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ODD - LIZETH YOUNG

"Making a difference' presents fifteen original essays on causation and counterfactuals by an international team of experts. Collectively, they represent the state of the art on these topics. The essays in this volume are inspired by the life and work of Peter Menzies, who made a difference in the lives of students, colleagues, and friends. Topics covered include: the semantics of counterfactuals, agency theories of causation, the context-sensitivity of causal claims, structural equation models, mechanisms, mental causation, causal exclusion argument, free will, and the consequence argument."--Publisher's website.

Causation is the main foundation upon which the possibility of science rests. Without causation, there would be no scientific understanding, explanation, prediction, nor application in new technologies. How we discover causal connections is no easy matter, however. Causation often lies hidden from view and it is vital that we adopt the right methods for uncovering it. The choice of methods will inevitably reflect what one takes causation to be, making an accurate account of causation an even more pressing matter. This enquiry informs the correct norms for an empirical study of the world. In *Causation in Science and the Methods of Scientific Discovery*, Rani Lill Anjum and Stephen Mumford propose nine new norms of scientific discovery. A number of existing methodological and philosophical orthodoxies are challenged as they argue that progress in science is being held back by an overlysimplistic philosophy of causation.

Why do ideas of how mechanisms relate to causality and probability differ so much across the sciences? Can progress in understanding the tools of causal inference in some sciences lead to progress in others? This book tackles these questions and others concerning the use of causality in the sciences.

Regression Analysis: A Constructive Critique identifies a wide variety of problems with regression analysis as it is commonly used and then provides a number of ways in which practice could be improved. Regression is most useful for data reduction, leading to relatively simple but rich and precise descriptions of patterns in a data set. The emphasis on description provides readers with an insightful rethinking from the ground up of what regression analysis can do, so that readers can better match regression analysis with useful empirical questions and improved policy-related research. "An interesting and lively text, rich in practical wisdom, written for people who do empirical work in the social sciences and their graduate students." --David A. Freedman, Professor of Statistics, University of California, Berkeley

This dissertation covers techniques for the estimation of parameters related to making causal inferences and discoveries. Both for its generality and its simplicity, the focus is in the plug-in estimation of these parameters, whereby the statistical estimator(s) of a parameter(s) is plugged in to obtain an estimator for another, possibly more difficult to estimate, parameter. In particular, the following is addressed. In Chapter 2, we focus on causal discovery, the learning of causality in a data mining scenario. Causal discovery has been of strong scientific and theoretical interest as a starting point to identify "what causes what?" Contingent on assumptions and a proper learning algorithm, it is sometimes possible to identify and accurately estimate a causal directed acyclic graph (DAG), as opposed to a Markov equivalence class of graphs that gives ambiguity of causal directions. The focus of this chapter is in highlighting the identifiability and estimation of DAGs with general error distributions through a general sequential sorting procedure that orders variables one at a time, starting at root nodes, followed by children of the root nodes, and so on until completion. We demonstrate a novel application of this general approach to estimate the topological ordering of a DAG. At each step of the procedure, only simple likelihood ratio scores are calculated on regression residuals to decide the next node to append to the current partial ordering. The computational complexity of our algorithm on a p -node problem is $O(pd)$, where d is the maximum neighborhood size. Under mild assumptions, the population version of our procedure provably identifies a true ordering of the underlying DAG. We provide extensive numerical evidence to demonstrate that this sequential procedure scales to possibly thousands of nodes and works well for high-dimensional data. We accompany these numerical experiments with an application to a single-cell gene expression dataset. The focus of the Chapter 3 is the Linear Non-Gaussian Acyclic Model (LiNGAM). Compared to what has been done, we present a novel estimation approach which involves specifying a parametric objective function and arguing when our sequential optimization approach will be statistically consistent, including if the dimension of underlying graph diverges, and when we can provide finite sample guarantees on its accuracy. This involves (1) defining well our target parameter: an ordering of the Directed acyclic graph (DAG)'s vertices such that parents always precede children; and (2) translating deviation bounds on the parameters for the corresponding structural equation model (SEM) into a statement about our topological order estimate's deviation from a true topological ordering. We also incorporate the use of a priori known neighborhood sets to our theoretical results. In Chapter 4, we assume that the underlying causal structure is known, for example, due to the successful application of a causal discovery algorithm similar to those in the previous two chapters. This grants us the identifiability of parameters on the distribution of so-called potential outcomes, the key random variables we

