

Advances in Intelligent Systems and Computing

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Series editor

Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland
e-mail: kacprzyk@ibspan.waw.pl

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Edgardo Bucciarelli · Marcello Silvestri
Sara Rodríguez González
Editors

Decision Economics,
In Commemoration
of the Birth Centennial
of Herbert A. Simon
1916–2016 (Nobel Prize
in Economics 1978)

Distributed Computing and Artificial
Intelligence, 13th International Conference

Editors

Edgardo Bucciarelli
University of Chieti-Pescara
Pescara
Italy

Sara Rodríguez González
Departamento de Informática y Automática
Universidad de Salamanca
Salamanca
Spain

Marcello Silvestri
Department of Economical-Statistical
and PES
University of Chieti-Pescara
Pescara
Italy

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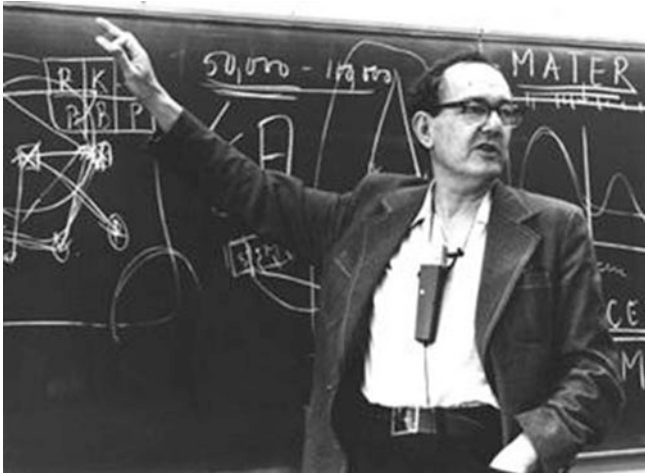
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Preface

“There can no longer be any doubt that the microassumptions of the theory - the assumptions of perfect rationality - are contrary to fact. It is not a question of approximation; they do not even remotely describe the processes that human beings use for making decisions in complex situations.” (Herbert A. Simon, from the Nobel Lecture, 1978, p. 366)



Decision economics, in commemoration of the Birth Centennial of Herbert A. Simon 1916–2016.

This book presents a selection of distinguished contributions to the research field of economics and decision-making presented at the special session on “Decision Economics” during the 13th International Conference on Distributed Computing and Artificial Intelligence (DCAI) 2016 held in the University of Seville, Spain.

There was a special reason for holding this session during the Conference: the commemoration of the Birth Centennial of Herbert A. Simon, 1916–2016, one of the pioneers and founders of Artificial Intelligence (AI) and the main precursor of the modern Behavioral Economics (BE) with the related applied research that has resulted in order to progress economics. The special session provided an international forum for social scientists to discuss emerging topics and integrate insights from basic research with those stemming from more applied research efforts. The extensive research done in the emergent field of *decision economics* has raised fundamental questions and issues regarding the nature of rationality. These questions and issues particularly affect the decision theory, which is a crossroads of different scientific disciplines – statistics, mathematics, probability calculus, psychology, biology, economics, and philosophy – around which numerous efforts have been made to compose or recompose a single behavioral model to be valid for several applications. Nevertheless, decision theory is concerned with goal-directed behavior in the presence of alternatives (options). Therefore, decision theory can in turn be placed in the wider field of behavioral studies by finding its most innovative definition within the complex of cognitive sciences.

The first appearance of interest in the cognitive sciences and their contribution to the interpretation of economic phenomena is traced to Herbert A. Simon. The scientific community has unanimously recognized the fundamental role played by Simon's insights in this context and the upheavals generated by him in the concepts and methods of microeconomics and applied economics. His theoretical and methodological reflections proposed a veritable paradigm shift with respect to the views grounded in neoclassical economics. Specifically, among others, Simon argues that economics should not deal of rational behavior in an abstract manner, but must re-found itself as an empirical study of the limitations of the decision makers' capabilities and how those limitations affect the actual economic behavior.

Not yet thirty, Simon was the first to discuss the issue of decisions made by managers within business organizations, when those decisions are made under conditions of uncertainty, that is, when the available information is imperfect because inaccurate and incomplete. Although these decisions basically aim at maximizing profits, it is not evident from an empirical standpoint that entrepreneurs, thus in general business organizations, necessarily follow the principles of the marginalist tradition of maximizing profits and minimizing costs. This is due, in large part, to the inherent limitations of rationality rooted in the decision-makers. Because of these limitations, decision-makers can only make decisions not aiming the optimum, i.e. the absolutely best decision of all possible decisions, but settling for the *satisficing*, that is an acceptable decision. Hence, the objective of business organizations is not addressing issues related to the optimization, such as maximizing profits, but finding acceptable solutions to urgent problems. In particular, Simon proposes, as the best method to study problems of this nature, the modeling with computer simulations according to AI and BE methods. Last but not least, from the origins in the classic works of Herbert Simon, the two subjects of AI and BE appear to have developed into several sub-fields, all of them actively pursued at the frontiers of economic theory and applied economics.

