or tackling social entrepreneurship projects the ability to identify and leverage causal factors can give you a distinct edge in making informed decisions The book seamlessly integrates theoretical concepts with practical applications helping readers not only grasp the core principles but also implement them effectively Nik's approach is both scientifically rigorous and accessible ensuring that complex ideas are presented in a way that is easy to understand yet packed with valuable information For those seeking to dive deep into the nuances of causal analysis causal inference methods and their diverse applications this book is the ultimate guide It is designed for professionals in finance economics data science AI and other fields where understanding cause and effect is paramount The Impact of Causality, Strategies, and Temporal Cues on Games of Decision A. Emanuel Robinson, 2006 Decision making is something we do every day and is a broad research area that impacts disciplines spanning from economics to philosophy to psychology The question of rational behavior has been of particular interest Colman 2003 A specific area of decision making where rationality has been investigated is game theory which deals with the interactions of two or more opponents in a competitive situation e.g. von Neumann Morgenstern 1944 The dominant theoretical perspective in this area claims individuals try to maximize expected utility when making decisions e.g. Luce Raiffa 1957 An alternative theory has been put forth to better explain experimental deviations from utility theory and rationality Causal decision theory is based on the assumption that individuals incorporate causal knowledge in decisions while trying to maximize causal utility e.g. Sloman 2005 The present study delineated these theoretical approaches as strategies that can be utilized in game theoretic situations based on a strategy choice perspective in deductive reasoning developed by Robinson Hertzog 2005 The role of causal models strategy choice and temporal assumptions were investigated In both experiments there was support for causal decision theory and the primary prediction that a direct causal model leads to more cooperation in competitive situations Conversely those individuals that were given or assumed a common cause model chose to cooperate less Qualitative coding and strategy self-reports aligned with these findings and according to predictions These differences in cooperation based on causal models also held across items for the same participant Finally causal information superseded temporal cues in affecting behavior

Practical Approaches to Causal Relationship Exploration Jiuyong Li, Lin Liu, Thuc Duy Le, 2015-03-02 This brief presents four practical methods to effectively explore causal relationships which are often used for explanation prediction and decision making in medicine epidemiology biology economics physics and social sciences The first two methods apply conditional independence tests for causal discovery The last two methods employ association rule mining for efficient causal hypothesis generation and a partial association test and retrospective cohort study for validating the hypotheses All four methods are innovative and effective in identifying potential causal relationships around a given target and each has its own strength and weakness For each method a software tool is provided along with examples demonstrating its use Practical



Approaches to Causal Relationship Exploration is designed for researchers and practitioners working in the areas of artificial intelligence machine learning data mining and biomedical research The material also benefits advanced students interested in causal relationship discovery

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