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The series “Advances in Intelligent Systems and Computing” contains publications on theory, applications, and design methods of Intelligent Systems and Intelligent Computing. Virtually all disciplines such as engineering, natural sciences, computer and information science, ICT, economics, business, e-commerce, environment, healthcare, life science are covered. The list of topics spans all the areas of modern intelligent systems and computing such as: computational intelligence, soft computing including neural networks, fuzzy systems, evolutionary computing and the fusion of these paradigms, social intelligence, ambient intelligence, computational neuroscience, artificial life, virtual worlds and society, cognitive science and systems, Perception and Vision, DNA and immune based systems, self-organizing and adaptive systems, e-Learning and teaching, human-centered and human-centric computing, recommender systems, intelligent control, robotics and mechatronics including human-machine teaming, knowledge-based paradigms, learning paradigms, machine ethics, intelligent data analysis, knowledge management, intelligent agents, intelligent decision making and support, intelligent network security, trust management, interactive entertainment, Web intelligence and multimedia.

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The photo of Herbert A. Simon was found in the public domain.
To Herbert A. Simon.
(The Editors)
Preface

Decision Economics. Designs, Models and Techniques for Boundedly Rational Decisions

Decision economics is a growing field of research which has been given much attention by several scholars in recent decades. The special session on Decision Economics (DECON) is a multidisciplinary international forum dedicated to advancing knowledge and improving practice in the areas of economics, business, computer science, cognitive sciences, quantitative methods, and related disciplines. To pursue this mission, DECON has facilitated the development and dissemination of a curriculum programme package concerning the diverse disciplines of the decision sciences by seeking to reconcile theory and practice in the tradition of Herbert A. Simon’s interdisciplinary heritage. Indeed, Herbert A. Simon was—and still is—one of the most influential founding father of the multidisciplinary fields of decision sciences: his contributions range across administrative behaviour and organisation theory, management science and operation research, behavioural decision theory, cognitive psychology, and artificial intelligence.

In 2018, DECON reported a third consecutive year of record-breaking activity based on theoretical, empirical, and methodological investigations of socio-economic decisions made by several economic agents in a complex market economy, not at all according to standard “rational” economic principles, but especially in light of behavioural and cognitive factors and bounded rationality. Such investigations have focused methodologically on quantitative approaches, qualitative methods, or have taken the form of insightful logic and flowing argumentation as well as reviews and commentaries on best practices in social science research. Furthermore, the special session has particularly dealt with analytics as an emerging synthesis of sophisticated methodology and large data systems used to guide economic decision-making in an increasingly complex business environment.

The recent negative economic and financial events, which have hit the world economies over approximately the last decade (2007–2017), call for new and innovative studies mainly in economics, business and finance, involving different
research fields such as economics, psychology or strictly related social sciences, leading source for original research on the interplay of those fields within computer science and artificial intelligence. The editors of this book, chairs of DECON, strongly believe that this is a moral duty, as well as a scientific duty, for prudent and wise economists aware of the complexity of the real world in which they live and work in the third millennium. Certainly, the combination of economics and decision sciences is a field of studies which proves to be useful and, thus, should be fostered to academicians and practitioners interested in the application of quantitative, behavioural and cognitive methods to the problems of society. The special session has focused on interdisciplinary approaches to the study of economic analysis and policies within several major areas, as shown below among others:

- Experimental Research in Economics; Behavioural Game Theory; Cognitive Economics; Interrelations of Economics and Psychology with AI;
- Complexity of Behavioural Decision Processes; Microfoundations and Micro–Macro Relationships; Organisational Decision-Making;
- Computation and Computability in Economics; Decision Theory and the Economics of Uncertainty; Algorithmic Social Sciences Research;
- Decision Support Systems and Business Decisions; Business Intelligence Analytics and Decision-Making; Big Data, Data Mining and Robotics;
- Managerial Decision-Making; Complex Business Environments; Information Technology and Operational Decision Sciences.

