## Contents

	Coldedo processi	
1.	Financial markets as complex systems	1
1.1	Real problems in finance	1
1.2	Complex systems and complexity	3
1.3	Financial market overview	4
1.4	Observing the market	16
2.	Standard finance theory	19
2.1	The problem for standard finance theory	19
2.2	Taking a random walk	20
2.3	Risk: tails of the unexpected	42
2.4	Eliminating risk within the Black–Scholes option pricing theory	44
3.	A complex walk down Wall Street	55
3.1	Facing the stylized facts	55
3.2	Statistical tools and datasets	57
3.3	Empirical analysis	58
3.4	Challenging the standard theory	69
3.5	Towards a general stochastic process framework	71
3.6	Effects of temporal correlations in a market	73
4.	Financial market models with global interactions	81
4.1	A bottom-up approach	81
4.2	Two's company, but three's a crowd	83
4.3	'To bar, or not to bar'	87
4.4	From the bar to the market	88
4.5	Choosing a model	108
4.6	The 'El Farol Market Model'	109

## x Contents

4.7 4.8	Dynamics of the 'El Farol Market Model' Statics of the 'El Farol Market Model': the origins of volatility	115 116
	Financial market models with local interactions	137
5.1	Clustering and herd behaviour	137
5.2	Transmission of information: the EZ model	140
5.3	Analytic model: generating function approach	144
5.4	The percolation problem	149
5.5	Cont-Bouchaud model on a lattice	150
5.6	Variations on a theme	151
5.7	Modified EZ models	153
5.8	Other microscopic market models	156
6.	Non-zero risk in the real world	161
6.1	The other side of derivatives	161
6.2	Hedging to reduce risk	163
6.3	Zero risk?	164
6.4	Pricing and hedging with real-world asset movements	165
6.5	Generalizing the formalism	202
7.	Deterministic dynamics, chaos, and crashes	223
7.1	Living with non-linearity	223
7.2	Non-linear dynamical models for finance and economics	226
7.3	Financial crashes and drawdowns	239
7.4	Predicting the future: who wants to be a Millionaire?	250
Further reading		252
Index		253