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978-0-521-70978-1 - Decision Behaviour, Analysis and Support

Simon French, John Maule and Nadia Papamichail

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Advance praise

‘Decision analysis has evolved in recent years to be increasingly synthetic, and this text is an impressive achievement in bringing together the diverse ingredients. It is highly recommended as a timely, integrated and practical course book.’

DEREK W. BUNN, Professor of Decision Sciences, London Business School

‘This text makes a valuable contribution to the literature in decision making. The explicit goal of the authors has been to help the reader to understand the multifaceted field and learn the essentials in practical decision support. There is a balanced coverage of both descriptive and normative models with a strong emphasis on the process. The discussion of the social aspects and methods of participation in decision support contributes to the understanding of the big picture of this important field. The comprehensive list of up-to-date references gives the interested reader easy access to current research in the area.’

RAIMO P. HÄMÄLÄINEN, Professor and Director of the Systems Analysis Laboratory, Helsinki University of Technology

‘The authors lead us in an exciting waltz through descriptive, prescriptive and normative models for decision aid. Other authors have addressed all three approaches, but none has woven together such a tapestry in which each modelling approach informs and is informed by the other approaches. Between them, the authors bring together expertise from a wide range of disciplines ranging from quantitative analysis, information systems and cognitive psychology. The text is a must for those wishing to gain comprehensive understanding of the subtleties of decision science.’

THEO STEWART, Professor of Statistical Sciences, University of Cape Town

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Decision Behaviour, Analysis and Support

Behavioural studies have shown that, while we humans may be the best decision makers on the planet, we are not quite as good as we think we are. We are regularly subject to biases, inconsistencies and irrationalities in our decision making. *Decision Behaviour, Analysis and Support* explores perspectives from many different disciplines in order to help decision makers to deliberate and make better decisions. It considers the use of computers and databases to support decisions, as well as aids to building analyses and some ‘fast-and-frugal’ tricks to facilitate more consistent decision making. In its exploration of decision support the book draws together results and observations from decision theory, behavioural and psychological studies, artificial intelligence and information systems, philosophy, operational research and organisational studies. This provides a valuable resource for managers with decision-making responsibilities and students from a range of disciplines, including management, engineering and information systems.

SIMON FRENCH is Professor of Information and Decision Sciences at Manchester Business School, the University of Manchester.

JOHN MAULE is Professor of Human Decision Making and Director of the Centre for Decision Research at Leeds University Business School, University of Leeds.

NADIA PAPAMICHAIL is Senior Lecturer in Information and Decision Systems at Manchester Business School, the University of Manchester.

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To Judy, Beth and George

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Abbreviations and notation

Abbreviation/notation Meaning

a_i	The i^{th} action in the action space $A = \{a_1, a_2, \dots, a_m\}$
$a \succcurlyeq b$	The DM holds a to be at least as good as b
$a \succ b$	The DM strictly prefers a to b
$a \sim b$	The DM is indifferent between a and b
AHP	Analytic hierarchy process
AI	Artificial intelligence
ANN	Artificial neural network
CBA	Cost–benefit analysis
c_{ij}	The consequence of taking action a_i when the state of the world is θ_j
CSCW	Computer-supported cooperative work
DA	Decision analyst
DBMS	Database management system
DM	Decision maker
DSS	Decision support system
D2P	Decisioning for decision support
EBA	Elimination by aspects
EIS	Executive information system
ES	Expert system
$Eu[a]$	Expected utility of action a
GDSS	Group decision support system
GIS	Geographic information system
HCI	Human–computer interface
KB-DSS	Knowledge-based decision support system
KMS	Knowledge management system
MAU	Multi-attribute utility
MAVA	Multi-attribute value analysis
MCDAd	Multi-criteria decision aid
MCDM	Multi-criteria decision making
MIS	Management information system

MODM	Multi-objective decision making
NPV	Net present value
OR	Operational research
$P(\theta)$	Subjective probability representing a DM's likelihood for the state θ
SEU	Subjective expected utility
SMART	Simple multi-attribute rating technique
SQL	Structured query language
$u(\cdot)$	A utility function representing a DM's preferences in conditions of uncertainty
$v(\cdot)$	An (ordinal) value function representing a DM's preferences in conditions of certainty
wGDSS	Web-based group decision support system
θ_j	The j^{th} possible state of the world lying in the state space, $\Theta = \{\theta_1, \theta_2, \dots, \theta_n\}$

Preface

An article by Ian Ayres in the *Financial Times Magazine* of 1 September 2007 begins:

How can a mathematical formula outperform a wine connoisseur? Or predict how the US Supreme Court will vote more accurately than a panel of legal experts? The answer lies partly in the overconfidence of humans and partly in the fast improving powers of database analysis.

In many ways these sentences chart the course we shall be steering in exploring decision making: how we do it and how we could do it better. Many behavioural studies have shown that, while we humans may be the best decision makers on the planet, we are not as good as we think we are. We are subject to biases, inconsistencies and – dare we say it? – irrationalities in our decision making. We could do better. Therefore, it is not surprising, perhaps, that computers bringing advanced forecasting algorithms to bear on vast modern databases that bulge with fact upon fact are able to outperform even the best experts in highly structured forecasting tasks.