This book presents a collection of selected peer-reviewed papers presented at DECON 2018 and discussed decision economics from a wide spectrum of methodological issues and applications. The content of each chapter is described briefly below.

Chapter 1. “Auto regressive integrated moving average modeling and support vector machine classification of financial time series” by Alexander Kocian and Stefano Chessa. In this chapter, with cloud computing offering organisations a level of scalability and power, the authors are at a point where machine learning is set to support human financial analysts in FOReign EXchange (FOREX) markets. Trading accuracy of current robots, however, is still hard limited. They deal with the derivation of a one-step predictor for a single FOREX pair time-series. In contrast to many other approaches, the authors’ predictor is based on a theoretical framework. The historical price actions are modelled as autoregressive integrated moving average (ARIMA) random process, using maximum likelihood fitting. The minimum akaike information criterion estimation (MAICE) yields the order of the process. A support vector machine (SVM), whose feature space is spanned by historical price actions, yields the one-step-ahead class label UP or DOWN. Backtesting results on the EURUSD pair on different time frames indicate that their predictor is capable of achieving high instantaneous profit but on long-term average, profitable when the risk-to-reward ratio per trade is around 1:1.2. The authors’ result is in line with related studies.
Chapter 2. “Do information quantity and transmission make a difference to the stable contrarian?” by Hung-Wen Lin, Jing-Bo Huang, Kun-Ben Lin and Shu-Heng Chen. In this chapter, the authors study how financial transparency and media coverage work in the Chinese stock markets. In this work, transparency means information quantity, while media means information transmission. The market has negative momentum profits no matter how transparency or media coverage changes, which suggests that transparency—or media coverage—does not work individually in China. High transparency and high media coverage make significantly positive momentum profits, whereas low transparency and low media coverage make significantly negative momentum profits. These outcomes show that transparency and media coverage work jointly in China. The authors’ findings imply that information quantity and transmission are both crucial in China.

Chapter 3. “The logistic map: an AI tool for economists investigating complexity and suggesting policy decisions” by Carmen Pagliari and Nicola Mattoscio. In this chapter, the authors give an original interpretation of the logistic map popularised by the biologist Robert May in 1976. This map is potentially a powerful AI tool based on a deterministic methodology having a double opportunity to be applied in economics. On the one hand, indeed, the first application concerns the investigation of a certain intrinsic complexity of real economic phenomena characterised by endogenous nonlinear dynamics. Closely related to a normative research, on the other hand, the second application helps determine results useful for suggesting policy decisions as a contribution to avoiding chaos and unpredictability within real economic systems. In the first application, therefore, the logistic map can be used as an AI tool for forecasting and anticipating the unknown (for previsions of bifurcations, cycles and chaos), while in the second one, it can be considered as an AI tool for policymakers in order to deduce the analytical conditions that aid the economic system in being sufficiently far away from chaos and uncontrollability.

Chapter 4. “Optimal noise manipulation in asymmetric tournament” by Zhiqiang Dong and Zijun Luo. In this chapter, the authors fill a gap in the literature of asymmetric tournament by allowing the principal to optimally alter noise in relative performance evaluation, such that the observed performance of each agent is less or more dependent of ability and effort. The authors show that there exists an optimal noise level from the principal’s standpoint of expected profit maximisation. It is shown that this optimal noise level is higher than what would induce the highest efforts from the two agents.

Chapter 5. “Decision-making process underlying travel behavior and its incorporation in applied travel models” by Peter Vovsha. In this chapter, the author provides a broad overview of the state of the art and practice in travel modelling in its relation to individual travel behaviour. The work describes how different travel decision-making paradigms led to different generations of applied travel models in practice—from aggregate models to disaggregate trip-base models, then to tour-based models, then to activity-based models and finally to agent-based models. The chapter shows how these different modelling approaches can be effectively generalised in one framework where different model structures correspond to
different basic assumptions on the decision-making process. The author focus on three key underlying behavioural aspects: (i) how different dimensions of travel and associated individual choices are sequenced and integrated; (ii) how the real-world constraints on different travel dimensions are represented; and (iii) what are the behavioural factors and associated mathematical and statistical models applied for modelling each decision-making step. The work analyses the main challenges associated with understanding and modelling travel behaviour and outlines avenues for future research.