On the one hand, therefore, for a long time the economic analysis considered decisions whose consequences are supposed perfectly foreseen and, therefore, perfectly planned. This is the case of the consumption and production theories as well as the theory of market structures and the related industrial organization approach. Over the past sixty years, however, the field of analysis was extended to include also the decisions under risk and uncertainty. In developing this analysis, the standard economic theory had to rely on both drastic and unrealistic simplifications, and on the predominance of strongly reductionist research programs characterized by a deductive logic. On the other hand, the current research is engaged in an effort to reverse the trend, in the hope of reaching a more accurate and truthful description of reality based on observations and experimentations, becoming able to explain those actual phenomena shortly considered or completely neglected by the mainstream economics. In Herbert Simon's vision, economics shares a common ground with the traditional sciences of nature, but concurrently benefits from the fact of being addressed as engineering sciences. The economic science, in fact, as the natural sciences investigates reality starting from the need to observe real phenomena and, as the engineering, aims to build processes and artifacts that meet the purpose for which they were conceived by humans, since they put in place projects for human action, well-being and happiness.

In a nutshell, *bounded rationality*, *satisficing* and *problem solving*, within the context of decision processes faced by economic agents situated in complex organizations evolving dynamically, in a macro-economy viewed as a complex dynamic system, characterize the subject that has gradually come to be called *decision economics*.

In line with this debate, several contributions are presented in this volume, each of which has gradually moved away from the idea of being able to develop a general theory of decision-making, thus leaving open the question to see to what extent the results achieved analytically can then be translated, given different actual forms of rationality, in a real progress to understand complex phenomena. Therefore, this book discusses decision economics from a wide spectrum of methodological issues and applications. The content of each chapter is discussed next.

Chapter 1. "*The missing legacy of Herbert Simon in Agent-based Computational Economics*" by Shu-Heng Chen. In this chapter, the author provides insight into his vision regarding the missing legacy of Herbert A. Simon in Agent-based Computational Economics community. In particular, the author focuses the discussion on two key elements that have been neglected: near decomposability and modularity. The former refers to a system having the so called near decomposable architecture organized as a layers of parts where interactions are much more than those belonging to different parts. The latter refers on how to model autonomous agents capable of discovering chances and novelties without supervision.

Chapter 2. "*Incomplete soft sets: new solutions for decision making problems?*" by José Carlos R. Alcantud, and Gustavo Santos-García. In this chapter, the authors introduce a novel approach for soft based decision making under incomplete

information by revisiting a previous work of their own. More in depth, their solution relies on a classical Laplacian argument from probability theory. In view of the computational characteristics of such algorithm, they propose two related solutions that efficiently evaluate problems with many more incomplete data.

Chapter 3. “*A mixed model of optimal saving*” by Irina Georgescu, Adolfo Cristóbal-Campoamor, and Ana María Lucía Casademunt. In this chapter, the authors propose a mixed model to study a consumer’s optimal saving in the presence of two types of risk: income risk and background risk. In their model, the income risk is represented by a fuzzy number and the background risk by a random variable. Three notions of precautionary saving are defined as indicators of the extra saving induced by the income and the background risk on the consumer’s optimal choice. The authors demonstrate necessary and sufficient conditions for precautionary saving when adopting a mixed model of optimal saving.

Chapter 4. “*The role of technological changes in foreign-exchange market inefficiency*” by Svitlana Galeshchuk. In this chapter, the author develops an empirical methodology to study market inefficiency, which comes from rapidly developing software and technological progress, by introducing a technological bias in the exchange-rate market. The key idea is that computational methods based on evolving software, such as deep neural network, could help to forecast price movements and find the best trading strategies, rather than those methods based on traditional technical analysis.

Chapter 5. “*Web browser-based forecasting of economic time-series*” by V.M. Rivas, E. Parras-Gutiérrez, JJ Merelo, M.G. Arenas, and P. García-Fernández. In this chapter, the authors investigate the role that technology plays in decision analysis by presenting the implementation of a time series forecasting algorithm that uses genetic algorithm written in JavaScript and neural nets. The methodology is based on the use of web browsers as agents able to download a set of data, execute an evolutionary algorithm that evolves neural nets, and apply this neural nets to forecast an economic time-series. The experiments show the results yielded by the algorithm over a data set related to currencies exchange.

Chapter 6. “*Cross-entropy based ensemble classifiers*” by Giovanni Lafratta. In this chapter, the author simultaneously identifies multiple classification rules by applying the Cross-Entropy method to the maximization of accuracy measures in a supervised learning context. The author searches for optimal ensembles of rules through stochastic traversals of the rule space. Each rule contributes to classify a given instance when the observed attribute values belong to specific subsets of the corresponding attribute domains. Classifications of the various rules are combined applying majority voting schemes. The performance of the proposed algorithm has been tested on some data sets from the UCI repository.

Chapter 7. “*How does fairness relate to economic decision-making? An experimental investigation of pro-social behavior*” by Edgardo Bucciarelli, and Tony E. Persico. In this chapter, the authors discuss the role of fairness in economic decisions focusing

on Amartya K. Sen's concept of meta-ranking to study sets of preference orderings according to some fair principle. On the one hand, the authors propose a model based on a meta-utility function to explore different structures of preferences. On the other hand, they run an experimental economic game to test the role of meta-ranking, analyzing the results with a tensor-based method.

