CONTENTS

CONTRIBUTORS vii
PREFACE ix

Self-Affine Time Series: I. Generation and Analyses

BRUCE D. MALAMUD AND DONALD L. TURCOTTE

1. Introduction 1
   1.1 Brief Overview of Article 1
   1.2 What Is a Time Series? 2
   1.3 How Is a Time Series Quantified? 3
   1.4 Autocorrelations and Semivariograms 6
   1.5 Self-Affine Fractals 10
   1.6 Gaussian White Noises and Brownian Motions 13
2. Spectral Analysis 19
   2.1 The Fourier Transform 19
   2.2 The Power-Spectral Density 22
   2.3 The Relation of β, Ha, and D 28
   2.4 Weak vs Strong Persistence 31
   2.5 Spectral Variance and Leakage 32
3. Synthetic Fractional Noises and Motions 35
   3.1 What Are They? 35
   3.2 Spectral Analysis 35
   3.3 Method of Successive Random Additions 43
   3.4 Semivariograms 47
4. Log-Normal Noises and Motions 51
   4.1 Log-Normal Distributions 51
   4.2 Fractional Log-Normal Noises and Motions 53
   4.3 Spectral Analysis 53
   4.4 Semivariograms 56
5. Rescaled-Range (R/S) Analysis 58
   5.1 The Method 58
   5.2 Applications to Fractional Gaussian Noises and Motions 62
   5.3 Applications to Fractional Log-Normal Noises and Motions 64
6. Average Extreme-Value Analysis 64
   6.1 The Method 64
   6.2 Applications to Fractional Gaussian Noises and Motions 66
   6.3 Applications to Fractional Log-Normal Noises and Motions 70

7. Wavelet Analysis 71
7.1 The Method 71
7.2 Applications to Fractional Gaussian Noises and Motions 72
7.3 Applications to Fractional Log-Normal Noises and Motions 75
8. Summary 79
Acknowledgments 83
Appendix 83
References 87

Self-Affine Time Series: II. Applications and Models

JON D. PELLETIER AND DONALD L. TURCOTTE

1. Introduction 91
2. Natural Variability of Climate 92
2.1 Temperature Spectra 92
2.2 River-Discharge and Tree-Ring Spectra 98
2.3 Stochastic Diffusion Model 100
2.4 Variations in Solar Luminosity 114
2.5 Drought Hazard Assessment 115
3. Variations in Sedimentation 117
3.1 Introduction 117
3.2 Stochastic Diffusion Model 118
3.3 Observations 124
3.4 Completeness of the Sedimentary Record 131
3.5 Bed Thicknesses 136
4. Variability of the Earth's Magnetic Field 140
4.1 Variations of the Dipole Moment 140
4.2 Reversal Record 142
4.3 Inclination and Declination Data 148
4.4 Model for Geomagnetic Variations 152
5. Other Applications 155
6. Conclusions 157
Acknowledgments 160
References 160

INDEX 167