
Contents

Foreword	ix
Preface	xi
Introduction	xv
Chapter 1. Methodological Context	1
1.1. A systemic approach to health	1
1.2. Risk and public health.	5
1.3. Epidemiology	9
1.4. Health geography	10
1.5. Spatial analysis for epidemiology and health geography.	11
1.6. Geographic information systems	16
1.7. Book structure	18
Chapter 2. Spatial Analysis of Health Phenomena: General Principles	21
2.1. Spatial analysis in epidemiology and health geography	21
2.1.1. Spatial distribution of a health phenomenon	21
2.1.2. Spatial analysis in epidemiology	23
2.1.3. Spatial and statistical dependence	28
2.1.4. Causal relationships, explanatory factors, confounding factors.	29
2.1.5. Uncertainty in event localization	30
2.1.6. Health data are often aggregated into geographical units	30
2.2. Spatial analysis terminology and formalism.	32
2.2.1. Objects, attributes, events	33
2.2.2. Localization and spatial domain	34
2.2.3. The formalism of descriptive analysis	36
2.2.4. The formalism of the explanatory analysis	39

2.3. General approach of spatial analysis in epidemiology	42
2.3.1. The approach of descriptive analysis	42
2.3.2. The approach of explanatory analysis	44
2.3.3. Spatial analysis methods	45
2.3.4. Spatial analysis and health geography	46
2.4. Required knowledge on epidemiology and statistics	47
2.4.1. Epidemiology	47
2.4.2. Statistical analysis	48
2.4.3. Methods for model adjustment.	52
2.4.4. Several distributions and models	58
Chapter 3. Spatial Data in Health	63
3.1. Introduction	63
3.2. Health data	64
3.2.1. Various types of data for individuals	64
3.2.2. Individual and aggregated health data.	65
3.2.3. Description of the healthcare system	66
3.3. Spatialization of epidemiological data	66
3.3.1. Localization in space	66
3.3.2. Localization in time.	68
3.3.3. Localization in time and space.	68
3.3.4. Data aggregated according to a spatial criterion	68
3.3.5. Ethics and localization	69
3.4. Sources of data.	70
3.4.1. Epidemiological data	70
3.4.2. Geographical and environmental data.	71
3.4.3. Access to geographical data	72
Chapter 4. Cartographic Representations and Synthesis Tools	75
4.1. Introduction	75
4.1.1. Why use mapping methods?	75
4.1.2. How to use mapping?	76
4.2. Cartographic representations	78
4.2.1. Mapping events or health status	78
4.2.2. Mapping rates: prevalence, incidence, risk and odds ratio	78
4.2.3. Mapping flows and spatial relationships	82
4.2.4. Mapping limitations	83
4.2.5. Mapping rate significance	89
4.2.6. Rate adjustment	90
4.3. Descriptive statistics and visual synthesis tools.	93
4.3.1. Average points, median points.	93
4.3.2. Standard deviational ellipses.	95

4.4. Interpolations and trend surfaces	97
4.4.1. Interpolations and continuous representation	97
4.4.2. Directions and gradients	103
4.4.3. Anamorphoses	103
4.5. Spatio-temporal animations	104
4.5.1. What and how	104
4.5.2. Animated mapping	105
Chapter 5. Spatial Distribution Analysis	109
5.1. Introduction	109
5.1.1. “Direct” methods for spatial analysis	109
5.1.2. Continuous space, point pattern, subsets	113
5.2. Global spatial analyses	115
5.2.1. Geographical location, extent, orientation	115
5.2.2. Centrality	118
5.2.3. Spatial dependence of values	120
5.2.4. Bivariate spatial analysis	133
5.2.5. Global pattern of the phenomenon and search for a geometric model	138
5.3. Local spatial analyses	139
5.3.1. Local indicators of spatial association (LISA)	140
5.3.2. Spatial scan-based search for singularities	145
5.3.3. Analyses around a source point	151
5.4. Example: emergence and diffusion of avian influenza	153
5.4.1. Introduction	153
5.4.2. Mapping	155
5.4.3. Analysis of the spatial distribution of cases	157
5.4.4. Spatio-temporal analyses	165
5.4.5. Analyses of risk factors	172
Chapter 6. Spatial Analysis of Risk	177
6.1. Introduction	177
6.2. Aggregation-based spatial analyses	177
6.2.1. Spatial aggregation operation	179
6.2.2. Statistical analysis	183
6.2.3. Spatial analysis of aggregation	195
6.2.4. Spatial belonging	198
6.3. Statistical modeling of spatial data	198
6.3.1. Statistical correlations and spatial relationships	199
6.3.2. Statistical modeling	200
6.3.3. Spatial models	201
6.3.4. Spatial heterogeneity of parameters	204

6.4. An example: analysis of tuberculosis risk factors.	207
6.4.1. Epidemiological and socio-economic data	208
6.4.2. Analysis of the statistical and spatial distribution of rates.	209
6.4.3. Statistical modeling of SMR and incidence.	213
Chapter 7. Space–time Analyses and Modeling.	219
7.1. Time–distance relationships	219
7.2. Mobile mean points	220
7.3. Spatio-temporal autocorrelation and clusters	222
7.3.1. Global spatio-temporal autocorrelation	222
7.3.2. Local spatio-temporal autocorrelation	222
7.3.3. Spatio-temporal clusters	222
7.3.4. Statistical modeling: GTWR	223
7.4. Emergence, diffusion, pathway.	224
7.5. Spatio-temporal modeling of health phenomena	226
7.5.1. Process modeling and simulation	226
7.5.2. The deterministic approach of SEIR models	229
7.5.3. SEIR models and localization	231
7.5.4. Non-deterministic approach of multi-agent models	232
Glossary	235
References.	237
Index.	247