

# Contents

1	R Basics	1
1.1	Working Directory	3
1.2	Workspace	4
1.3	Object Types	5
1.4	Mathematical and Logical Operations	8
1.5	Indexing and Subsetting	10
1.6	Data Coercion	13
1.7	User Interfaces	15
1.8	Working with Script Files	17
2	The <b>QCA</b> Package	19
2.1	Installing the <b>QCA</b> Package	19
2.2	Structure	20
2.3	Command Line Mode	22
2.3.1	Getting Help	22
2.3.2	Function Arguments	23
2.4	The Graphical User Interface (GUI)	26
2.4.1	Description	27
2.4.2	Starting the Graphical User Interface	29
2.4.3	Creating an Executable Icon	30
2.4.4	Command Construction	32
2.4.5	The Web R Console	34
2.4.6	Graphics	36
2.4.7	The Data Editor	39
2.4.8	Import, Export and Load Data	41
3	Set Theory	47
3.1	The Binary System and the Boolean Algebra	48
3.2	Types of Sets	48
3.2.1	Bivalent Crisp Sets	49
3.2.2	Multivalent Crisp Sets	50
3.2.3	Fuzzy Sets	52

3.3	Set Operations . . . . .	53
3.3.1	Set Negation . . . . .	53
3.3.2	Logical AND . . . . .	54
3.3.3	Logical OR . . . . .	57
3.4	Complex Operations . . . . .	59
<b>4</b>	<b>Calibration . . . . .</b>	<b>61</b>
4.1	Calibrating to Crisp Sets . . . . .	63
4.2	Calibrating to Fuzzy Sets . . . . .	71
4.2.1	Direct Assignment . . . . .	72
4.2.2	Direct Method, the “S-Shape” Functions . . . . .	74
4.2.3	How Does It Works: The Logistic Function . . . . .	85
4.2.4	Direct Method, the “Bell-Shape” Functions . . . . .	88
4.2.5	The Indirect Method . . . . .	92
4.3	Calibrating Categorical Data . . . . .	94
<b>5</b>	<b>Analysis of Necessity . . . . .</b>	<b>99</b>
5.1	Conceptual Description . . . . .	99
5.2	Inclusion/Consistency . . . . .	105
5.3	Coverage/Relevance . . . . .	110
5.4	Necessity for Conjunctions and Disjunctions . . . . .	119
5.5	Exploring Possible Necessity Relations . . . . .	122
<b>6</b>	<b>Analysis of Sufficiency . . . . .</b>	<b>125</b>
6.1	Conceptual Description . . . . .	126
6.2	Inclusion/Consistency . . . . .	130
6.3	The PRI Score . . . . .	134
6.4	Coverage: Raw and Unique . . . . .	136
<b>7</b>	<b>The Truth Table . . . . .</b>	<b>139</b>
7.1	General Considerations . . . . .	139
7.2	Command Line and GUI Dialog . . . . .	143
7.3	From Fuzzy Sets to Crisp Truth Tables . . . . .	146
7.4	Calculating Consistency Scores . . . . .	151
7.5	The OUTput Value . . . . .	154
7.6	Other Details . . . . .	158
<b>8</b>	<b>The Logical Minimization . . . . .</b>	<b>159</b>
8.1	Command Line and GUI Dialog . . . . .	161
8.2	Conservative (Complex) Solutions . . . . .	163
8.3	What Is Explained . . . . .	167
8.4	Parsimonious Solutions . . . . .	172
8.5	A Note on Complexity . . . . .	176
8.6	Types of Counterfactuals . . . . .	178
8.7	Intermediate Solutions: SA and ESA . . . . .	183
8.8	Theory Evaluation . . . . .	194

<b>9 Pseudo-Counterfactual Analysis</b> .....	197
9.1 eQMC .....	198
9.2 Consistency Cubes.....	203
9.2.1 Search Space.....	205
9.3 Include vs. Exclude .....	207
<b>10 QCA Extensions</b> .....	209
10.1 Temporal QCA .....	209
10.2 Coincidence Analysis: CNA .....	214
10.3 Panel/Clustered Data .....	225
10.4 Robustness Tests .....	230
<b>11 Less Known Features</b> .....	241
11.1 Boolean Expressions .....	242
11.2 Negate Expressions .....	248
11.3 Factorize Expressions .....	250
11.4 More Parameters of Fit .....	252
11.5 XY Plots .....	255
11.6 Venn Diagrams.....	263
11.7 Custom Labels .....	271
<b>References</b> .....	273

the QCA package.

Chapter 11 will help you go further in this area, especially Section 11.7 which describes how to extend user functions via Boolean expressions, factorizations, and negations. This section also provides the reader with the basic knowledge of how to create new objects in R and what it is all about and provides more importantly, how to do this without understanding the underlying data analysis process.

The second topic will be covered in Chapter 12. Boolean and other expressions can be used to filter data sets. In this chapter, the reader will learn how to understand what these objects are and what criteria is outside of the scope of this book. These are formal descriptions of what knowledge and what data structures are used to represent them. Whether they feel that basic understanding does not suffice, the reader can always refer to the R documentation for more information.

Chapter 13 is focused on the concept of consistency cubes. This chapter is very important because there are no specific requirements for the data set. It can be a data frame or a data set like an R dataset, and it can be a data set from a database.

Chapter 14 is focused on the concept of pseudo-counterfactual analysis. This chapter is very important because it can be used to analyze data sets that have missing values.

Chapter 15 is focused on the concept of QCA extensions. This chapter is very important because it can be used to analyze data sets that have missing values.