Contents

Preface v

1. Point Processes: Distribution Theory 1

1.1 Random measures and point processes 4
1.2 Distributional descriptors and uniqueness 8
1.3 Convergence in distribution 13
1.4 Marked point processes and cluster processes 16
1.5 Transformations of point processes 22
1.6 Approximation of point processes 27
1.7 Palm distributions 33
1.8 Stationary point processes 38
Exercises 44
Notes 48

2. Point Processes: Intensity Theory 52

2.1 The internal history of a marked point process 53
2.2 Stochastic integration 57
2.3 Compensators 59
2.4 Stochastic intensities 69
2.5 Representation of point process martingales 74
2.6 Conditioning in general spaces 77
Exercises 86
Notes 90

3. Inference for Point Processes: Introduction 94
3.1 Forms of observation 96
3.2 Problems of statistical inference 101
3.3 State estimation for point processes 110
3.4 Combined statistical inference and state estimation 115
3.5 Example: inference for ordinary Poisson processes 118
Exercises 124
Notes 128

4. Empirical Processes Associated with a Sequence of Point Processes 132
4.1 Empirical measures 134
4.2 Empirical Laplace functionals 140
4.3 Empirical zero-probability functionals 144
4.4 Estimation of reduced Palm distributions 147
4.5 Empirical inference for thinned point processes 152
4.6 Empirical processes: some additional aspects 158
Exercises 162
Notes 164

5. Intensity-Based Inference: General Theory 167
5.1 Statistical models involving stochastic intensities 169
5.2 Consistency and asymptotic normality of martingale estimators 178
5.3 Hypothesis testing 191
5.4 Filtering with point process observations 197
5.5 The Cox regression model 203
Exercises 211
Notes 214

6. Inference for Poisson Processes on General Spaces 217
6.1 Estimation 219
6.2 Equivalence and singularity; hypothesis testing 230
6.3 Partially observed Poisson processes 237
6.4 Inference given integral data 248
6.5 Random measures with independent increments; Poisson cluster processes 252
Exercises 256
Notes 260

7. Inference for Cox Processes on General Spaces 264
7.1 General aspects of estimation 267
7.2 State estimation 273
7.3 Likelihood ratios and hypothesis tests 287
7.4 Combined inference and state estimation 293
7.5 Martingale inference for Cox processes on $\mathbf{R}_+$ 302
Exercises 308
Notes 311

8. Nonparametric Inference for Renewal Processes 314
8.1 Estimation of the interarrival distribution 319
8.2 Likelihood ratios and hypothesis tests 328
8.3 State estimation; combined inference and state estimation 338
8.4 Estimation for Markov renewal processes 343
Exercises 352
Notes 355

9. Inference for Stationary Point Processes 359
9.1 Estimation of moment and Palm measures 364
9.2 Likelihood-based inference 373
9.3 Spectral analysis 382
9.4 Linear state estimation 389
Exercises 394
Notes 398

10. Inference for Stochastic Processes Based on Point Process Samples 401
10.1 Markov processes 403
10.2 Stationary processes on $\mathbf{R}$ 409
10.3 Stationary random fields 421
Exercises 428
Notes 429

Appendix A Spaces of Measures 432
Appendix B Continuous-Time Martingales 437
References 446
Index 485