
Contents

Preface **viii**

Chapter 1 Introduction **1**

- 1.1 What is a Thematic Map? 2
- 1.2 How are Thematic Maps Used? 3
- 1.3 Basic Steps for Communicating Map Information 3
- 1.4 Consequences of Technological Change in Cartography 6
- 1.5 Geographic Visualization 11
- 1.6 Related Techniques 12
- 1.7 Cognitive Issues in Cartography 14
- 1.8 Social and Ethical Issues in Cartography 15

Part I Principles of Cartography

Chapter 2 History of U.S. Academic Cartography **18**

- 2.1 Four Major Periods of U.S. Academic Cartography 18
- 2.2 The Paradigms of American Cartography 30

Chapter 3 Statistical and Graphical Foundation **33**

- 3.1 Population and Sample 34
- 3.2 Descriptive Versus Inferential Statistics 34

- 3.3 Methods for Analyzing Spatial Data, Ignoring Location 34
- 3.4 Numerical Summaries in Which Location Is an Integral Component 47

Chapter 4 Principles of Symbolization **56**

- 4.1 Spatial Arrangement of Geographic Phenomena 57
- 4.2 Levels of Measurement 60
- 4.3 Visual Variables 61
- 4.4 Comparison of Choropleth, Proportional Symbol, Isoleth, and Dot Mapping 64
- 4.5 Selecting Visual Variables for Choropleth Maps 70

Chapter 5 Data Classification **74**

- 5.1 Common Methods of Data Classification 75
- 5.2 Using Spatial Context to Simplify Choropleth Maps 89
- 5.3 Cluster Analysis 92

Chapter 6 Scale and Generalization **103**

- 6.1 Geographic and Cartographic Scale 103
- 6.2 Definitions of Generalization 104
- 6.3 Models of Generalization 105
- 6.4 The Fundamental Operations of Generalization 110
- 6.5 An Example of Generalization 117

Chapter 7	The Earth and Its Coordinate System	121		
7.1	Basic Characteristics of the Earth's Graticule	121		
7.2	A Brief History of Latitude and Longitude	126		
7.3	Determining the Earth's Size and Shape	127		
Chapter 8	Elements of Map Projections	137		
8.1	The Map Projection Concept	138		
8.2	The Reference Globe and Developable Surfaces	138		
8.3	The Mathematics of Map Projections	139		
8.4	Map Projection Characteristics	142		
8.5	Distortion on Map Projections	146		
8.6	Projection Properties	152		
Chapter 9	Selecting an Appropriate Map Projection	160		
9.1	Potential Selection Guidelines	161		
9.2	Examples of Selecting Projections	166		
Chapter 10	Principles of Color	181		
10.1	How Color Is Processed by the Human Visual System	181		
10.2	Hardware Considerations in Producing Soft-Copy Color Maps	187		
10.3	Models for Specifying Color	192		
Chapter 11	Elements of Cartographic Design	199		
11.1	Alignment and Centering	200		
11.2	Map Elements	201		
11.3	Typography	212		
11.4	Cartographic Design	218		
Chapter 12	Map Reproduction	229		
12.1	Reproduction Versus Dissemination	230		
12.2	Planning Ahead	230		
12.3	Map Editing	231		
12.4	Raster Image Processing for Print Reproduction	231		
12.5	Screening for Print Reproduction	232		
12.6	Aspects of Color Printing	235		
12.7	Low-Volume Print Reproduction	237		
12.8	High-Volume Print Reproduction	239		
12.9	Nonprint Reproduction and Dissemination	245		
			Part II	Mapping Techniques
Chapter 13	Choropleth Mapping	250		
13.1	Selecting Appropriate Data	250		
13.2	Data Classification	252		
13.3	Factors for Selecting a Color Scheme	253		
13.4	Details of Color Specification	258		
13.5	Legend Design	262		
13.6	Classed Versus Unclassed Mapping	265		
Chapter 14	Isarithmic Mapping	271		
14.1	Selecting Appropriate Data	272		
14.2	Manual Interpolation	272		
14.3	Automated Interpolation for True Point Data	273		
14.4	Criteria for Selecting an Interpolation Method for True Point Data	281		
14.5	Limitations of Automated Interpolation Approaches	283		
14.6	Tobler's Pycnophylactic Approach: An Interpolation Method for Conceptual Point Data	284		
14.7	Symbolization	286		
Chapter 15	Symbolizing Topography	292		
15.1	Nature of the Data	292		
15.2	Vertical Views	293		
15.3	Oblique Views	305		
15.4	Physical Models	307		
Chapter 16	Proportional Symbol Mapping	310		
16.1	Selecting Appropriate Data	311		
16.2	Kinds of Proportional Symbols	313		
16.3	Scaling Proportional Symbols	313		
16.4	Legend Design	321		
16.5	Handling Symbol Overlap	323		
16.6	Redundant Symbols	325		

Chapter 17	Dot and Dasymetric Mapping	328	Chapter 23	Visualizing Uncertainty	419
17.1	Selecting Appropriate Data and Ancillary Information	329	23.1	Elements of Uncertainty	419
17.2	Manual Versus Automated Production	329	23.2	General Methods for Depicting Uncertainty	420
17.3	Creating a Dot Map	329	23.3	Visual Variables for Depicting Uncertainty	420
17.4	Eicher and Brewer's Comparison of Dasymetric Methods	335	23.4	Applications of Visualizing Uncertainty	423
17.5	Langford and Unwin's Approach for Mapping Population Density	337	23.5	Studies of the Effectiveness of Methods for Visualizing Uncertainty	430
Chapter 18	Bivariate and Multivariate Mapping	341	Chapter 24	Virtual and Mixed Environments	434
18.1	Bivariate Mapping	342	24.1	Defining Virtual and Mixed Environments	434
18.2	Multivariate Mapping	349	24.2	Technologies for Creating Virtual Environments	436
Chapter 19	Additional Techniques	360	24.3	The Four "I" Factors of Virtual Environments	437
19.1	Cartograms	360	24.4	Applications of Geospatial Virtual Environments	439
19.2	Novel Methods for Flow Mapping	364	24.5	Research Issues in Geospatial Virtual Environments	444
19.3	Mapping True 3-D Phenomena	366	24.6	Developments in Mixed Environments	444
19.4	Framed-Rectangle Symbols	369	24.7	Health, Safety, and Social Issues	447
19.5	The Chorodot Map	370	Chapter 25	Ongoing Developments	450
Part III	Geographic Visualization		25.1	Carr and His Colleagues' Work	451
Chapter 20	Map Animation	375	25.2	Using Sound to Interpret Spatial Data	453
20.1	Early Developments	375	25.3	Collaborative Geovisualization	455
20.2	Visual Variables and Categories of Animation	376	25.4	Multimodal Interfaces	457
20.3	Examples of Animations	378	25.5	Information Visualization	459
20.4	Does Animation Work?	386	25.6	Spatial Data Mining	461
Chapter 21	Data Exploration	389	25.7	Keeping Pace with Recent Developments	462
21.1	Goals of Data Exploration	389	Appendix A	Lengths of One Degree Latitude and Longitude	466
21.2	Methods of Data Exploration	390	Appendix B	Using the CIE L*u*v* Uniform Color Space to Create Equally Spaced Colors	469
21.3	Examples of Data Exploration Software	392	Glossary	470	
Chapter 22	Electronic Atlases and Multimedia	406	References	486	
22.1	Defining Electronic Atlases	407	Index	509	
22.2	Examples of Electronic Atlases	407			
22.3	Multimedia Systems	416			