Chapter 6. “Formalisation of situated dependent-type theory with underspecified assessments” by Roussanka Loukanova. In this chapter, the author introduces a formal language of situated dependent-type theory by extending its potentials for structured data integrated with quantitative assessments. The language has terms for situated information which is partial and underspecified. The enriched formal language provides integration of a situated dependent-type theory with statistical and other approaches to machine learning techniques.

Chapter 7. “Scholarship, admission and application of a postgraduate program” by Yehui Lao, Zhiqiang Dong and Xinyuan Yang. In this chapter, the authors aim to construct a game of admission and application behaviour of a postgraduate programme. They attempt to expand the decision of graduate school from one party model to two party model. The authors suggest that the interval of postgraduate programme’s scholarship determines the decision made by applicants with different capacity and family background. Furthermore, graduate schools will try to use scholarship as a tool to select students.

Chapter 8. “Subgroup optimal decisions in cost-effectiveness analysis” by Elias Moreno, Francisco-José Vázquez-Polo, Miguel-Angel Negrín and María Martel-Escobar. In this chapter, the authors deal with cost-effectiveness analysis (CEA) of medical treatments. In this framework, the optimal treatment is chosen using a statistical model of the cost and effectiveness of the treatments and data from patients under the treatments. Sometimes, however, these data also include values of certain deterministic covariates of the patients with usually have valuable clinical information that would be incorporated into the statistical treatment selection procedure. In this respect, the authors discuss the usual statistical models to undertake this task and the main statistical problems it involves. They present a Bayesian variable selection procedure and find optimal treatments for subgroups defined by selected covariates.

Chapter 9. “A statistical tool as a decision support in enterprise financial crisis” by Francesco De Luca, Stefania Fensore and Enrica Meschieri. In this chapter, the authors focus on the recent reform of Italian Insolvency Law (III) which has introduced new instruments aimed to restore companies bearing financial distresses and potentially incurring bankruptcy proceedings. In particular, the Article 182-bis restructuring agreements have been introduced by the Italian Civil Code to manage, among others, these distresses and potential proceedings. Therefore, the authors’ objective is to underline the ability of seven specific accounting ratios and coefficients to help predict the status of financial distress of companies. The authors introduce a new formula that they call M-Index indicator.
and then provide an empirical analysis through a sample of Italian listed companies collected from Borsa Italiana (Italian Stock Exchange) in the period 2003–2012. The results of the empirical analysis performed by the authors validate the predictive accuracy power of their indicator.

**Chapter 10.** “A mediation model of absorptive and innovative capacities: The case of Spanish family businesses” by Felipe Hernández-Perlines and Wenkai Xu. In this paper, the authors analyse the mediating effect of innovation capacity on the influence of absorptive capacity in the performance of family businesses. For the analysis of results, the use of a second-generation structural equation method is proposed (PLS-SEM) using smartPLS 3.2.7 computer software, applied to the data coming from 218 Spanish family businesses. The main contribution of this work is given by the fact that the performance of family businesses is determined by the absorptive capacity (absorptive capacity is able to explain approximately 36% of the performance variability of family businesses). The second relevant contribution of this work is that the influence of the absorptive capacity on the performance of family businesses is strengthened by the effect of innovation capacity, explaining around 40% of the variability. The third contribution is that the absorptive capacity is a precedent for innovation capacity, able to explain about 50% of its variability.