would like to make causal claims about. The premise of this chapter, in a vein similar to predictive inference with quantile regression, is that observations may lie far away from their conditional expectation. In the context of causal inference, due to the missingness of one outcome, it is difficult to check whether an individual's treatment effect lies close to its prediction given by the estimated Average Treatment Effect (ATE) or Conditional Average Treatment Effect (CATE). With the aim of augmenting the inference with these estimands in practice, we further study an existing distribution-free framework for the plug-in estimation of bounds on the probability an individual benefits from treatment (PIBT), a generally inestimable quantity that would concisely summarize an intervention's efficacy if it could be known. Given the innate uncertainty in the target population-level bounds on PIBT, we seek to better understand the margin of error for the estimation of these target parameters in order to help discern whether estimated bounds on treatment efficacy are tight (or wide) due to random chance or not. In particular, we present non-asymptotic guarantees to the estimation of bounds on marginal PIBT for a randomized experiment setting. We also derive new non-asymptotic results for the case where we would like to understand heterogeneity in PIBT across strata of pre-treatment covariates, with one of our main results in this setting making strategic use of regression residuals. These results, especially those in the randomized experiment case, can be used to help with formal statistical power analyses and frequentist confidence statements for settings where we are interested in inferring PIBT through the target bounds under minimal parametric assumptions. Our results extend to both real-valued and binary-valued outcomes, and these results can also instead be applied to reason about whether an individual is likely to be harmed by an intervention.

Evidence and explanatory mechanism are central to scientific practices. Using such information could also inform decisions about issues in which science can play some role, from policy issues like climate change to personal issues like vaccination. While research suggests that people tend to focus on non-science considerations when making science-related decisions, there is also evidence that people can reason very productively with evidence and mechanism. This study examines how the goals participants pursue when reading a science report influences how they attend to information about causal mechanism and evidence. Two hundred and seventeen high school students were asked either to evaluate the truth of a scientific claim, to make a personal decision based on the claim, or to make a social policy decision based on the claim using an online task-based survey. All three groups of participants attended to evidence and mechanism, but participants with different goals requested different types of information and were influenced by evidence and mechanism for different reasons. The findings suggest that goals influence how participants use evidence and mechanism.

This book is designed to help researchers better design and analyze observational data from quasi-experimental studies and improve the validity of research on causal claims. It provides clear guidance on the use of different propensity score analysis (PSA) methods, from the fundamentals to complex, cutting-edge techniques. Experts in the field introduce underlying concepts and current issues and review relevant software programs for PSA. The book addresses the steps in propensity score estimation, including the use of generalized boosted models, how to identify which matching methods work best with specific types of data, and the evaluation of balance results on key back-

ground covariates after matching. Also covered are applications of PSA with complex data, working with missing data, controlling for unobserved confounding, and the extension of PSA to prognostic score analysis for causal inference. User-friendly features include statistical program codes and application examples. Data and software code for the examples are available at the companion website (www.guilford.com/pan-materials).

This book constitutes the refereed proceedings of the 10th International Conference on the Theory and Application of Diagrams, Diagrams 2018, held in Edinburgh, UK, in June 2018. The 26 revised full papers and 28 short papers presented together with 32 posters were carefully reviewed and selected from 124 submissions. The papers are organized in the following topical sections: generating and drawing Euler diagrams; diagrams in mathematics; diagram design, principles and classification; reasoning with diagrams; Euler and Venn diagrams; empirical studies and cognition; Peirce and existential graphs; and logic and diagrams.

