Contents

Chapter 1: Introduction

re insights? ictionary ne business perspective ur definition ur ecology example We love fruit n, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	1 1 2 3 3 5 7 8 9 11 16
ictionary ne business perspective ur definition ur ecology example We love fruit n, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	1 2 3 3 5 7 8 9 11 16
he business perspective ur definition ur ecology example We love fruit n, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	2 3 5 7 8 9 11 16
ur definition ur ecology example We love fruit n, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	3 3 5 7 8 9 11 16
ur ecology example We love fruit on, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	3 5 7 8 9 11 16
an, question, question (how are data born?) at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	5 7 8 9 11 16
at exactly are data? se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	7 8 9 11 16
se and predictor variables ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	8 9 11 16
ey features of datasets strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	9 11 16
strations of getting insights from data eral <i>Insights</i> workflow ng up and looking forward	11 16
eral <i>Insights</i> workflow ng up and looking forward	16
ng up and looking forward	
	17
ting acquainted	19
acquainted with R and RStudio	19
Thy R?	20
'hy RStudio?	21
etting and installing R	22
etting and installing RStudio	23
brief tour of RStudio	24
st R command!	26
etting to know R a little better	27
oring and reusing results	29
That names should Luse?	.8 31
hat humes should I use.	32
scripts	34
scripts omments in your scripts	35
scripts omments in your scripts we and keep safe your script file	36
scripts omments in your scripts we and keep safe your script file unning your scripts	36
scripts omments in your scripts we and keep safe your script file unning your scripts hings go wrong	50
5	Comments in your scripts ave and keep safe your script file tunning your scripts things go wrong

1

INSIGHTS FROM DATA WITH R

		2.4.2 Warnings	38
		2.4.3 The dreaded +	38
	2.5	Functions	39
		2.5.1 Functions, the sequel	41
	2.6	Add-on packages	42
		2.6.1 Finding add-on packages	43
		2.6.2 Installing (downloading) packages	44
		2.6.3 Loading packages	46
		2.6.4 An analogy	46
		2.6.5 Updating R, RStudio, and your packages	4/
	2.7	Getting help	48
		2.7.1 R help system and files	48
		2.7.2 Navigating help mes	50
		2.7.5 Vigneties	50
		2.7.5 Other sources of help	51
		2.7.6 Asking for help from others	51
	2.8	Common pitfalls	52
	2.9	Summing up and looking forward	52
cł	nante	er 3: Workflow Demonstration part 1: Preparation	55
	aper	But what exactly are date	57
	3.1	What is the question?	5/
		3.1.1 The three response variables	50
	2.2	Design of the study	60
	3.2	Design of the study	00
	3.3	Preparing your data	61
	2.4	5.5.1 Acquire the dataset	66
	3.4	2.4.1 Making the project folder for the bat data	67
		3.4.2 Projects in RStudio	68
		3 4 3 Create a new R script and load packages	71
	35	Cet the data into R	72
	5.5	3.5.1 View and refine the import	76
	36	Getting going with data management	78
	5.0	3.6.1 How the data are stored in R	79
	37	Clean and tidy the data	81
	5.7	3.7.1 Tidving the data	82
		3.7.2 Cleaning the data	82
		3.7.3 Refine the variable names	83
		3.7.4 Fix the dates	85
		3.7.5 Rename some values in a variable	86
		3.7.6 Check for duplicates	87

I Errors

CONTENTS

	3.7.7 Check for implausible and invalid values	89
	3.7.8 What about those NAs?	90
3.8	Stop that! Don't even think about it!	92
	3.8.1 Don't mess with the 'working directory'	92
	3.8.2 Don't use the data import tool or file.choose	93
	3.8.3 Don't even think about using the attach function	93
	3.8.4 Avoid using square brackets or dollar signs	93
3.9	Summing up and looking forward	94
Chapt	er 4: Workflow Demonstration part 2: Getting insights	97
4.1	Initial insights 1: Numbers and counting	98
	4.1.1 Our first insights: The number, sex, and	
	age of bats	98
4.2	Initial insights 2: Distributions	103
	4.2.1 Insights you've done it!	105
4.3	Transform the data	108
4.4	Insights about our questions	111
(in the	4.4.1 Distribution of number of prey	111
	4.4.2 Shapes: Mean wingspan	113
	4.4.3 Shapes: Proportion migratory	114
	4.4.4 Relationships	116
	4.4.5 Communication (beautifying the graphs)	121
	4.4.6 Beautifying the wingspan, age, sex graph	122
4.5	Another view of the question and data	125
	4.5.1 Before you continue	125
	4.5.2 A prey-centric view	125
4.6	A caveat	137
4.7	Summing up and looking forward	138
4.8	A small reward, if you like dogs	139
Chapt	er 5: Dealing with data 1: Digging into dplyr	141
51	Introducing dplyr	142
5.1	5.1.1. Selecting variables with the select function	143
	5.1.2 Renaming variables with select and rename	146
	5.1.3 Creating new variables with the mutate function	146
	5.1.4 Getting particular observations with filter	149
	5.1.5 Ordering observations with arrange	153
5.2	Grouping and summarizing data with dplyr	155
1 I I	5.2.1 Summarizing data—the nitty-gritty	156
	5.2.2 Grouped summaries using group by magic	160
	5.2.3 More than one grouping variable	163
	5.2.4 Using group by with other verbs	165