**Chapter 11.** “The mathematics of interdependence for superordinate decision-making with teams” by William Lawless. In this chapter, the author reviews the function of decision-making as a human process in the field affected by interdependence (additive and destructive social interference). The scope of this review is first to define and describe why interdependence is difficult to grasp intellectually, but much easier intuitively in social contexts (bistability, convergence to incompleteness, non-factorable social states); second to describe the research accomplishments and applications to hybrid teams (arbitrary combinations of humans, machines and robots); and third to advance the research by beginning to incorporate the value of intelligence for teams as they strive to achieve a team’s superordinate goals (e.g. in the tradeoffs between a team’s structure and its effort to achieve its mission with maximum entropy production, MEP). The author discussed prior results, future research plans and draw conclusions for the development of theory.

**Chapter 12.** “Towards a natural experiment leveraging big data to analyse and predict users” by Raffaele Dell’Aversana and Edgardo Bucciarelli. In this chapter, the authors develop a model for multi-criteria evaluation of big data within organisations concerned with the impact of an ad exposure on online consumption behaviour. The model has been structured to help organisations make decisions in order to improve the business knowledge and understanding on big data and, specifically, heterogeneous big data. The model accommodates a multilevel structure of data with a modular system that can be used both to automatically analyse data and to produce helpful insights for decision-making. This modular system and its modules, indeed, implement artificial intelligent algorithms such as neural networks and genetic algorithms. To develop the model, therefore, a prototype has been built by the
authors as proof-of-concept using a marketing automation software that collects
data from several sources (public social and editorial media content) and stores
them into a large database so as the data can be analysed and used to help
implement business model innovations. In this regard, the authors are conducting a
natural experiment which has yet to be completed in order to show that the model
can provide useful insights as well as hints to help decision-makers take further
account of the most ‘satisficing’ decisions among alternative courses of action.

Chapter 13. “Google trends and cognitive finance: Lessons gained from the
Taiwan stock market” by Pei-Hsuan Shen, Shu-Heng Chen and Tina Yu. In this
chapter, the authors investigate the relationship between Google Trends Search
Volume Index (SVI) and the average returns of Taiwan Stock Exchange
Capitalization Weighted Stock Index (TAIEX). In particular, the authors used the
aggregate SVI searched by a company’s abbreviated name and by its ticker symbol
to conduct our research. The results are very different. While the aggregate SVI of
abbreviated names is significantly and positively correlated to the average returns of
TAIEX, the aggregate SVI of ticker symbols is not. This gives strong evidence that
investors in the Taiwan stock market normally use abbreviated names, not ticker
symbols, to conduct Google search for stock information. Additionally, the authors
found the aggregate SVI of small–cap companies has a higher degree of impact on
the TAIEX average returns than that of the mid–cap and large–cap companies.
Finally, the authors found the aggregate SVI with an increasing trend also has a
stronger positive influence on the TAIEX average returns than that of the overall
aggregate SVI, while the aggregate SVI with a decreasing trend has no influence on
the TAIEX average returns. This supports the attention hypothesis of Terrance
Odean in that the increased investors attention, which is measured by the
Google SVI, is a sign of their buying intention, hence caused the stock prices to
increase while decreased investors attention is not connected to their selling
intention or the decrease of stock prices.

Chapter 14. “Research on the evaluation of scientists based on weighted
h-index” by Guo-He Feng and Xing-Qing Mo. In this chapter, the authors proposed
two weighted h-index models which are named hw-index and hw_t-index and then
selected 30 active Chinese scholars in Library and information science field for
empirical analysis. Revealing highly cited papers and considering the contribution
of scientists’ whole papers, hw-index not only weakens the influence of self-citation
on the results, but also makes it easy to distinguish scientists’ contributions. The
hw_t-index focuses on the research output of scientists in recent years, also con-
considering their past contributions. Therefore, in the short-term evaluation, the
hw_t-index is more reasonable for young scientists and scholars who made a great
contribution during the past years. Potential scholars can be identified by the way of
comparing hw-index with hw_t-index.