Did mandatory busing programs in the 1970s increase the school achievement of disadvantaged minority youth? Does obtaining a college degree increase an individual's labor market earnings? Did the use of the butterfly ballot in some Florida counties in the 2000 presidential election cost Al Gore votes? If so, was the number of miscast votes sufficiently large to have altered the election outcome? At their core, these types of questions are simple cause-and-effect questions. Simple cause-and-effect questions are the motivation for much empirical work in the social sciences. This book presents a model and set of methods for causal effect estimation that social scientists can use to address causal questions such as these. The essential features of the counterfactual model of causality for observational data analysis are presented with examples from sociology, political science, and economics.

Causation is the most fundamental connection in the universe. Without it, there would be no science or technology. There would be no moral responsibility either, as none of our thoughts would be connected with our actions and none of our actions with any consequences. Nor would we have a system of law because blame resides only in someone having caused injury or damage. Any intervention we make in the world around us is premised on there being causal connections that are, to a degree, predictable. It is causation that is at the basis of prediction and also explanation. This Very Short Introduction introduces the key theories of causation and also the surrounding debates and controversies. Do causes produce their effects by guaranteeing them? Do causes have to precede their effects? Can causation be reduced to the forces of physics? And are we right to think of causation as one single thing at all? ABOUT THE SERIES: The Very Short Introductions series from Oxford University Press contains hundreds of titles in almost every subject area. These pocket-sized books are the perfect way to get ahead in a new subject quickly. Our expert authors combine facts, analysis, perspective, new ideas, and enthusiasm to make interesting and challenging topics highly readable.

An introduction to causal case study methods, complete with step-by-step guidelines and examples Explores the relationship between correlation and causation using a series of novel statistical methods.

A pioneer of artificial intelligence shows how the study of causality revolutionized science and the

world 'Correlation does not imply causation.' This mantra was invoked by scientists for decades in order to avoid taking positions as to whether one thing caused another, such as smoking and cancer and carbon dioxide and global warming. But today, that taboo is dead. The causal revolution, sparked by world-renowned computer scientist Judea Pearl and his colleagues, has cut through a century of confusion and placed cause and effect on a firm scientific basis. Now, Pearl and science journalist Dana Mackenzie explain causal thinking to general readers for the first time, showing how it allows us to explore the world that is and the worlds that could have been. It is the essence of human and artificial intelligence. And just as Pearl's discoveries have enabled machines to think better, *The Book of Why* explains how we can think better.

An accessible, contemporary introduction to the methods for determining cause and effect in the social sciences "Causation versus correlation has been the basis of arguments--economic and otherwise--since the beginning of time. *Causal Inference: The Mixtape* uses legit real-world examples that I found genuinely thought-provoking. It's rare that a book prompts readers to expand their outlook; this one did for me."--Marvin Young (Young MC) Causal inference encompasses the tools that allow social scientists to determine what causes what. In a messy world, causal inference is what helps establish the causes and effects of the actions being studied--for example, the impact (or lack thereof) of increases in the minimum wage on employment, the effects of early childhood education on incarceration later in life, or the influence on economic growth of introducing malaria nets in developing regions. Scott Cunningham introduces students and practitioners to the methods necessary to arrive at meaningful answers to the questions of causation, using a range of modeling techniques and coding instructions for both the R and the Stata programming languages.

In this comprehensive reconstruction of causal case study methods, Derek Beach, Rasmus Brun Pedersen, and their coauthors delineate the ontological and epistemological differences among these methods, offer suggestions for determining the appropriate methods for a given research project, and explain the step-by-step application of selected methods. *Causal Case Study Methods* begins with the cohesive, logical foundations for small-n comparative methods, congruence methods, and process tracing, then delineate the distinctive types of causal relationships for which each method is appropriate. Next, the authors provide practical instruction for deploying each of the methods individually and in combination. They walk the researcher through each stage of the research process, starting with issues of concept formation and the formulation of causal claims in ways that are compatible with case-based research. They then develop guidelines for using Bayesian logic as a set of practical questions for translating empirical data into evidence that may or may not confirm causal inferences. Widely acclaimed instructors, the authors draw upon their extensive experience at the graduate level in university classrooms, summer and winter school courses, and professional workshops, around the globe.

