Contents

Preface	vi
Principal Notation	xv
CHAPTER 1	
Early History	1
1.1. Life Tables and Renewal Theory	1
1.2. Counting Problems	8
1.3. Some More Recent Developments	13
CHAPTER 2	
Basic Properties of the Poisson Process	18
2.1. The Stationary Poisson Process	18
2.2. Characterizations of the Stationary Poisson Process:	
I. Complete Randomness	25
2.3. Characterizations of the Stationary Poisson Process:	
II. The Form of the Distribution	29
2.4. The General Poisson Process	32
CHAPTER 3	
Simple Results for Stationary Point Processes on the Line	38
3.1. Specification of a Point Process on the Line	38
3.2. Stationarity: Definitions	41
3.3. Mean Density, Intensity, and Batch-Size Distribution	43
3.4. Palm-Khinchin Equations	50
3.5. Ergodicity and an Elementary Renewal Theorem Analogue	57
3.6. Sub- and Superadditive Functions	60

Contents

xii

CHAPTER 4	(2)
Renewal Processes	63
4.1. Basic Properties	63
4.2. Stationarity and Recurrence Times	71
4.3. Some Simple Operations Involving Renewal Processes and Characterizations	75
4.4. Renewal Theorems	80
4.5. Neighbours of the Renewal Process: Wold Processes	89
4.6. Hazard Measures and Conditional Intensities	103
CHAPTER 5	
Finite Point Processes	109
5.1. An Elementary Example: Independently and Identically Distributed Clusters	110
5.2. Factorial Moments, Cumulants, and Generating Function Relations	110
for Discrete Distributions	112
5.3. The General Finite Point Process: Definitions and Distributions	121
5.4. Moment Measures and Product Densities	129
5.5. Generating Functionals and Their Expansions	141
CHAPTER 6	
Introduction to the General Theory of Random Measures	153
6.1. Definitions and Examples	154
6.2. Finite-Dimensional Distributions and the Existence Theorem	166
6.3. Sample-Path Properties and Completely Random Measures	171
6.4. Random Integrals, Characteristic Functionals, and Moment	102
Measures	182
CHAPTER 7	40=
Introduction to the General Theory of Point Processes	197
7.1. Definitions and Existence Theorems	197
7.2. Simple Point Processes and Orderliness	207
7.3. Characterizations via the Avoidance Function	215
7.4. The Probability Generating Functional and Factorial	220
Moment Measures	220
CHAPTER 8	
Cluster Processes, Infinitely Divisible Processes, and Doubly	234
Stochastic Processes	234
8.1. Point Processes Defined via Conditioning	235
8.2. The General Cluster Process	236
8.3. Poisson Cluster Processes	243 255
8.4. Infinitely Divisible Point Processes	233

8.4. Infinitely Divisible Point Processes

8.5. Cox Processes (Doubly Stochastic Poisson Processes)

261

Contents	xii
CHAPTER 9	
Convergence Concepts and Limit Theorems	269
9.1. Convergence Concepts for Random Measures and Point Processes	270
9.2. Limit Theorems for Superpositions	281
9.3. Thinned Point Processes	290
9.4. Random Translations and Cluster Iterates	300
CHAPTER 10	
Stationary Point Processes and Random Measures	316
10.1. Basic Concepts	317
10.2. Ergodic Theorems	330
10.3. Mixing Properties	341
10.4. Moment Stationarity	355
10.5. Marked and Planar Point Processes	374
10.6. Stationary Line Processes in the Plane	385
CHAPTER 11	
Spectral Theory	399
11.1. Positive Positive-Definite Measures	400
11.2. The Bartlett Spectrum	410
11.3. The Spectral Representation	418
11.4. Linear Prediction	429
11.5. Applications to Multivariate and Other Point Processes	440
CHAPTER 12	
Palm Theory	452
12.1. Campbell Measures and Palm Distributions	453
12.2. Palm Theory for Stationary Random Measures	460
12.3. Palm Theory for Point Processes	469
12.4. Convergence to Equilibrium	484
CHAPTER 13	
Conditional Intensities and Likelihoods	495
13.1. Point Process Likelihood	496
13.2. Compensators and Martingales	514
13.3. Filtering, Likelihood Ratios, and a Central Limit Theorem	528
13.4. Some Applications of Point Process Compensators	549
13.5. Complete Intensities and Point Process Entropy	558
CHAPTER 14	
Exterior Conditioning	573
14.1. Motivation	573
14.2. Modified Campbell Measures and Papangelou Kernels	577
14.3. The Papangelou Intensity Measure and Exvisibility	587
, G	207

xiv Contents

APPENDIX 1 A Review of Some Basic Concepts of Topology	
and Measure Theory	592
A1.1. Set Theory	592
A1.2. Topologies	593
A1.3. Finitely and Countably Additive Set Functions	596
A1.4. Measurable Functions and Integrals	599
A1.5. Product Spaces	602
APPENDIX 2	
Measures on Metric Spaces	607
A2.1. Borel Sets, Dissecting Systems, and Atomic and Diffuse Measures	607
A2.2. Regular and Tight Measures	610
A2.3. Weak Convergence of Measures	615
A2.4. Compactness Criteria for Weak Convergence	619
A2.5. Metric Properties of the Space $\mathcal{M}_{\mathcal{X}}$	622
A2.6. Boundedly Finite Measures and the Space $\mathcal{M}_{\mathcal{X}}$	627
A2.7. Measures on Topological Groups	631
A2.8. Fourier Transforms	636
APPENDIX 3	
Conditional Expectations, Stopping Times, and Martingales	639
A3.1. Conditional Expectations	639
A3.2. Convergence Concepts	643
A3.3. Processes and Stopping Times	648
A3.4. Martingales	653
References and Author Index	659
Subject Index	679