Chapter 15. “Decision analysis based on artificial neural network for feeding
an industrial refrigeration system through the use of photovoltaic energy” by Fabio
Porreca. In this chapter, the author deals with the evaluation of the energy avail-
ability from renewable sources in the industrial processes. The subject matter of the
research is at the basis of many studies concerning engineering applications. The
non-programmable nature of many of the renewable sources often leads to consider them as a simple support and not as a primary source of supply. With this in mind, the author tries to exploit the forecasting abilities of the neural networks in order to create scenarios applicable in different high-energy-consuming industrial contexts which reckon the optimisation of the energy consumption as the new objective of the so-called green business.

**Chapter 16.** “Exit, voice and loyalty in consumers” online-posting behaviour: An empirical analysis of reviews and ratings found on Amazon.com” by Tony Ernesto Persico, Giovanna Sedda and Assia Liberatore. In this chapter, the authors aim to describe e-commerce consumers’ behaviour by analysing the distribution of online reviews and ratings. Different from previous studies focused on the positivity and negativity of ratings, this work analyses the ratings distribution through a tensor-based approach. This approach allows the authors to observe a new range of information related to distributions’ features that they describe through the “Exit, Voice and Loyalty” scheme. In addition, the authors seek a distribution function capable of capturing these features, and they aim to over-perform the synthesis provided by using a polynomial regression model. For this reason, the authors introduce an ad hoc beta-type modified function to create a proxy of collected data. Finally, the authors found a tri-modal distribution (S-modal) as a relevant component of the J-shaped distributions referred in the literature.

**Chapter 17.** “Effective land-use and public regional planning in the mining industry: The case of Abruzzo” by Francesco De Luca, Stefania Fensore and Enrica Meschieri. In this chapter, the authors deal with issues concerning land use patterns, public planning and extractive industry. More specifically, the authors aim to help describe the socio-economic variables most affected by quarry extraction processes by referring to the case of Abruzzo (region of Central Italy). The authors, moreover, introduce a model for quantification of the quarry material requirements expressed by the economic operators of the same territory with a time horizon of 2020. To this end, they suggest the use of several economic and statistical indicators, such as public investment on infrastructures, GDP growth, social housing policies and private building permits, in order to optimise the predicting power of the model as the indicators represent reliable proxies of the demand of raw materials, with respect to the need to limit the impact on the natural environment.

**Chapter 18.** “Do ICTs matter for Italy?” by Daniela Cialfi and Emiliano Colantonio. In this chapter, the authors investigate the relationship between ICTs and social capital through the study of the relative disparities among Italian regions. This work provides an operational definition of the concepts of ICT and social capital and presents consistent evidence on the geography of this relationship in Italy. The statistical and geographical analysis, based on nonlinear clustering with self-organising map (SOM) neural networks, are performed to analyse the performance of Italian regions in the period 2006–2013. The results show the isolation of Southern Italian regions. In particular, the authors found that ICTs may not promote social capital; that is, ICTs could not play a decisive role in creating and developing social capital. These results prompt the formulation of new policies for Italian regions.
Chapter 19. “Relationship of Weak Modularity and Intellectual Property Rights for Software Products” by Stefan Kambiz Behfar and Qumars Behfar. In this chapter, the authors focus on the impact of modularity on intellectual property rights, referring to modularity of underlying products to capture value within firms. In particular, the authors bring together the theory of software modularity from computer science and intellectual property (IP) rights from management literature to address the issue of value appropriation for IP rights within software products. The work defines the term of intellectual property associated with software products or platforms as opposed to the term of intellectual property used within firms serving as a source of economic rents. Initially, the work discusses the concepts behind usage of modularity as a means to protect IP rights and explain differences of organisation and product modularity, while rendering calculation for probability of imitation for weak modular systems. Then, the work investigates the threat of imitation. The main contribution of this paper is to provide a systematic analysis of value appropriation in weak modular systems by introducing a relationship between probability of imitation and module interdependency.