Causality offers the first comprehensive coverage of causal analysis in many sciences, including recent advances using graphical methods. Pearl presents a unified account of the probabilistic, manipulative, counterfactual and structural approaches to causation, and devises simple mathematical tools for analyzing the relationships between causal connections, statistical associations, actions and observations. The book will open the way for including causal analysis in the standard curriculum of statistics, artificial intelligence ...

Sections include: experiments and generalised causal inference; statistical conclusion validity and internal validity; construct validity and external validity; quasi-experimental designs that either lack a control group or lack pretest observations on the outcome; quasi-experimental designs that use both control groups and pretests; quasi-experiments: interrupted time-series designs; regression discontinuity designs; randomised experiments: rationale, designs, and conditions conducive to doing them; practical problems 1: ethics, participation recruitment and random assignment; practical problems 2: treatment implementation and attrition; generalised causal inference: a grounded theory; generalised causal inference: methods for single studies; generalised causal inference: methods for multiple studies; a critical assessment of our assumptions.

This book provides a post-positivist theory of deterministic and probabilistic causality that supports both quantitative and qualitative explanations. Features of particular interest include the ability to provide true explanations in contexts where our knowledge is incomplete, a systematic interpretation of causal modeling techniques in the social sciences, and a direct realist view of causal relations that is compatible with a liberal empiricism. The book should be of wide interest to both philosophers and scientists. Originally published in 1989. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

Approximately one in six top economic research papers draws an explicitly causal conclusion. But what do economists mean when they conclude that A 'causes' B? Does 'cause' say that we can influence B by intervening on A, or is it only a label for the correlation of variables? Do quantitative analyses of observational data followed by such causal inferences constitute sufficient grounds for guiding economic policymaking? *The Philosophy of Causality in Economics* addresses these questions by analyzing the meaning of causal claims made by economists and the philosophical presuppositions underlying the research methods used. The book considers five key causal approaches: the regularity approach, probabilistic theories, counterfactual theories, mechanisms, and interventions and manipulability. Each chapter opens with a summary of literature on the relevant approach and discusses its reception among economists. The text details case studies, and goes on to examine papers which have adopted the approach in order to highlight the methods of causal inference used in contemporary economics. It analyzes the meaning of the causal claim put forward, and finally reconstructs the philosophical presuppositions accepted implicitly by economists. The strengths and limitations of each method of causal inference are also considered in the context of using the results as evidence for policymaking. This book is essential reading to those interested in literature on the philosophy of economics, as well as the philosophy of causality and economic methodology in general. Causal reasoning is one of our most central cognitive competencies, enabling us to adapt to our world. Causal knowledge allows us to predict future events, or diagnose the causes of observed facts. We plan actions and solve problems using knowledge about cause-effect relations. Although causal reasoning is a component of most of our cognitive functions, it has been neglected in cognitive psychology for many decades. *The Oxford Handbook of Causal Reasoning* offers a state-of-the-

art review of the growing field, and its contribution to the world of cognitive science. The Handbook begins with an introduction of competing theories of causal learning and reasoning. In the next section, it presents research about basic cognitive functions involved in causal cognition, such as perception, categorization, argumentation, decision-making, and induction. The following section examines research on domains that embody causal relations, including intuitive physics, legal and moral reasoning, psychopathology, language, social cognition, and the roles of space and time. The final section presents research from neighboring fields that study developmental, phylogenetic, and cultural differences in causal cognition. The chapters, each written by renowned researchers in their field, fill in the gaps of many cognitive psychology textbooks, emphasizing the crucial role of causal structures in our everyday lives. This Handbook is an essential read for students and researchers of the cognitive sciences, including cognitive, developmental, social, comparative, and cross-cultural psychology; philosophy; methodology; statistics; artificial intelligence; and machine learning.

