

# Contents

<b>1</b>	<b>Introduction to Machine Learning</b>	<b>1</b>
1	Summary	1
1.1	Background	1
1.2	Objective and Methods	1
1.3	Results and Conclusions	1
2	Introduction	2
3	Machine Learning Terminology	4
3.1	Artificial Intelligence	4
3.2	Bootstraps	4
3.3	Canonical Regression	4
3.4	Components	4
3.5	Cronbach's alpha	4
3.6	Cross-Validation	5
3.7	Data Dimension Reduction	5
3.8	Data Mining	5
3.9	Discretization	5
3.10	Discriminant Analysis	5
3.11	Eigenvectors	6
3.12	Elastic Net Regression	6
3.13	Factor Analysis	6
3.14	Factor Analysis Theory	6
3.15	Factor Loadings	7
3.16	Fuzzy Memberships	7
3.17	Fuzzy Modeling	7
3.18	Fuzzy Plots	7
3.19	Generalization	7
3.20	Hierarchical Cluster Analysis	7
3.21	Internal Consistency Between the Original Variables Contributing to a Factor in Factor Analysis	8
3.22	Iterations	8
3.23	Lasso Regression	8

3.24	Latent Factors.....	8
3.25	Learning .....	8
3.26	Learning Sample .....	9
3.27	Linguistic Membership Names .....	9
3.28	Linguistic Rules .....	9
3.29	Logistic Regression.....	9
3.30	Machine Learning .....	9
3.31	Monte Carlo Methods .....	9
3.32	Multicollinearity or Collinearity .....	9
3.33	Multidimensional Modeling.....	10
3.34	Multilayer Perceptron Model .....	10
3.35	Multivariate Machine Learning Methods.....	10
3.36	Multivariate Method.....	10
3.37	Network.....	10
3.38	Neural Network.....	10
3.39	Optimal Scaling .....	10
3.40	Overdispersion, Otherwise Called Overfitting.....	11
3.41	Partial Correlation Analysis .....	11
3.42	Partial Least Squares.....	11
3.43	Pearson's Correlation Coefficient (R).....	11
3.44	Principal Components Analysis.....	12
3.45	Radial Basis Functions.....	12
3.46	Radial Basis Function Network .....	12
3.47	Regularization .....	12
3.48	Ridge Regression .....	12
3.49	Splines.....	12
3.50	Supervised Learning .....	12
3.51	Training Data .....	13
3.52	Triangular Fuzzy Sets .....	13
3.53	Universal Space.....	13
3.54	Unsupervised Learning .....	13
3.55	Varimax Rotation .....	13
3.56	Weights.....	13
4	Discussion .....	14
5	Conclusions.....	14
	Reference .....	15
<b>2</b>	<b>Logistic Regression for Health Profiling.....</b>	<b>17</b>
1	Summary.....	17
1.1	Background.....	17
1.2	Methods and Results .....	17
1.3	Conclusions.....	17
2	Introduction.....	18
3	Real Data Example .....	19
4	Discussion.....	21

5	Conclusions .....	23
	References .....	24
<b>3</b>	<b>Optimal Scaling: Discretization .....</b>	<b>25</b>
1	Summary .....	25
1.1	Background .....	25
1.2	Objective and Methods .....	25
1.3	Results .....	25
1.4	Conclusions .....	26
2	Introduction .....	26
3	Some Terminology .....	28
3.1	Cross-Validation .....	28
3.2	Discretization .....	28
3.3	Elastic Net Regression .....	28
3.4	Lasso Regression .....	28
3.5	Overdispersion, Otherwise Called Overfitting .....	28
3.6	Monte Carlo Methods .....	28
3.7	Regularization .....	28
3.8	Ridge Regression .....	29
3.9	Splines .....	29
4	Some Theory .....	29
5	Example .....	29
6	Discussion .....	30
7	Conclusion .....	32
8	Appendix: Datafile of 250 Subjects Used as Example .....	32
	References .....	37
<b>4</b>	<b>Optimal Scaling: Regularization Including Ridge, Lasso, and Elastic Net Regression .....</b>	<b>39</b>
1	Summary .....	39
1.1	Background .....	39
1.2	Objective .....	39
1.3	Methods .....	39
1.4	Results .....	39
1.5	Conclusions .....	40
2	Introduction .....	40
3	Some Terminology .....	40
3.1	Discretization .....	40
3.2	Splines .....	41
3.3	Overdispersion, Otherwise Called Overfitting .....	41
3.4	Regularization .....	41
3.5	Ridge Regression .....	41
3.6	Monte Carlo Methods .....	41
3.7	Cross-Validation .....	41
3.8	Lasso Regression .....	41
3.9	Elastic Net Regression .....	42

4	Some Theory .....	42
5	Example .....	42
6	Discussion .....	46
7	Conclusions .....	47
8	Appendix: Datafile of 250 Subjects Used as Example .....	47
	References .....	53
<b>5</b>	<b>Partial Correlations .....</b>	<b>55</b>
1	Summary .....	55
1.1	Background .....	55
1.2	Objective .....	55
1.3	Methods .....	55
1.4	Results .....	55
1.5	Conclusions .....	56
2	Introduction .....	56
3	Some Theory .....	57
4	Case-Study Analysis .....	61
5	Discussion .....	63
6	Conclusions .....	64
	References .....	64
<b>6</b>	<b>Mixed Linear Models .....</b>	<b>65</b>
1	Summary .....	65
1.1	Background .....	65
1.2	Objective .....	65
1.3	Methods and Results .....	65
1.4	Conclusions .....	66
2	Introduction .....	66
3	A Placebo-Controlled Parallel Group Study of Cholesterol Treatment .....	67
4	A Three Treatment Crossover Study of the Effect of Sleeping Pills on Hours of Sleep .....	69
5	Discussion .....	75
6	Conclusion .....	76
	References .....	76
<b>7</b>	<b>Binary Partitioning .....</b>	<b>79</b>
1	Summary .....	79
1.1	Background .....	79
1.2	Objective .....	79
1.3	Methods and Results .....	79
1.4	Conclusions .....	80
2	Introduction .....	80
3	Example .....	80
4	ROC (Receiver Operating Characteristic) Method for Finding the Best Cut-off Level .....	81

