

Contents

1	Digital Soil Mapping	1
1.1	The Fundamentals of Digital Soil Mapping	1
1.2	What Is Going to Be Covered in this Book?	4
	References	5
2	R Literacy for Digital Soil Mapping	7
2.1	Objective	7
2.2	Introduction to R	7
2.2.1	R Overview and History	7
2.2.2	Finding and Installing R	8
2.2.3	Running R: GUI and Scripts	8
2.2.4	RStudio	9
2.2.5	R Basics: Commands, Expressions, Assignments, Operators, Objects	10
2.2.6	R Data Types	13
2.2.7	R Data Structures	15
2.2.8	Missing, Indefinite, and Infinite Values	17
2.2.9	Functions, Arguments, and Packages	18
2.2.10	Getting Help	21
2.2.11	Exercises	22
2.3	Vectors, Matrices, and Arrays	23
2.3.1	Creating and Working with Vectors	23
2.3.2	Vector Arithmetic, Some Common Functions, and Vectorised Operations	26
2.3.3	Matrices and Arrays	29
2.3.4	Exercises	31
2.4	Data Frames, Data Import, and Data Export	32
2.4.1	Reading Data from Files	33
2.4.2	Creating Data Frames Manually	36
2.4.3	Working with Data Frames	37

2.4.4	Writing Data to Files	40
2.4.5	Exercises	41
2.5	Graphics: The Basics.....	41
2.5.1	Introduction to the <code>plot</code> Function	41
2.5.2	Exercises	45
2.6	Manipulating Data.....	46
2.6.1	Modes, Classes, Attributes, Length, and Coercion.....	46
2.6.2	Indexing, Sub-setting, Sorting, and Locating Data	48
2.6.3	Factors.....	56
2.6.4	Combining Data	57
2.6.5	Exercises	58
2.7	Exploratory Data Analysis	58
2.7.1	Summary Statistics	58
2.7.2	Histograms and Box Plots.....	59
2.7.3	Normal Quantile and Cumulative Probability Plots.....	62
2.7.4	Exercises	64
2.8	Linear Models: The Basics	64
2.8.1	The <code>lm</code> Function, Model Formulas, and Statistical Output	64
2.8.2	Linear Regression	65
2.8.3	Exercises	71
2.9	Advanced Work: Developing Algorithms with R	71
	Reference.....	79
3	Getting Spatial in R.....	81
3.1	Basic GIS Operations Using R.....	82
3.1.1	Points.....	82
3.1.2	Rasters.....	85
3.2	Advanced Work: Creating Interactive Maps in R	88
3.3	Some R Packages That Are Useful for Digital Soil Mapping	91
	Reference.....	93
4	Preparatory and Exploratory Data Analysis for Digital Soil Mapping	95
4.1	Soil Depth Functions	96
4.1.1	Fit Mass Preserving Splines with R.....	97
4.2	Intersecting Soil Point Observations with Environmental Covariates.....	101
4.2.1	Using Rasters from File	105
4.3	Some Exploratory Data Analysis	106
	References.....	116
5	Continuous Soil Attribute Modeling and Mapping	117
5.1	Model Validation	117
5.1.1	Model Goodness of Fit	118
5.1.2	Model Validation	119

5.2	Multiple Linear Regression	122
5.2.1	Applying the Model Spatially	126
5.3	Decision Trees	130
5.4	Cubist Models	133
5.5	Random Forests	136
5.6	Advanced Work: Model Fitting with Caret Package	141
5.7	Regression Kriging	143
5.7.1	Universal Kriging	144
5.7.2	Regression Kriging with Cubist Models	146
	References	149
6	Categorical Soil Attribute Modeling and Mapping	151
6.1	Model Validation of Categorical Prediction Models	152
6.2	Multinomial Logistic Regression	155
6.3	C5 Decision Trees	161
6.4	Random Forests	164
	References	167
7	Some Methods for the Quantification of Prediction	
	Uncertainties for Digital Soil Mapping	169
7.1	Universal Kriging Prediction Variance	170
7.1.1	Defining the Model Parameters	170
7.1.2	Spatial Mapping	173
7.1.3	Validating the Quantification of Uncertainty	176
7.2	Bootstrapping	178
7.2.1	Defining the Model Parameters	179
7.2.2	Spatial Mapping	182
7.2.3	Validating the Quantification of Uncertainty	185
7.3	Empirical Uncertainty Quantification Through Data Partitioning and Cross Validation	187
7.3.1	Defining the Model Parameters	188
7.3.2	Spatial Mapping	192
7.3.3	Validating the Quantification of Uncertainty	195
7.4	Empirical Uncertainty Quantification Through Fuzzy Clustering and Cross Validation	198
7.4.1	Defining the Model Parameters	200
7.4.2	Spatial Mapping	211
7.4.3	Validating the Quantification of Uncertainty	216
	References	218
8	Using Digital Soil Mapping to Update, Harmonize and	
	Disaggregate Legacy Soil Maps	221
8.1	DSMART: An Overview	223
8.2	Implementation of DSMART	224
8.2.1	DSMART with R	224
	References	229

9	Combining Continuous and Categorical Modeling: Digital Soil Mapping of Soil Horizons and Their Depths	231
9.1	Two-Stage Model Fitting and Validation.....	234
9.2	Spatial Application of the Two-Stage Soil Horizon Occurrence and Depth Model.....	242
	References.....	244
10	Digital Soil Assessments	245
10.1	A Simple Enterprise Suitability Example	245
10.1.1	Mapping Example of Digital Land Suitability Assessment	249
10.2	Homosoil: A Procedure for Identifying Areas with Similar Soil Forming Factors	254
10.2.1	Global Climate, Lithology and Topography Data	254
10.2.2	Estimation of Similarity	255
10.2.3	The homosoil Function	256
10.2.4	Example of Finding Soil Homologues	259
	References.....	260
	Index.....	261

Using R for Digital Soil Mapping

Malone, B.P.; Minasny, B.; McBratney, A.B.

2017, XVI, 262 p. 61 illus., 44 illus. in color., Hardcover

ISBN: 978-3-319-44325-6