Research design is of critical importance in social research, despite its relative neglect in many methods resources. Early consideration of design in relation to research questions leads to the elimination or diminution of threats to eventual research claims, by encouraging internal validity and substantially reducing the number of alternative explanations for any finite number of research 'observations'. This new book: discusses the nature of design; gives an introduction to design notation; offers a flexible approach to new designs; looks at a range of standard design models; and presents craft tips for real-life problems and compromises. Most importantly, it provides the rationale for preferring one design over another within any given context. Each section is illustrated with case studies of real work and concludes with suggested readings and topics for discussion in seminars and workshops, making it an ideal textbook for postgraduate research methods courses. Based on the author's teaching on the ESRC Doctoral Training Centre "Masters in Research Methods" at the University of Birmingham, and his ongoing work for the ESRC Researcher Development Initiative, this is an essential text for postgraduate researchers and academics. There is no book like Research Design on the market that addresses all of these issues in an easy to comprehend style, for those who want to design research and make critical judgements about the designs of others.

The most comprehensive account available of causal asymmetry, written by a pre-eminent philosopher of science.

Head hits cause brain damage - but not always. Should we ban sport to protect athletes? Exposure to electromagnetic fields is strongly associated with cancer development - does that mean exposure causes cancer? Should we encourage old fashioned communication instead of mobile phones to reduce cancer rates? According to popular wisdom, the Mediterranean diet keeps you healthy. Is this belief scientifically sound? Should public health bodies encourage consumption of fresh fruit and vegetables? Severe financial constraints on research and public policy, media pressure, and public anxiety make such questions of immense current concern not just to philosophers but to scientists, governments, public bodies, and the general public. In the last decade there has been an explosion of theorizing about causality in philosophy, and also in the sciences. This literature is both fascinating and important, but it is involved and highly technical. This makes it inaccessible to many who would like to use it, philosophers and scientists alike. This book is an introduction to philosophy of causality - one that is highly accessible: to scientists unacquainted with philosophy, to philosophers unac-

quainted with science, and to anyone else lost in the labyrinth of philosophical theories of causality. It presents key philosophical accounts, concepts and methods, using examples from the sciences to show how to apply philosophical debates to scientific problems.

This textbook introduces the scientific study of politics, supplying students with the basic tools to be critical consumers and producers of scholarly research.

In Making Things Happen, James Woodward develops a new and ambitious comprehensive theory of causation and explanation that draws on literature from a variety of disciplines and which applies to a wide variety of claims in science and everyday life. His theory is a manipulationist account, proposing that causal and explanatory relationships are relationships that are potentially exploitable for purposes of manipulation and control. This account has its roots in the commonsense idea that causes are means for bringing about effects; but it also draws on a long tradition of work in experimental design, econometrics, and statistics. Woodward shows how these ideas may be generalized to other areas of science from the social scientific and biomedical contexts for which they were originally designed. He also provides philosophical foundations for the manipulationist approach, drawing out its implications, comparing it with alternative approaches, and defending it from common criticisms. In doing so, he shows how the manipulationist account both illuminates important features of successful causal explanation in the natural and social sciences, and avoids the counterexamples and difficulties that infect alternative approaches, from the deductive-nomological model onwards. Making Things Happen will interest philosophers working in the philosophy of science, the philosophy of social science, and metaphysics, and as well as anyone interested in causation, explanation, and scientific methodology.

Many of the concepts and terminology surrounding modern causal inference can be quite intimidating to the novice. Judea Pearl presents a book ideal for beginners in statistics, providing a comprehensive introduction to the field of causality. Examples from classical statistics are presented throughout to demonstrate the need for causality in resolving decision-making dilemmas posed by data. Causal methods are also compared to traditional statistical methods, whilst questions are provided at the end of each section to aid student learning.