Chapter 8. "*What network analysis can teach us about Chinese economic structure*" by Vittorio Carlei, Alina Castagna, Leila Chentouf, and Donatella Furia. In this chapter, the authors use a network based approach in order to identify industrial intersectoral interdependencies in the Chinese economy. The idea behind the work is to highlight the behaviour of these interdependencies in reaction to exogenous shocks or in spreading shocks through the system.

Chapter 9. "*Regional income differentials in Italy: a MARS analysis*" by Iacopo Odoardi, and Fabrizio Muratore. In this chapter, the authors propose a multivariate adaptive regression splines analysis to investigate regional income difference in Italy and in order to provide an efficient complement to traditional econometric techniques.

Chapter 10. "*Data aware business process models: a framework for the analysis and verification of properties*" by Raffaele Dell'Aversana. In this chapter, the author presents a logic framework that enables the possibility of studying the properties of data-aware business processes, and gives directions for open research challenges in order to develop more efficient and effective organizations.

As with any such undertaking, there are many acknowledgements due, and they do not adequately represent the scope and depth of the support received. This book would not have been possible without financial support from the BISITE research group, University of Salamanca, Spain. Indeed, we began this project while we were at the Department of Economics and Economic History of the University of Salamanca and concluded it while at University of Seville, and their support is gratefully acknowledged.

In terms of the content of this book, we have been deeply influenced by a number of colleagues and friends. First and foremost, our initial interest in this subject arose through conversations and subsequent research with Gianfranco Giulioni. We have continued to learn about *decision economics* and enjoy the interaction with a group of scholars listed below in alphabetical order: José Carlos R. Alcantud, Thierry Burger-Helmchen, Claudia Casadio, Shu-Heng Chen, David C. Colander, Juan Manuel Corchado, S. Barry Cooper, Sameeksha Desai, Fernando De la Pietra, John Duffy, Giuseppe Fontana, Felix Freitag, Frank Heinemann, Herrade Igersheim, Rebeca Jiménez-Rodríguez, Amin M. Khan, Jakob Kapeller, Steve Keen, Alan Kirman, Marc Lavoie, Nadine Levratto, Nicola Mattoscio, Rosemarie Nagel, Giulio Occhini, Lionel Page, Carmen Pagliari, Javier Bajo Pérez, Enrico Rubaltelli, Neri Salvadori, Anwar Shaikh, Sergeja Slapničar, Amartya K. Sen, Pietro Terna, Katsunori Yamada, Kumaraswamy Vela Velupillai, Stefano Zambelli, John Wooders.

Finally, this book would not have the value and meaning it does without the support and interest of young scholars and PhD students who have discussed and commented on early versions of the contributions here included.

June 2016

Edgardo Buciarelli
Marcello Silvestri
Sara Rodríguez González

The Editors

Edgardo Bucciarelli is Aggregate Professor of Economics at University of Chieti-Pescara (Italy), he received a PhD in Economics from this university. His main research interests lie in the area of complexity and market dynamics, experimental and behavioral economics, applied economics, economic methodology, development economics. His main scientific articles appeared, among others, in the Journal of Economic Behavior and Organization, Journal of Post Keynesian Economics, Applied Economics, Rivista di Politica Economica, and other international journals. Several key contributions appeared in chapters of book in Physica-Verlag, and Springer Lecture Notes in Economics and Mathematical Systems. At present, he teaches Experimental economics and Economics of financial intermediaries at University of Chieti-Pescara. He is one of the Directors of the Research Centre for Evaluation and Socio-Economic Development and one of the co-founders of the academic spin-off company “*Economics Education Services*”. He is the co-founder, organizing chair, program committee chair in a number of international conferences.

Marcello Silvestri is Research Fellow of Economics at University of Chieti-Pescara (Italy), he received a PhD in Economics from this university. His main research interests lie in the area of macroeconomics, monetary economics, economic methodology, experimental and computational economics. He is the author and co-author of several articles published in international journals and volumes. He is one of the co-founders of the academic spin-off company “*Economics Education Services*” at University of Chieti-Pescara. He is the organizing chair and the co-founder of the special session in Decision Economics within the DCAI 2016 international conference.

Sara Rodríguez González is Associate Professor of Computer Science at University of Salamanca (Spain), she received a PhD in Computer Science from this University. She obtained a Technical Engineering in Systems Computer Sciences degree, and Engineering in Computer Sciences degree. Her main research interests lie in the area of agent and multi-agent systems, application of hybrid

systems on bioinformatics, computer graphics animation, and artificial vision. She is the author and co-author of several papers published in international journals. She was and is the organizing chair, program committee chair, steering committee member and session chair in a number of international conferences. At present, she is member of the IEEE Spanish Section Board, Spanish Association for Artificial Intelligence (AEPIA), Research Institute Art and Animation Technologies of the University of Salamanca and Bioinformatics, Intelligent System and Educational Technology Research Group (BISITE).

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