

Contents

<i>Preface to the second edition</i>	<i>page xi</i>
1 Econophysics: why and what	1
1.1 Why econophysics?	1
1.2 Invariance principles and laws of nature	4
1.3 Humanly invented law can always be violated	5
1.4 Origins of econophysics	7
1.5 A new direction in econophysics	8
2 Neo-classical economic theory	10
2.1 Why study "optimizing behavior"?	10
2.2 Dissecting neo-classical economic theory (microeconomics)	12
2.3 The myth of equilibrium via perfect information	18
2.4 How many green jackets does a consumer want?	24
2.5 Macroeconomics	25
3 Probability and stochastic processes	29
3.1 Elementary rules of probability theory	29
3.2 Ensemble averages formed empirically	30
3.3 The characteristic function	32
3.4 Transformations of random variables	33
3.5 Laws of large numbers	34
3.6 Examples of theoretical distributions	38
3.7 Stochastic processes	43
3.8 Stochastic calculus	" 57
3.9 Ito processes	63
3.10 Martingales and backward-time diffusion	77

4	Introduction to financial economics	80
4.1	What does no-arbitrage mean?	80
4.2	Nonfalsifiable notions of value	82
4.3	The Gambler's Ruin	84
4.4	The Modigliani-Miller argument	85
4.5	Excess demand in uncertain markets	89
4.6	Misidentification of equilibrium in economics and finance	91
4.7	Searching for Adam Smith's Unreliable Hand	93
4.8	Martingale markets (efficient markets)	94
4.9	Stationary markets: value and inefficiency	98
4.10	Black's "equilibrium": dreams of recurrence in the market	101
4.11	Value in real, nonstationary markets	102
4.12	Liquidity, noise traders, crashes, and fat tails	103
4.13	Long-term capital management	105
5	Introduction to portfolio selection theory	107
5.1	Introduction	107
5.2	Risk and return	107
5.3	Diversification and correlations	109
5.4	The CAPM portfolio selection strategy	113
5.5	Hedging with options	117
5.6	Stock shares as options on a firm's assets	120
5.7	The Black-Scholes model	122
5.8	The CAPM option pricing strategy	124
5.9	Backward-time diffusion: solving the Black-Scholes pde	127
5.10	Enron 2002	130
6	Scaling, pair correlations, and conditional densities	133
6.1	Hurst exponent scaling	133
6.2	Selfsimilar Ito processes	135
6.3	Long time increment correlations	139
6.4	The minimal description of dynamics	145
6.5	Scaling of correlations and conditional probabilities?	145
7	Statistical ensembles: <i>deducing dynamics from time series</i>	148
7.1	Detrending economic variables	148
7.2	Ensemble averages constructed from time series	149
7.3	Time series analysis	152
7.4	Deducing dynamics from time series	162

7.5	Early evidence for variable diffusion models	167
7.6	Volatility measures	167
7.7	Spurious stylized facts	168
7.8	An sde for increments?	173
7.9	Topological inequivalence of stationary and nonstationary processes	173
8	Martingale option pricing	176
8.1	Introduction	176
8.2	Fair option pricing	178
8.3	Pricing options approximately via the exponential density	182
8.4	Option pricing with fat tails	185
8.5	Portfolio insurance and the 1987 crash	186
8.6	Collateralized mortgage obligations	186
9	FX market globalization: <i>evolution of the Dollar to worldwide reserve currency</i>	188
9.1	Introduction	188
9.2	The money supply and nonconservation of money	189
9.3	The gold standard	190
9.4	How FX market stability worked on the gold standard	190
9.5	FX markets from WWI to WWII	194
9.6	The era of "adjustable pegged" FX rates	196
9.7	Emergence of deregulation	197
9.8	Deficits, the money supply, and inflation	204
9.9	Derivatives and shadow banking	208
9.10	Theory of value under instability	211
9.11	How may regulations change the market?	212
10	Macroeconomics and econometrics: <i>regression models vs empirically based modeling</i>	214
10.1	Introduction	214
10.2	Muth's rational expectations	216
10.3	Rational expectations in stationary markets	219
10.4	Toy models of monetary policy	222
10.5	The monetarist argument against government intervention	* 224
10.6	Rational expectations in a nonstationary world	225
10.7	Integration $I(d)$ and cointegration	226
10.8	ARCH and GARCH models of volatility	238

11	Complexity	241
11.1	Reductionism and holism	241
11.2	What does "complex" mean?	244
11.3	Replication, mutations, and reliability	253
11.4	Emergence and self-organization	256
	<i>References</i>	261
	<i>Index</i>	268