The application of causal inference methods is growing exponentially in fields that deal with observational data. Written by pioneers in the field, this practical book presents an authoritative yet accessible overview of the methods and applications of causal inference. With a wide range of detailed, worked examples using real epidemiologic data as well as software for replicating the analyses, the text provides a thorough introduction to the basics of the theory for non-time-varying treatments and the generalization to complex longitudinal data.

The quasi-federal European Union stands out as the major exception in the thinly institutionalized world of international politics. Something has led Europeans—and only Europeans—beyond the nation-state to a fundamentally new political architecture. Craig Parsons argues in A Certain Idea of Europe that this "something" was a particular set of ideas generated in Western Europe after the Second World War. In Parsons's view, today's European Union reflects the ideological (and perhaps visionary) project of an elite minority. His book traces the progressive victory of this project in France, where the battle over European institutions erupted most divisively. Drawing on archival research and extensive interviews with French policymakers, the author carefully traces a fifty-year conflict

between radically different European plans. Only through aggressive leadership did the advocates of a supranational "community" Europe succeed at building the EU and binding their opponents within it. Parsons puts the causal impact of ideas, and their binding effects through institutions, at the center of his book. In so doing he presents a strong logic of "social construction"—a sharp departure from other accounts of EU history that downplay the role of ideas and ideology.

STATISTICS AND CAUSALITY A one-of-a-kind guide to identifying and dealing with modern statistical developments in causality. Written by a group of well-known experts, *Statistics and Causality: Methods for Applied Empirical Research* focuses on the most up-to-date developments in statistical methods in respect to causality. Illustrating the properties of statistical methods to theories of causality, the book features a summary of the latest developments in methods for statistical analysis of causality hypotheses. The book is divided into five accessible and independent parts. The first part introduces the foundations of causal structures and discusses issues associated with standard mechanistic and difference-making theories of causality. The second part features novel generalizations of methods designed to make statements concerning the direction of effects. The third part illustrates advances in Granger-causality testing and related issues. The fourth part focuses on counterfactual approaches and propensity score analysis. Finally, the fifth part presents designs for causal inference with an overview of the research designs commonly used in epidemiology. *Statistics and Causality: Methods for Applied Empirical Research* also includes: New statistical methodologies and approaches to causal analysis in the context of the continuing development of philosophical theories. End-of-chapter bibliographies that provide references for further discussions and additional research topics. Discussions on the use and applicability of software when appropriate. *Statistics and Causality: Methods for Applied Empirical Research* is an ideal reference for practicing statisticians, applied mathematicians, psychologists, sociologists, logicians, medical professionals, epidemiologists, and educators who want to learn more about new methodologies in causal analysis. The book is also an excellent textbook for graduate-level courses in causality and qualitative logic.

Agent-based Models and Causal Inference Scholars of causal inference have given little credence to the possibility that ABMs could be an important tool in warranting causal claims. Manzo's book makes a convincing case that this is a mistake. The book starts by describing the impressive progress that ABMs have made as a credible methodology in the last several decades. It then goes on to compare the inferential threats to ABMs versus the traditional methods of RCTs, regression, and instrumental variables showing that they have a common vulnerability of being based on untestable assumptions. The book concludes by looking at four examples where an analysis based on ABMs complements and augments the evidence for specific causal claims provided by other methods. Manzo has done a most convincing job of showing that ABMs can be an important resource in any researcher's tool kit. Christopher Winship, Diker-Tishman Professor of Sociology, Harvard University, USA *Agent-based Models and Causal Inference* is a first-rate contribution to the debate on, and practice of, causal claims. With exemplary rigor, systematic precision and pedagogic clarity, this book contrasts the assumptions about causality that undergird agent-based models, experimental methods, and statistically based observational methods, discusses the challenges these methods face as far as inferences go, and, in light of this discussion, elaborates the case for combining these methods' respective strengths: a remarkable achievement. Ivan Ermakoff, Professor of Sociology,

