Contents

Acknowledgments xiii
Preface xv

GIS Tutorial 1 Introducing GIS and health applications 1

What is GIS? 2
- Spatial data 2
- Digital map infrastructure 4
- Unique capabilities of GIS 5
- Installing ArcView and the health tutorial data CD 11

Introducing the ArcGIS user interface 12
- Launch ArcCatalog 12
- Review data source types 15
- Launch ArcMap 18
- View map layer attribute tables 21
- View map layer properties 22
- Use the map 25

Summary 28

Exercise assignment 1-1 ***Benchmark health GIS Web sites 30***

GIS Tutorial 2 Visualizing health data 31

Manipulate map layers in a map document 33
- Launch ArcMap and open an existing map document 33
- Add a layer 35
- Change a layer's display order 36
- Rename a layer 38
- Change a boundary layer's fill color 38
- Change a layer's outline color 39
- Change a layer's outline width 40

Zoom and pan health features on a map 42
- Zoom in 42
- Pan 43
- Zoom to full extent 44

Create spatial bookmarks 45

Identify cancer mortality rates and deaths by state 46
- Identify features 46

***GIS Tutorial 2 Visualizing health data** (continued)*

Select map features 49
- Select multiple features 49
- Zoom to selected features 50
- Clear selected features 50
- Change selection color 51
- Change selectable layers 51

Find map features 53

Use an attribute table to select counties with the highest number of breast cancer deaths 55
- Open an attribute table 55
- Show the connection between layers and tables 56
- Move a field 57
- Sort a single field 57
- Select the top five counties 58
- Show only selected records 58
- Clear selected records 59
- Sort multiple fields 59

Create a new layer of a subset of features 61
- Select the most populated cities 61
- Create a layer from selected features 62
- Create a new symbol for the new layer 62
- Label major cities in Texas 63
- Set label properties and features 63
- Remove labels 64
- Convert labels to annotations 65
- Move labels 65
- Save the project and exit ArcMap 66

Summary 67

Exercise assignment 2-1 ***Lung cancer mortality maps 68***

Exercise assignment 2-2 ***State lung cancer mortality maps 70***

GIS Tutorial 3 Designing maps for a health study 73

Begin a new map document 76

Create a choropleth map for the uninsured population in Texas 77
- Add a layer and change its name 77
- Select an attribute to display uninsured population 78
- Create custom classifications 80
- Manually change classification values for percentage uninsured 81
- Change labels 81
- Build a custom color ramp 84
- Save the Texas health-study map 85

Create a point map for percentage of unemployed in Texas 86
- Symbolize unemployment data as graduated points 86
- Modify point classifications 87
- Make a scatter plot comparing uninsured and unemployed populations 88
- Save the changes to your Texas health-study map 89

Work with layer files 90
Create a layer file 90
Create a group layer and add saved layers 91
Save the new Texas health-study map 93
Print layouts for a health-care study 94
Choose a prebuilt layout template 94
Add layers to the map layout 95
Create custom map layouts for multiple maps 96
Build a custom layout grid 96
Add layers and create multiple data frames 97
Classify data 98
Rename data frames 99
Add map titles and text 100
Add a legend 101
Unify map scales 102
Save the Texas health-study map 103
Export maps 104
Export a map to an image file 104
Copy and paste map images 105
Summary 106
Exercise assignment 3-1 ***Map comparing uninsured populations in California counties 107***
Exercise assignment 3-2 ***Map showing detailed Texas county demographics 108***

GIS Tutorial 4 Projecting and using spatial data 111

Explore map projections for world AIDS study 115
Open an existing map 115
Change Data Frame 1's projection to Mercator 116
Symbolize area maps using size-graduated point markers 118
Start a new map document 118
Symbolize layers 119
Create a prevalence map using point markers 121
Explore map projections for a U.S. lung cancer study 123
Prepare GIS data for a local health study 124
Add an ArcView shapefile 124
Set scale ranges 126
Add a CAD file 128
Import an ArcInfo interchange file and add an ArcInfo coverage 129
Export the coverage to a shapefile 130
Add an event file 130
Change the data frame projection to UTM 131
Add an aerial photo to the map 132
Improve labeling at the neighborhood level 133
Set parks as semitransparent 134
Summary 135
Exercise assignment 4-1 ***Map showing world infant mortality rates and life expectancy 136***
Exercise assignment 4-2 ***Map comparing walkable neighborhoods 137***

GIS Tutorial 5 Downloading and preparing spatial data 139

Download spatial and attribute data from the U.S. Census Bureau 142
- Lower Internet Explorer's security setting for downloading 142
- Download a TIGER/Line shapefile for census tracts 143
- Clean the census tract attribute data 145
- Download an SF3 housing variable 149
- Download census tract housing data from SF3 151
- Clean census tract SF3 data in Microsoft Excel 152
- Save file as dBASE using Microsoft Access 153

Download a shapefile from the ESRI Census TIGER/Line data Web site 154
- Download spatial data 154

Build a map layer for elevated blood levels of lead in children 156
- Extract Allegheny County tracts from Pennsylvania tracts 156
- Create a text data type version of the Tract ID 158

Join housing and elevated blood cases tables to census tract map 160
- Permanently join tables 161

Create a new personal geodatabase 162
- Import a shapefile into the geodatabase 162

Build a lead-study comparison map 163
- Add map layers and project the data frame 163
- Symbolize map layers 163

Summary 165

Exercise assignment 5-1 ***Map housing values compared to elevated blood levels of lead 166***

