

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Correspondence Analysis</b>	<b>4</b>
2.1	Introduction . . . . .	4
2.2	Simple Correspondence Analysis . . . . .	8
2.2.1	Notation and Computation . . . . .	8
2.2.2	Criteria . . . . .	9
2.2.3	Extensions . . . . .	10
2.2.3.1	Supplementary Points . . . . .	10
2.2.3.2	Correspondence Analysis of Subsets . . . . .	11
2.2.4	Implementation of Simple Correspondence Analysis in the <i>ca</i> package . . . . .	11
2.3	Multiple Correspondence Analysis . . . . .	14
2.3.1	Notation and Computation . . . . .	14
2.3.1.1	Computation of Multiple Correspondence Analysis based on the Indicator Matrix . . . . .	17
2.3.1.2	Computation of Multiple Correspondence Analysis based on the Burt Matrix . . . . .	17
2.3.2	Adjustment of Inertias . . . . .	18
2.3.3	Joint Correspondence Analysis . . . . .	18
2.3.4	Extensions . . . . .	21
2.3.4.1	Supplementary Points . . . . .	21
2.3.4.2	Multiple Correspondence Analysis in the Case of Subsets . . . . .	22

2.3.5	Implementation of Multiple Correspondence Analysis in the <i>ca</i> package . . . . .	23
2.4	Visualization of Results from Simple and Multiple Correspondence Analysis . . . . .	25
2.5	Further Topics in Correspondence Analysis . . . . .	29
2.5.1	Assessing the Stability of Results obtained from Correspondence Analysis . . . . .	29
2.5.2	The Application of Clustering based on Correspondence Analysis . . . . .	31
2.6	Existing Implementations of Simple and Multiple Correspondence Analysis in R . . . . .	33
<b>3</b>	<b>Web Mining</b> . . . . .	<b>35</b>
3.1	Introduction . . . . .	35
3.2	Technical Overview . . . . .	35
3.2.1	The Structure of the Web . . . . .	35
3.2.1.1	Web Resources . . . . .	36
3.2.1.2	Web Resource Identifiers . . . . .	37
3.2.1.3	Web Transfer Protocols . . . . .	38
3.2.2	Data Sources for Web Mining . . . . .	38
3.2.2.1	The Common Log Format . . . . .	39
3.2.2.2	Issues in Data Retrieval . . . . .	42
3.3	Web Mining . . . . .	43
3.3.1	Aspects in Web Mining . . . . .	43
3.3.2	Further Issues in Web Mining . . . . .	44
3.3.2.1	The Relation between Web Mining, Data Mining and Statistics . . . . .	44
3.3.2.2	Web Usage Data Abstractions . . . . .	44
3.3.2.3	Preprocessing Web Logs . . . . .	45
3.4	Selected Approaches to Web Usage Mining . . . . .	47
3.4.1	Early Studies on Browsing Behaviour . . . . .	47
3.4.2	Modelling Web Usage . . . . .	48

3.4.2.1	Representing Web Site Visits with Graphs . . . . .	48
3.4.2.2	Markov Chains . . . . .	49
3.4.2.3	Application of Markov Chains in the Analysis of Web Usage . . . . .	50
<b>4</b>	<b>A Case Study</b>	<b>53</b>
4.1	Introduction . . . . .	53
4.1.1	Web Site Structure . . . . .	54
4.1.2	Data Preprocessing . . . . .	56
4.2	Preliminary Results . . . . .	57
4.2.1	Distributional Properties of Web Site Accesses . . . . .	57
4.2.2	Temporal Properties of Web Site Accesses . . . . .	61
4.2.3	Transitional Properties of Web Site Accesses . . . . .	65
4.2.4	Consideration of Target Variables . . . . .	68
4.3	The Application of Correspondence Analysis in Web Usage Mining . . . . .	71
4.3.1	An Analysis of Users' Web Page Accesses . . . . .	71
4.3.2	Application of Supplementary Points in Correspondence Analysis . . . . .	76
4.4	Further Applications based on Correspondence Analysis . . . . .	79
4.4.1	Clustering of Web Usage Data based on Correspondence Analysis . . . . .	79
4.4.2	Real Time Monitoring of Web Site Accesses . . . . .	81
<b>5</b>	<b>Conclusions and Future Work</b>	<b>83</b>
<b>A</b>	<b>Correspondence Analysis in R: the ca package</b>	<b>85</b>
A.1	Package Overview . . . . .	85
A.2	Function Reference . . . . .	86
A.2.1	Simple Correspondence Analysis . . . . .	86
A.2.2	Multiple and Joint Correspondence Analysis . . . . .	96
A.2.3	Data sets and Miscellaneous Functions . . . . .	106

<b>B Web Mining in R: the <code>wm</code> package</b>	<b>109</b>
B.1 Package Overview . . . . .	109
B.2 Function Reference . . . . .	110
B.2.1 Data Import and Preprocessing . . . . .	110
B.2.2 Visualization . . . . .	116
B.2.3 Miscellaneous Functions . . . . .	117