University of Wisconsin-Madison, USA *Agent-based models* are a uniquely powerful tool for understanding how patterns in society may arise in often surprising and counter-intuitive ways. This book offers a strong and deeply reflected argument for how ABM's can do much more: add to actual empirical explanation. The work is of great value to all social scientists interested in learning how computational modelling can help unraveling the complexity of the real social world. Andreas Flache, Professor of Sociology at the University of Groningen, Netherlands *Agent-based Models and Causal Inference* is an important and much-needed contribution to sociology and computational social science. The book provides a rigorous new contribution to current understandings of the foundation of causal inference and justification in the social sciences. It provides a powerful and cogent alternative to standard statistical causal-modeling approaches to causation. Especially valuable is Manzo's careful analysis of the conditions under which an agent-based simulation is relevant to causal inference. The book represents an exceptional contribution to sociology, the philosophy of social science, and the epistemology of simulations and models. Daniel Little, Professor of philosophy, University of Michigan, USA *Agent-based Models and Causal Inference* delivers an insightful investigation into the conditions under which different quantitative methods can legitimately hold to be able to establish causal claims. The book compares agent-based computational methods with randomized experiments, instrumental variables, and various types of causal graphs. Organized in two parts, *Agent-based Models and Causal Inference* connects the literature from various fields, including causality, social mechanisms, statistical and experimental methods for causal inference, and agent-based computation models to help show that causality means different things within different methods for causal analysis, and that persuasive causal claims can only be built at the intersection of these various methods. Readers will also benefit from the inclusion of: A thorough comparison between agent-based computation models to randomized experiments, instrumental variables, and several types of causal graphs. A compelling argument that observational and experimental methods are not qualitatively superior to simulation-based methods in their ability to establish causal claims. Practical discussions of how statistical, experimental and computational methods can be combined to produce reliable causal inferences. Perfect for academic social scientists and scholars in the fields of computational social science, philosophy, statistics, experimental design, and ecology, *Agent-based Models and Causal Inference* will also earn a place in the libraries of PhD students seeking a one-stop reference on the issue of causal inference in agent-based computational models.

Twelve essays explore what bearing empirical findings might have on philosophical concerns about counterfactuals and causation, and how, in turn, work in philosophy might help clarify issues in empirical work on the relationships between causal and counterfactual thought.

Metaethics occupies a central place in analytical philosophy, and the last forty years has seen an upsurge of interest in questions about the nature and practice of morality. This collection presents original and ground-breaking research on metaethical issues from some of the very best of a new generation of philosophers working in this field.

There is a need for integrated thinking about causality, probability and mechanisms in scientific methodology. Causality and probability are long-established central concepts in the sciences, with a corresponding philosophical literature examining their problems. On the other hand, the philosophical literature examining mechanisms is not long-established, and there is no clear idea of how mech-

anisms relate to causality and probability. But we need some idea if we are to understand causal inference in the sciences: a panoply of disciplines, ranging from epidemiology to biology, from econometrics to physics, routinely make use of probability, statistics, theory and mechanisms to infer causal relationships. These disciplines have developed very different methods, where causality and probability often seem to have different understandings, and where the mechanisms involved often look very different. This variegated situation raises the question of whether the different sciences are really using different concepts, or whether progress in understanding the tools of causal inference in some sciences can lead to progress in other sciences. The book tackles these questions as well as others concerning the use of causality in the sciences.

A concise and self-contained introduction to causal inference, increasingly important in data science and machine learning. The mathematization of causality is a relatively recent development, and has become increasingly important in data science and machine learning. This book offers a self-contained and concise introduction to causal models and how to learn them from data. After explaining the need for causal models and discussing some of the principles underlying causal inference, the book teaches readers how to use causal models: how to compute intervention distributions, how to infer causal models from observational and interventional data, and how causal ideas could be exploited for classical machine learning problems. All of these topics are discussed first in terms of two variables and then in the more general multivariate case. The bivariate case turns out to be a particularly hard problem for causal learning because there are no conditional independences as used by classical methods for solving multivariate cases. The authors consider analyzing statistical asymmetries between cause and effect to be highly instructive, and they report on their decade of intensive research into this problem. The book is accessible to readers with a background in machine learning or statistics, and can be used in graduate courses or as a reference for researchers. The text includes code snippets that can be copied and pasted, exercises, and an appendix with a summary of the most important technical concepts.