Of course, this is not to suggest that computers are more intelligent than humans (we designed and programmed them, after all!), just that they are more consistent, able to keep more facts ‘in mind’ and less likely to be distracted by some outlying fact that runs against the broad thrust of evidence or, worse, some personal pet theory. They are not prone to overconfidence. Experts tend not to notice their failures. They fail to moderate their future predictions with the humility of their past inaccuracies.

Nor shall we suggest that we should leave prediction and decision making to computers: far from it. We believe that if we support people properly, perhaps with computers or perhaps just with a paper and pencil, then we can improve their decision-making behaviour. Most importantly, we believe that the responsibility for decision making should be left with the human. We do not seek to supplant humans, only support them.

Moreover, our book is about decision making, not forecasting. Certainly, forecasting is central to good decision making. It is surely impossible to

choose rationally if we cannot predict to some degree the possible consequences of our actions. We also need to consider and listen to our values, however. Decision making is about how much we care about the possible outcomes as well as how likely these are. Which do we prefer? Keeney in his seminal 1992 book *Value-focused Thinking* exhorts us to use values to drive our decision making. If we do not focus on our objectives and goals, can we really select a course of action to achieve them? Accordingly, much of our text focuses on how we might understand our values and use them to drive our decision making. Once we understand what we are trying to achieve, how do we combine that self-knowledge with our understanding of the world and our forecasts of what might result from our actions? In short, how do we balance our values and uncertainties?

All this assumes that we know what our options are. Sometimes they are obvious; but many times we face a mess of ill-comprehended issues without any idea of what we might do – and, yes, in decision science ‘mess’ is a technical term! Our opening quotation from Ayres misses perhaps the most difficult aspect of much decision making, and the one that computers, as yet at least, cannot address: novel situations. Another skill that we emphasise, therefore, is issue and problem formulation. We need to learn to understand the world and to think creatively about the different decisions we can take in response to it.

Our text, then, is about supporting decision makers. This is not a task that a single discipline can address alone. Certainly, artificial intelligence, cognitive science, economics, information systems, mathematics, management science, psychology, philosophy and many other disciplines all have much that is cogent to say about decision making. Alone, however, they do not say enough. Only when we draw on many complementary perspectives can we see how to support and improve decision making. Thus our text is multidisciplinary.

For the last six paragraphs we have been committing a failing that we attribute to many others: we have been talking about ‘decisions’ without acknowledging that there are many types of decision that occur in many contexts. While many texts focus on one type of decision, perhaps strategic or operational, ours is more catholic. We consider many different types of decision that occur in many different contexts, and we recognise that the type of support that each needs may vary from context to context. That and our multidisciplinary are, we believe, the contribution that this text makes to the literature.

To be more precise, our objectives are:

- to demonstrate that decision making permeates the activities of individuals, groups, organisations and society and that the characteristics of the choices faced vary greatly from context to context;
- to introduce cognitive and behavioural theories of how people make judgements and take decisions and the ‘errors and biases’ that may be found in these activities;
- to introduce some of the normative theories of how people should make decisions;
- to show how prescriptive approaches to decision support and analysis draw together our behavioural understandings of human judgement with the imperatives of normative theories to help improve decision making;
- to outline how such prescriptive decision support may be embedded in information systems; and
- to provide a guide to a very wide range of literature offering valuable perspectives on analysing and supporting decision making, thus reflecting the multidisciplinary nature of our topic.

We have written for a varied audience. Some of the material has been used with undergraduates in business studies, computer science, economics, mathematics and operational research. Other parts have been used to teach Masters students in a similar variety of subjects. Some have been used with Master of Business Administration (MBA) students, and some to support executive education. Many sections have served at more than one level. Other parts of the text derive from our research. We hope, nonetheless, that we have woven all the sections into a coherent whole. One of the joys of working across disciplines is that usually our students, whatever their background, find some new idea, theory or procedure to intrigue them. We hope that you do too.

Our one little indulgence has been to begin the majority of sections with what we believe are relevant quotations. This is possibly a dangerous indulgence. French began his 1986 book *Decision Theory: An Introduction to the Mathematics of Rationality* with the quotation “‘I used to be indecisive, but now I am not so sure.’ Boscoe Pertwee (18th-Century wit)’ (Rees, 1978: 37). He had originally heard it on the long-running BBC radio quiz *Quote...Unquote* in the late 1970s. Some thirty years after that broadcast, the show’s presenter, Nigel Rees, admitted on another series of the same programme that he had been conned. Someone had made up

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Preface

the quotation and the life of the eighteenth-century wit to whom it was attributed purely to hoodwink Rees. That he also hoodwinked French was an unintended, and probably unnoticed, side effect! So, if you spot some further mistakes in the quotations that we have used: laugh quietly to yourself and don't tell us!

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Our families too have had a major input, being supportive over several years as we worked on drafts and revisions. To them we owe the biggest 'thank you'.

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Reason is, and only ought to be, the slave of the Passions.

David Hume