## **Contents**

List of Figures	xvii
List of Tables	xxvii
1. Introduction and Roadmap	1
1.1 Behaviour and Rationality	4
1.2 'Anomalies'	6
1.3 Environment and Evolution	8
1.4 The Traditional Investment Paradigm	9
1.5 A New World Order	12
1.6 The Adaptive Markets Hypothesis	15
1.7 Practical Implications	19
1.8 Organizational Structure of the Book	25
I. FOUNDATIONS	
2. The Origin of Behaviour	31
2.1 The Binary Choice Model	39
2.2 Probability Matching	47
2.3 Risk Preferences	52
2.4 Idiosyncratic versus Systematic Risk	63
2.5 Discussion	69
3. Mutation	73
3.1 Environments with Mutation	75
3.2 The Optimal Degree of Irrationality	80
3.3 Generalization and Simulation	83
3.4 Discussion	87
4. Group Selection	91
4.1 Environments with Factor Structure	94
4.2 Individual versus Group Optimality	98
4.3 Multinomial Choice with Multiple Factors	99
4.4 A Numerical Example	102
4.5 Discussion	105

## II. BEHAVIOUR

5. Probability Matching	111
5.1 The Binary Choice Game	113
5.2 Summary Statistics	116
5.3 A Model of Individual Behaviour	118
5.4 Initial Learning	119
5.5 Decision Autocorrelation	121
5.6 Probability Matching	121
5.7 Individual Differences	124
5.8 Discussion	126
6. Risk Aversion	129
6.1 Environments with Mixed Risks	131
6.2 Individual Preferences	134
6.3 Risk Aversion and Systematic Risk	135
6.4 Common Distributions of Relative Fecundity	137
6.5 Testable Implications	140
6.6 Discussion	145
7. Cooperation	149
7.1 Environments with Interactions	150
7.2 Behavioural Implications	165
7.3 Discussion	168
8. Bounded Rationality and Intelligence	171
8.1 Environments with Intelligence	173
8.2 An Evolutionary Definition of Intelligence	176
8.3 Bounded Rationality	177
8.4 A Universal Measure of Intelligence and its Cost	178
8.5 Upper Bound on Correlation	180
8.6 Intelligence across Generations	181
8.7 Discussion	185
9. Learning to be Bayesian	189
9.1 Environments with States	190
9.2 Bayesian Behaviours in Stationary Environments	192
9.3 What is Intelligence? Revisited	196
9.4 Finite Memory in Nonstationary Environments	197
9.5 Sampling with Limited Information	200
9.6 Discussion	201
10. The Madness of Mobs	203
10.1 Political Polarization	208
10.2 Bias and Discrimination	214
10.3 Practical Implications 10.4 Discussion	227
10.4 DISCUSSION	229

## III. NEURONS

11.	Fear, Greed, and Financial Crises	235
	11.1 A Brief History of the Brain	237
	11.2 Fear	240
	11.3 Greed	245
	11.4 Risk	249
	11.5 Rationality	251
	11.6 Sentience	256
	11.7 Interactions Among Components	259
	11.8 Evolution at the Speed of Thought	263
	11.9 Practical Implications	265
	11.10 Discussion	268
12.	The Psychophysiology of Trading	273
	12.1 Measuring Emotional Response	274
	12.2 Experimental Design	278
	12.3 Results	282
	12.4 Discussion	289
13.	What Makes a Good Day Trader?	295
	13.1 Risk-Taking and Emotion	296
	13.2 Experimental Design	301
	13.3 Results	304
	13.4 Discussion	311
IV.	FINANCIAL MARKET DYNAMICS	
14.	A Computational View of Market Efficiency	315
	14.1 The Model	319
	14.2 A Computational Definition of Market Efficiency	321
	14.3 Market Evolution	323
	14.4 A Financial Turing Test	326
	14.5 Experimental Design	327
	14.6 Synthetic Processes and Results	331
	14.7 Discussion	340
15.	. Maximizing Relative versus Absolute Wealth	343
	15.1 The Kelly Criterion	345
	15.2 Maximizing Relative Wealth	347
	15.3 A Numerical Example	352
	15.4 Testable Implications	355
	15.5 Discussion	356

16.	Hedge Funds: The Galápagos Islands of Finance	359
	16.1 Hedge Fund Characteristics	361
	16.2 An Overview of Hedge Fund Return Data	367
	16.3 Investment Performance	378
	16.4 Illiquidity	390
	16.5 Hedge Fund Risks	398
	16.6 The Financial Crisis	421
	16.7 Implementation Issues for Hedge Fund Investing	437
	16.8 Discussion	461
17.	What Happened to the Quants in August 2007?	463
	17.1 The Data	468
	17.2 Factor Portfolios	470
	17.3 Measures of Market Liquidity	480
	17.4 Discussion	504
٧.	FINANCIAL INSTITUTIONS AND ADAPTATION	
18.	The Co-Evolution of Financial Markets and Technology	511
	18.1 Historical Context	511
	18.2 The Evolution of Technology and Finance	514
	18.3 Timetable of Financial Evolution	518
	18.4 The Eight Eras of Financial Evolution	523
	18.5 Discussion	548
19	. The Role of Culture in Finance	551
	19.1 What is Culture?	553
	19.2 What Determines Corporate Values?	554
	19.3 Examples from the Financial Industry	573
	19.4 Regulatory Culture	577
	19.5 The Importance of Feedback Loops	581
	19.6 Behavioural Risk Management	582
	19.7 Discussion	588
20	Regulation and Adaptive Markets	589
	20.1 Measures of Systemic Risk	594
	20.2 The Shadow Banking System	599
	20.3 The Shadow Hedge Fund System	603
	20.4 Behavioural Foundations of Systemic Risk	606
	20.5 A Process for Regulatory Design and Reform	612
	20.6 The Capital Markets Safety Board	615
	20.7 Transparency and Fair Value Accounting	619
	20.8 The Role of Technology and Education	624
	<ul><li>20.9 The Role of Corporate Governance</li><li>20.10 Discussion</li></ul>	631
	ZO.TO DISCUSSION	63/

Epilogue	
A. Notational Glossary	639
B. Proofs and Additional Results	643
B.1 Chapter 2: The Binary Choice Model	643
B.2 Chapter 3: Mutation	646
B.3 Chapter 4: Group Selection	653
B.4 Chapter 6: Risk Aversion	656
B.5 Chapter 7: Cooperation	657
B.6 Chapter 8: Bounded Rationality	671
B.7 Chapter 9: Learning to be Bayesian	677
B.8 Chapter 10: The Madness of Mobs	681
B.9 Chapter 14: A Computational View of Market Efficiency	683
B.10 Chapter 15: Maximizing Relative versus Absolute Wealth	684
B.11 Chapter 17: What Happened to the Quants in August	
2007?	687
C. Psychophysiological Methodology	693
C.1 Subjects	693
C.2 Physiological Data Collection	693
C.3 Physiological Data Feature Extraction	695
C.4 Financial Data Collection	696
C.5 Financial Data Feature Extraction	697
References	701
Index	749