Communication research is evolving and changing in a world of online journals, open-access, and new ways of obtaining data and conducting experiments via the Internet. Although there are generic encyclopedias describing basic social science research methodologies in general, until now there has been no comprehensive A-to-Z reference work exploring methods specific to communication and media studies. Our entries, authored by key figures in the field, focus on special considerations when applied specifically to communication research, accompanied by engaging examples from the literature of communication, journalism, and media studies. Entries cover every step of the research process, from the creative development of research topics and questions to literature reviews, selection of best methods (whether quantitative, qualitative, or mixed) for analyzing research results and publishing research findings, whether in traditional media or via new media outlets. In addition to expected entries covering the basics of theories and methods traditionally used in communication research, other entries discuss important trends influencing the future of that research, including contemporary practical issues students will face in communication professions, the influences of globalization on research, use of new recording technologies in fieldwork, and the challenges and opportunities related to studying online multi-media environments. Email, texting, cellphone video, and blogging are shown not only as topics of research but also as means of collecting and analyzing data.

Still other entries delve into considerations of accountability, copyright, confidentiality, data ownership and security, privacy, and other aspects of conducting an ethical research program. Features: 652 signed entries are contained in an authoritative work spanning four volumes available in choice of electronic or print formats. Although organized A-to-Z, front matter includes a Reader's Guide grouping entries thematically to help students interested in a specific aspect of communication research to more easily locate directly related entries. Back matter includes a Chronology of the development of the field of communication research; a Resource Guide to classic books, journals, and associations; a Glossary introducing the terminology of the field; and a detailed Index. Entries conclude with References/Further Readings and Cross-References to related entries to guide students further in their research journeys. The Index, Reader's Guide themes, and Cross-References combine to provide robust search-and-browse in the e-version.

What constitutes a causal explanation, and must an explanation be causal? What warrants a causal inference, as opposed to a descriptive regularity? What techniques are available to detect when causal effects are present, and when can these techniques be used to identify the relative importance of these effects? What complications do the interactions of individuals create for these techniques? When can mixed methods of analysis be used to deepen causal accounts? Must causal claims include generative mechanisms, and how effective are empirical methods designed to discover them? The Handbook of Causal Analysis for Social Research tackles these questions with nineteen chapters from leading scholars in sociology, statistics, public health, computer science, and human development.

The Effect: An Introduction to Research Design and Causality is about research design, specifically concerning research that uses observational data to make a causal inference. It is separated into two halves, each with different approaches to that subject. The first half goes through the concepts of causality, with very little in the way of estimation. It introduces the concept of identification thoroughly and clearly and discusses it as a process of trying to isolate variation that has a causal interpretation. Subjects include heavy emphasis on data-generating processes and causal diagrams. Concepts are demonstrated with a heavy emphasis on graphical intuition and the question of what we do to data. When we "add a control variable" what does that actually do? Key Features: • Extensive code examples in R, Stata, and Python • Chapters on overlooked topics in econometrics classes: heterogeneous treatment effects, simulation and power analysis, new cutting-edge methods, and uncomfortable ignored assumptions • An easy-to-read conversational tone • Up-to-date coverage of methods with fast-moving literatures like difference-in-differences

Understanding causal structure is a central task of human cognition. Causal learning underpins the development of our concepts and categories, our intuitive theories, and our capacities for planning, imagination and inference. During the last few years, there has been an interdisciplinary revolution in our understanding of learning and reasoning: Researchers in philosophy, psychology, and computation have discovered new mechanisms for learning the causal structure of the world. This new work provides a rigorous, formal basis for theory theories of concepts and cognitive development, and moreover, the causal learning mechanisms it has uncovered go dramatically beyond the traditional mechanisms of both nativist theories, such as modularity theories, and empiricist ones, such as association or connectionism.