Exercise assignment 5-2 ***Map housing complaints compared to elevated blood levels of lead 168***

GIS Tutorial 6 Geocoding tabular data 171

Geocode patients to ZIP Code centroids 174
- Begin a new health-care map project 174
- Add a ZIP Code layer 174
- Add patient database and open its attribute table 174
- Build address locator for ZIP Codes 175
- Add address locator in ArcMap 177
- Geocode patients using new address locator 177

Spatially join patient and ZIP Code layers 180
- Spatially join points to polygons 180

Create a choropleth map showing patient counts by ZIP Codes 183

Geocode hospital addresses to streets for competitive analysis 185
Begin a new health-care map 185
Add streets layer 185
Add hospital database 186
Build an address locator for streets 187
Geocode hospitals using new address locator 188
Interactively rematch an address 191
Interactively rematch more addresses 193
Use street TIGER/Line maps to find addresses 194
Rematch addresses 196
Create a final comparison map 199
Summary 200
Exercise assignment 6-1 ***Map mammography clinics by ZIP Code compared to females ages 40–64 201***
Exercise assignment 6-2 ***Map mammography clinics in a county by street address 203***

GIS Tutorial 7 Preparing and analyzing spatial data 205

Prepare study region 210
Extract Pittsburgh.shp 210
Clip water polygons 211
Edit the rivers features 213
Extract streets and tracts for Pittsburgh 216
Join tracts and the census data table 218
Append injury shapefiles 219
Clean up your map and rename a shapefile 220
Set the projection for the data and map layers 220
Add City Planning (PAGIS) map layers 222
Dissolve tracts to build the neighborhoods map layer 223
Investigate the correlation of poverty and injuries 226
Intersect map layers 226
Aggregate records 228
Join tables 230
Symbolize map layers 232
Count injuries by top and bottom 40 percent quantiles 233
Investigate injuries near parks 236
Build multiple-ring buffers 236
Analyze injuries and population using buffers 237
Summary 241
Exercise assignment 7-1 ***Additional sensitivity analysis 242***
Exercise assignment 7-2 ***Map injuries near schools and convenience stores 243***

GIS Tutorial 8 Transforming data using approximate methods 245

Aggregate block data for elderly population to health-referral regions 249
- Open an existing map 250
- Compute block centroid coordinates 251
- Create a block centroid shapefile 253
- Assign block centroids a spatial reference 254
- Spatially join health-referral areas to block centroids 255
- Aggregate (sum) block data to the health-referral region level 256
- Join the new aggregate data to health-referral region 257

Apportion SF3 data 259
- Spatially join ZipCodes to BlockCentroids 261
- Use the mid( ) function to calculate BlkGrpID 263
- Create a new field in BlockCentroidsXZip 265
- Join Blocks to BlockCentroidsXZip 265
- Calculate new field 266
- Remove Join 267
- Create another new field in BlockCentroidsXZip 268
- Summarize Indicator field by IntID 270
- Add Denominator field 271
- Join BlkGrpSF1 to Blocks_Dissolve 272
- Calculate Denominator field 272
- Remove the Join from Blocks_Dissolve 273
- Calculate the apportionment weights 274
- Join and calculate SF3 poverty data to Blocks_Dissolve 275
- Sum the SF3 attribute by ZIP Code 277
- Cleanup 277

Start building a model 279
- Create a new toolbox and model 279
- Spatially join ZipCodes to BlockCentroids 279
- Add and calculate a field 282

Summary 285

Exercise assignment 8-1 ***Population variables for health-service areas 286***

Exercise assignment 8-2 ***Population in urban areas 287***

GIS Tutorial 9 Using ArcGIS Spatial Analyst for demand estimation 289

Examine raster basemap layers 292
- Open a map document 292
- Examine raster map layer properties 293
- Change raster attribute table size 293

Create a raster mask 294

Process a raster layer with mask 296
- Convert a TIFF image to a grid 296
- Set ArcToolbox environment 297
- Extract land use using mask 298

Create a hillshade raster layer 300
Add Spatial Analyst toolbar and set its options 300
Create hillshade for elevation 301
Add contrast to hillshade 302
Make a kernel density map 303
Open a map document and examine environmental settings 303
Make a density map for heart attack incidence 304
Extract raster value points 307
Calculate predicted heart attacks 308
Create a scatter plot of actual versus predicted heart attacks 309
Conduct a site suitability study 310
Open a map document 310
Convert buffer to a raster layer 310
Calculate a simple query 312
Calculate a compound query 314
Build a model for risk index 315
Open a map document 316
Create a new toolbox and model 317
Create a kernel density layer for an input 318
Create a kernel density layer for a second input 320
Create a raster algebra expression for the index 322
Run the model 324
Create a poverty contour 325
Summary 326
Exercise assignment 9-1 ***Display schools and land use for locating school-based health centers 327***
Exercise assignment 9-2 ***Determine heart attack fatalities outside of hospitals in Mount Lebanon by gender 329***

GIS Tutorial 10 Case study: Studying food-borne disease outbreaks 331

Part 1: Assemble basemaps 335
Part 2: Trace an outbreak source 337
Part 3: Identify affected office buildings 338
Part 4: Assess vulnerable populations 339

GIS Tutorial 11 Case study: Forming a national ACHE chapter 341

Phase 1: Creating market analysis maps 343
Phase 2: Creating a territory analysis map 344
Phase 3: Tracking chapter status 346

Appendix A Data source credits 347
Appendix B Data license agreement 353
Appendix C Installing the data and software 357