xxiii

INSIGHTS FROM DATA WITH R

	5.2.5 Removing grouping information	166
5.3	Summing up and looking forward	167
Chapt	er 6: Dealing with data 2: Expanding your toolkit	169
6.1	Pipes and pipelines	170
	6.1.1 Why do we need pipes?	170
	6.1.2 On why you shouldn't nest functions	174
6.2	Subduing the pesky string	175
6.3	Elegantly managing dates and times	178
	6.3.1 Date/time formats	178
	6.3.2 Dates in the bat project data	179
	6.3.3 Why parse dates?	180
	6.3.4 More about parsing dates/times	181
	6.3.5 Calculations with dates/times	183
6.4	Changing between wider and longer data arrangements	186
	6.4.1 Going longer	187
	6.4.2 Going wider	190
6.5	Summing up and looking forward	192
Chapt	er 7: Getting to grips with ggplot2	195
7.1	Anatomy of a ggplot	196
	7.1.1 Layers	197
	7.1.2 Scales	200
	7.1.3 Coordinate system	200
	7.1.4 Fantastic faceting	201
7.2	Putting it into practice	201
	7.2.1 Inheriting data and aesthetics from ggplot	202
7.3	Beautifying plots	204
	7.3.1 Working with layer-specific geom properties	205
	7.3.2 Adding titles and labels	207
	7.3.3 Themes	207
7.4	Summing up and looking forward	208
Chapt	er 8: Making deeper insights part 1: Working with single variables	211
8.1	Variables and data	212
	8.1.1 Numeric versus categorical variables	213
	8.1.2 Ratio versus interval scales	215
8.2	Samples and distributions	216
	8.2.1 Understanding numerical variables	218
8.3	Graphical summaries of numeric variables	220
	8.3.1 Making some insights about wingspan	222

CONTENTS

	8.3.2 Descriptive statistics for numeric variables	227
	8.3.3 Measuring central tendency	228
	8.3.4 Measuring dispersion	229
	8.3.5 Mapping measures of central tendency and dispersion to a figure	231
	8.3.6 Combining histograms and boxplots	233
8.4	A moment with missing values in numeric variables (NAs)	234
8.5	Exploring a categorical variable	236
	8.5.1 Understanding categorical variables	236
8.6	Summing up and looking forward	244
8.7	A cat-related reward	245
Chapt	er 9: Making deeper insights part 2: Relationships among (many) variables	247
9.1	Associations between two numeric variables	248
	9.1.1 Descriptive statistics: Correlations	248
	9.1.2 Other measures of correlation	251
	9.1.3 Graphical summaries between two numeric variables:	
	The scatterplot	252
9.2	Associations between two categorical variables	256
	9.2.1 Numerical summaries	256
	9.2.2 Graphical summaries	258
	9.2.3 An alternative, and perhaps more valuable	260
9.3	Categorical-numerical associations	261
	9.3.1 Numerical summaries	262
	9.3.2 Graphical summaries for numerical versus categorical data	262
	9.3.3 Alternatives to box-and-whisker plots	264
9.4	Building in complexity: Relationships among three or more variables	267
9.5	Summing up and looking forward	269
Chapt	er 10: Looking back and looking forward	271
10	1 Next learning steps	272
10	.2 Reproducibility: What, why, and how?	274
	10.2.1 Why should you try and make your work reproducible?	274
	10.2.2 How can you make your work more reproducible?	275
10	.3 Congratulations!	281
Index		283
maex		205

XXV