# Modeling Bounded Rationality

Ariel Rubinstein

The MIT Press Cambridge, Massachusetts London, England

## Contents

Series Foreword ix Preface xi

#### Introduction 1

- 1 "Modeling" and "Bounded Rationality" 1
- 2 The Aim of This Book 2
- 3 The State of the Art 3
- 4 A Personal Note 5
- 5 Bibliographic Notes 5

#### Bounded Rationality in Choice 7

- 1.1 The "Rational Man" 7
- 1.2 The Traditional Economist's Position 10
- 1.3 The Attack on the Traditional Approach 13
- 1.4 Experimental Evidence 16
- 1.5 Comments 21
- 1.6 Bibliographic Notes 23
- 1.7 Projects 24

#### Modeling Procedural Decision Making 25

- 2.1 Motivation 25
- 2.2 Preparing the Tools: Similarity Relations 28
- 2.3 A Procedure of Choice Between Vectors 29
- 2.4 Analysis 31
- 2.5 Case-Based Theory 34
- 2.6 Bibliographic Notes 37
- 2.7 Projects 37

## 3 Modeling Knowledge 41

- 3.1 Knowledge and Bounded Rationality 41
- 3.2 Information Structure 41
- 3.3 The Set-Theoretical Definition of Knowledge 46
- 3.4 Kripke's Model 48
- 3.5 The Impact of the Timing of Decisions and Having More Information 52
- 3.6 On the Possibility of Speculative Trade 56
- 3.7 Bibliographic Notes 60
- 3.8 Projects 61

## 4 Modeling Limited Memory 63

- 4.1 Imperfect Recall 63
- 4.2 An Extensive Decision, Making Model with Imperfect Information 64
- 4.3 Perfect and Imperfect Recall 68
- 4.4 Time Consistency 70
- 4.5 The Role of Randomization 75
- 4.6 The Multiselves Approach 78
- 4.7 On the Problematics of Using the Model 81
- 4.8 Bibliographic Notes 84
- 4.9 Projects 84

## 5 Choosing What to Know 87

- 5.1 Optimal Information Structures 87
- 5.2 What Is "High" and What Is "Low"? 89
- 5.3 Manipulating Informational Restrictions 93
- 5.4 Perceptrons 100
- 5.5 Bibliographic Notes 104
- 5.6 Projects 104

## 6 Modeling Complexity in Group Decisions 107

- 6.1 Introduction 107
- 6.2 The Model of a Team 108
- 6.3 Processing Information 113
- 6.4 Aggregating Preferences 117
- 6.5 Bibliographic Notes 119
- 6.6 Projects 120

#### Contents

## 7 Modeling Bounded Rationality in Games 121

- 7.1 Introduction 121
- 7.2 Interaction Between Luce Players 122
- 7.3 A Game with Procedural Rational Players 124
- 7.4 Limited Foresight in Extensive Games 129
- 7.5 Bibliographic Notes 135
- 7.6 Projects 135

### 8 Complexity Considerations in Repeated Games 137

- 8.1 Introduction 137
- 8.2 The Model of Repeated Games: A Brief Review 138
- 8.3 Strategies as Machines in Infinitely Repeated Games 143
- 8.4 Complexity Considerations in Repeated Games 149
- 8.5 The Structure of Machine Game Equilibria 152
- 8.6 Repeated Extensive Games 159
- 8.7 Concluding Remarks 161
- 8.8 Bibliographic Notes 163
- 8.9 Projects 163

## 9 Attempts to Resolve the Finite Horizon Paradoxes 165

- 9.1 Motivation 165
- 9.2 Implementation of Strategies by Machines 166
- 9.3 Counting Is Costly 168
- 9.4 Bounded Capability to Count 169
- 9.5 Machines Also Send Messages 170
- 9.6 The e-Equilibrium Approach: A Deviation Is Costly 172
- 9.7 Conclusion 173
- 9.8 Bibliographic Notes 174
- 9.9 Projects 174

### 10 Computability Constraints in Games 175

- 10.1 Introduction 175
- 10.2 Informal Results on Computability 178
- 10.3 Is There a Rational Player? 181
- 10.4 Turing Machine Game 184
- 10.5 Bibliographic Notes 185
- 10.6 Projects 185

11 Final Thoughts 18711.1 Simon's Critique 18711.2 Response 190

References 195 Index 203