Last but not least, once again, this year's special session on Decision Economics would not have been possible without the advice and support of many scholars, particularly those belonging to the Programme Committee. Among these scholars, furthermore, special thanks are due to Sara Rodríguez González and Fernando De la Prieta for their dedicated guidance as well as their time, generosity and comments. The programme committee members and English language mentors have helped ensure the quality of the contributions with their extensive and continuous feedback to most of the authors and the editors, too.

Edgardo Buciarelli
Shu-Heng Chen
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Edgardo Bucciarelli is an Italian economist who holds the position of research professor of economics at the University of Chieti-Pescara (Italy), where he earned his PhD in economics (cv SECS/P01). His main research interests lie in the area of complexity and market dynamics; decision theory, design research, experimental microeconomics, classical behavioural economics and economic methodology. His main scientific articles appeared, among others, in the Journal of Economic Behavior and Organization, Journal of Post Keynesian Economics, Metroeconomica, Applied Economics, Computational Economics 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, cognitive economics and finance and economic methodology at the University of Chieti-Pescara. He is one of the directors of the Research Centre for Evaluation and Socio-Economic Development and the co-founder of the academic spin-off company “Economics Education Services”. He is the co-founder, organising chair, programme committee chair in a number of international conferences.

Shu-Heng Chen is a Taiwanese economist. He earned his PhD in economics at the University of California (UCLA, Los Angeles, USA) in 1992. Currently, he is a distinguished professor of economics in the Department of Economics and also the dean of the Office of International Cooperation at the National Chengchi University (Taipei, Taiwan). Furthermore, he is the founder and director of the AI-ECON Research Center at the College of Social Sciences of the National Chengchi University and the coordinator of the Laboratory of Experimental Economics in the same University. He is unanimously considered one of the most influential and pioneer scholars in the world in the field of applied research known as computational economics. His scientific contributions were directed to the affirmation of the computational approach aimed to the interpretation of the theoretical issues and applied economic problems still today unresolved, from a perspective more connected to reality and therefore different from the dominant neoclassical paradigm. In
particular, his most decisive contributions are aimed to the approach based on models with heterogeneous agents and the genetic programming in the socio-economic studies. His work as a scholar is interdisciplinary and focused since the beginning on methodologies related to the bounded rationality and Herbert A. Simon’s contributions. Shu-Heng Chen holds the position of editor of prestigious international economic journals and is author of more than 150 publications including scientific articles, monographs and book chapters.

Juan Manuel Corchado is a full professor with Chair at the University of Salamanca. He was the vice president for Research and Technology Transfer from December 2013 to December 2017 and the director of the Science Park of the University of Salamanca, director of the Doctoral School of the University until December 2107, and also, he has been elected twice as the dean of the Faculty of Science at the University of Salamanca. In addition to a PhD in computer sciences from the University of Salamanca, he holds a PhD in artificial intelligence from the University of the West of Scotland. Juan Manuel Corchado is a visiting professor at Osaka Institute of Technology since January 2015, visiting professor at the University Teknologi Malaysia since January 2017 and a member of the Advisory group on Online Terrorist Propaganda of the European Counter Terrorism Centre (EUROPOL). Corchado is the director of the BISITE (Bioinformatics, Intelligent Systems and Educational Technology) Research Group, which he created in the year 2000, president of the IEEE Systems, Man and Cybernetics Spanish Chapter, academic director of the Institute of Digital Art and Animation of the University of Salamanca. He also oversees the master’s programmes in digital animation, security, mobile technology, community management and management for TIC enterprises at the University of Salamanca. Corchado is also the editor and editor-in-chief of specialised journals like ADCAIJ (Advances in Distributed Computing and Artificial Intelligence Journal), IJDCA (International Journal of Digital Contents and Applications) and OJCST (Oriental Journal of Computer Science and Technology).