Contents

	List	of figures	xiii
	List	of tables	xvi
	Pref	ace	xvii
PAI	RT I		
Ide	eas ai	nd structures of the book	1
1	Eco	nomics in an interdisciplinary context	3
	1.1	The interdisciplinary framework 5	
	1.2	Organization of the book 6	
2	Age	nt-based modeling in the social sciences	11
	2.1	What is it? 11	
	2.2	Why? 15	
	2.3	Agent-based modeling in different disciplines 18	
	2.4	The ten that make it new 24	
PA]	RT 11		
Or	igins	of ACE	29
3	The	markets origin	31
	3.1	Agent-based modeling of the tâtonnement process 34	
	3.2	Agent-based modeling of the non-tâtonnement process 38	
	3.3	Auctions 60	
	3.4	Macroeconomics 71	
	3.5	Interacting heterogeneous agents 83	
4	Cell	ular automata	88
	4.1	Segregation 89	
	4.2	Game of Life 92	
	4.3	Elementary cellular automata 94	

	1 1	Opinion dynamics and market sentiment 99	
	4.4	Other physics-oriented agent-based models 108	
	4.5		
	4.6	Further explorations 109	
5	Eco	nomic tournament origin	113
	5.1	Novelty-discovering agents 113	
	5.2	Tournament-based economic analysis 114	
	5.3	Automated open tournaments 116	
	5.4	Concluding remarks 119	
6	Age	nt-based modeling of economic experiments	121
Ū	6.1	Agent-based modeling of cobweb experiments 122	
	6.2	Agent-based modeling of inflation experiments 128	
	6.3	Agent-based modeling of foreign exchange experiments 136	
	6.4	Concluding remarks 142	
		_	
	RT II		1.45
De	sıgnı	ng artificial economic agents	145
7	Cal	ibrated artificial agents	147
	7.1	Challenges proposed 147	
	7.2	N-armed bandit problem 149	
	7.3	Reinforcement learning: Arthur's version 149	
	7.4	Early experiments on learning and choice-making 151	
	7.5	Concluding remark 155	
8	Zer	o-intelligence agents in the DA markets	156
	8.1	Principles beyond calibration 156	150
	8.2	Double auction markets and experiments 157	
	8.3	Gode-Sunder model 157	
	8.4	Near zero-intelligence agents 159	
	8.5	Simplicity, intelligence, and randomness 160	
	8.6	Concluding remarks 163	
9	Aut	onomous agents in the DA markets	165
	9.1	Programmed agents and autonomous agents 165	165
	9.2	Santa Fe double auction markets 167	
	9.3	Andrews—Prager model 176	
	9.4	AIE-DA tournaments 180	
	9.5	U-Mart 186	
	9.6	Wisdom of crowds 186	
	9.7	Further explorations 101	

PART IV	
Computational intelligence	193
10 Reinforcement learning	195
10.1 The three-parameter Roth–Ever model 196	
10.2 Generalized reinforcement learning 198	
10.3 Level-k reasoning and sophisticated EWA 202	
10.4 Regime-switching agents 205	
11 Fuzzy logic and rough sets	207
11.1 Fuzzy logic 207	
11.2 Rough sets 209	
12 Artificial neural networks	211
12.1 Multilayer perceptron neural networks 211	
12.2 Radial basis network 213	
12.3 Recurrent neural networks 214	
12.4 Auto-associative neural networks 216	
12.5 Support vector machines 219	
12.6 Self-organizing maps and k-means 221	
12.7 K nearest neighbors 224	
12.8 Instance-based learning 225	
12.9 Finite state automata 227	
12.10 Decision trees 231	
12.11 Further study 233	
13 Evolutionary computation	237
13.1 Tools for evolutionary economics 237	
13.2 Evolutionary strategies 239	
13.3 Evolutionary programming 241	
13.4 Genetic programming and genetic algorithms 242	
PART V	
Agent-based financial markets	251
14 Artificial financial markets with programmed	
agents	253
14.1 Few-type design 254	
14.2 Many-type designs 258	
14.3 Illustrations 260	
14.4 A mesoscopic approach to complex dynamics 261	
14.5 Market fraction hypothesis 266	

15	Artif	icial financial markets with autonomous	275
	agents		275
	15.1	Genetic algorithms 275	
	15.2	Classifier system 277	
	15.3	Genetic programming and autonomous agents 277	
	15.4	Artificial stock markets 278	
16	Emp	irically based agent-based models	285
	16.1	Financial stylized facts 285	
	16.2	Presenting agent-based economics with	
		econometrics 292	
		Building ACE with econometrics 297	
		How to estimate? 297	
		What to estimate? 301	
	16.6	Forecasts with agent-based financial models 306	
	16.7	ACE as a foundation of econometrics 307	
	16.8	Concluding remarks 311	
PAI	RT VI		
		e and psychological agent-based modeling	315
17	Eco	nomic significance of personal traits	317
		Intelligence, income, and prosperity 317	
		Intelligence in experimental economics 317	
		Intelligence and risk preference 321	
		Intelligence and time preference 322	
		Personality and earning capacity 323	
		Personality in experimental economics 323	
		Culture in experimental economics 325	
18	Neu	roeconomic agents	333
	18.1	Neuroeconomics: an ACE viewpoint 333	
		Preference 334	
	18.3	Value and choice 337	
	18.4	Risk 339	
	18.5	Learning 341	
	18.6	Software agents with neurocognitive dual system 342	
	18.7		
19	Cog	nitive agents	345
	19.1	Introduction: heterogeneity and	5-13
		hierarchy 345	

	19.2	Heterogeneity 347	
	19.3	Cognitive hierarchy 351	
	19.4	Concluding remarks 357	
	19.5	Further study 357	
20	Cult	urally sensitive agents	359
	20.1	Evolutionary models of cultures 360	
	20.2	Culturally based behavioral rules 360	
	20.3	Culturally based preference 361	
21	Age	nt-based lottery market	363
	21.1	Behavioral institutional economics 363	
	21.2	Lottery market designs 364	
	21.3	Lottery tax rates 369	
	21.4	Simulation 371	
	21.5	Agent-based modeling and policy design .	372
	21.6	Further exploration 373	
PAl	RT VI	I	
Ne	twork	xs .	375
22	Gra	phs and social networks	377
	22.1	Origin in sociology 378	
	22.2	Origin in mathematics: graphs 380	
	22.3	Network formation: sociophysical	
		models 380	
	22.4	Networks in economics 386	
	22.5	Network formation: agent-based models 3	388
	22.6	Further reading 394	
PAI	RT VI	п	
Ec	onom	ics of changes	397
23	Agei	nt-based modular economy	401
	23.1	Twin assumptions of the modular	
		economy 402	
	23.2	Preference and utility function 410	
	23.3	Firms' behavior 418	
		Markets 423	
	23.5	ModularEcon: a demonstration 427	
		Innovation 430	
	23.7	Further explorations 435	

24	Epilogue	439	
	24.1 The Simon hierarchy 440		
	24.2 The Chomsky hierarchy 446		
	24.3 Challenges ahead 450		
	Bibliography	451	
	Index	500	