

Contents

Preface *xi*

About the Companion Website *xv*

1 Introduction *1*

Part I Count Time Series 9

2 A First Approach for Modeling Time Series of Counts: The Thinning-based INAR(1) Model *11*

2.0 Preliminaries: Notation and Characteristics of Count Distributions *11*

2.1 The INAR(1) Model for Time-dependent Counts *16*

2.1.1 Definition and Basic Properties *17*

2.1.2 The Poisson INAR(1) Model *20*

2.1.3 INAR(1) Models with More General Innovations *22*

2.2 Approaches for Parameter Estimation *26*

2.2.1 Method of Moments *26*

2.2.2 Maximum Likelihood Estimation *28*

2.3 Model Identification *29*

2.4 Checking for Model Adequacy *32*

2.5 A Real-data Example *34*

2.6 Forecasting of INAR(1) Processes *37*

3 Further Thinning-based Models for Count Time Series *43*

3.1 Higher-order INARMA Models *43*

3.2 Alternative Thinning Concepts *54*

3.3 The Binomial AR Model *59*

3.4 Multivariate INARMA Models *64*

4	INGARCH Models for Count Time Series	73
4.1	Poisson Autoregression	73
4.2	Further Types of INGARCH Models	85
4.3	Multivariate INGARCH Models	93
5	Further Models for Count Time Series	95
5.1	Regression Models	95
5.2	Hidden-Markov Models	107
5.3	Discrete ARMA Models	116
 Part II Categorical Time Series 119		
6	Analyzing Categorical Time Series	121
6.1	Introduction to Categorical Time Series Analysis	122
6.2	Marginal Properties of Categorical Time Series	126
6.3	Serial Dependence of Categorical Time Series	128
7	Models for Categorical Time Series	133
7.1	Parsimoniously Parametrized Markov Models	133
7.2	Discrete ARMA Models	139
7.3	Hidden-Markov Models	146
7.4	Regression Models	151
 Part III Monitoring Discrete-Valued Processes 161		
8	Control Charts for Count Processes	163
8.1	Introduction to Statistical Process Control	163
8.2	Shewhart Charts for Count Processes	165
8.2.1	Shewhart Charts for i.i.d. Counts	166
8.2.2	Shewhart Charts for Markov-Dependent Counts	171
8.3	Advanced Control Charts for Count Processes	177
8.3.1	CUSUM Charts for i.i.d. Counts	178
8.3.2	CUSUM Charts for Markov-dependent Counts	182
8.3.3	EWMA Charts for Count Processes	186
9	Control Charts for Categorical Processes	193
9.1	Sample-based Monitoring of Categorical Processes	194
9.1.1	Sample-based Monitoring: Binary Case	194
9.1.2	Sample-based Monitoring: Categorical Case	198

9.2	Continuously Monitoring Categorical Processes	203
9.2.1	Continuous Monitoring: Binary Case	203
9.2.2	Continuous Monitoring: Categorical Case	209

Part IV Appendices 213

A	Examples of Count Distributions	215
A.1	Count Models for an Infinite Range	215
A.2	Count Models for a Finite Range	221
A.3	Multivariate Count Models	223
B	Basics about Stochastic Processes and Time Series	229
B.1	Stochastic Processes: Basic Terms and Concepts	229
B.2	Discrete-Valued Markov Chains	233
B.2.1	Basic Terms and Concepts	233
B.2.2	Stationary Markov Chains	236
B.3	ARMA Models: Definition and Properties	238
B.4	Further Selected Models for Continuous-valued Time Series	243
B.4.1	GARCH Models	243
B.4.2	VARMA Models	245
C	Computational Aspects	249
C.1	Some Comments about the Use of R	250
C.2	List of R Codes	253
C.3	List of Datasets	256

References 257

List of Acronyms 275

List of Notations 277

Index 279