5	Entropy Method for Finding the Best Cut-off Level.....	82
6	Discussion.....	84
7	Conclusions.....	85
	References.....	86
<b>8</b>	<b>Item Response Modeling .....</b>	<b>87</b>
1	Summary.....	87
1.1	Background .....	87
1.2	Objective .....	87
1.3	Methods.....	87
1.4	Results.....	87
1.5	Conclusions .....	88
2	Introduction.....	88
3	Item Response Modeling, Principles .....	89
4	Quality of Life Assessment.....	90
5	Clinical and Laboratory Diagnostic-Testing.....	93
6	Discussion.....	94
7	Conclusions.....	97
7.1	We Conclude .....	97
	References.....	97
<b>9</b>	<b>Time-Dependent Predictor Modeling.....</b>	<b>99</b>
1	Summary.....	99
1.1	Background .....	99
1.2	Objective .....	99
1.3	Methods and Results .....	99
1.4	Conclusions .....	100
2	Introduction.....	100
3	Cox Regression Without Time-Dependent Predictors .....	101
4	Cox Regression with a Time-Dependent Predictor.....	103
5	Cox Regression with a Segmented Time-Dependent Predictor.....	106
6	Multiple Cox Regression with a Time-Dependent Predictor.....	108
7	Discussion.....	109
8	Conclusions.....	110
8.1	We Conclude .....	111
	References.....	111
<b>10</b>	<b>Seasonality Assessments .....</b>	<b>113</b>
1	Summary.....	113
1.1	Background .....	113
1.2	Objective and Methods.....	113
1.3	Results .....	113
1.4	Conclusions .....	114
2	Introduction.....	114
3	Autocorrelations.....	114
4	Examples.....	116

5	Discussion .....	119
6	Conclusions .....	125
	References .....	125
<b>11</b>	<b>Non-Linear Modeling .....</b>	<b>127</b>
1	Summary .....	127
1.1	Background .....	127
1.2	Objective .....	127
1.3	Results and Conclusions .....	127
2	Introduction .....	128
3	Testing for Linearity .....	128
4	Logit and Probit Transformations .....	131
5	“Trial and Error” Method, Box Cox Transformation, Ace/Avas Packages .....	133
6	Sinusoidal Data .....	134
7	Exponential Modeling .....	135
8	Spline Modeling .....	135
9	Loess Modeling .....	139
10	Discussion .....	141
11	Conclusions .....	141
12	Appendix .....	142
	References .....	143
<b>12</b>	<b>Artificial Intelligence, Multilayer Perceptron Modeling .....</b>	<b>145</b>
1	Summary .....	145
1.1	Background .....	145
1.2	Objective .....	145
1.3	Methods and Results .....	145
1.4	Conclusions .....	146
2	Introduction .....	146
3	Historical Background .....	146
4	The Back Propagation (BP) Neural Network: The Computer Teaches Itself to Make Predictions .....	147
5	A Real Data Example .....	148
6	Discussion .....	152
7	Conclusions .....	153
	References .....	154
<b>13</b>	<b>Artificial Intelligence, Radial Basis Functions .....</b>	<b>157</b>
1	Summary .....	157
1.1	Background .....	157
1.2	Objective .....	157
1.3	Methods .....	157
1.4	Results .....	157
1.5	Conclusions .....	158
2	Introduction .....	158
3	Example .....	159

4	Radial Basis Function Analysis .....	159
5	Discussion .....	164
6	Conclusions .....	165
	References .....	165
<b>14</b>	<b>Factor Analysis .....</b>	<b>167</b>
1	Summary .....	167
1.1	Background .....	167
1.2	Objective and Methods .....	167
1.3	Results .....	167
1.4	Conclusions .....	168
2	Introduction .....	168
3	Some Terminology .....	168
3.1	Internal Consistency Between the Original Variables Contributing to a Factor .....	168
3.2	Cronbach's Alpha .....	169
3.3	Multicollinearity or Collinearity .....	169
3.4	Pearson's Correlation Coefficient (R) .....	169
3.5	Factor Analysis Theory .....	169
3.6	Magnitude of Factor Value for Individual Patients .....	170
3.7	Factor Loadings .....	170
3.8	Varimax Rotation .....	171
3.9	Eigenvectors .....	171
3.10	Iterations .....	171
3.11	Components .....	172
3.12	Latent Factors .....	172
3.13	Multidimensional Modeling .....	172
4	Example .....	172
5	Making Predictions for Individual Patients, Health Risk Profiling .....	175
6	Discussion .....	176
7	Conclusions .....	176
8	Appendix: Data File of 200 Patients Admitted Because of Sepsis .....	177
	References .....	181
<b>15</b>	<b>Hierarchical Cluster Analysis for Unsupervised Data .....</b>	<b>183</b>
1	Summary .....	183
1.1	Background .....	183
1.2	Objective .....	183
1.3	Methods .....	183
1.4	Results .....	183
1.5	Conclusions .....	184
2	Introduction to Hierarchical Cluster Analysis .....	184
2.1	A Novel Approach to Drug Efficacy Testing .....	184
2.2	A Novel Statistical Methodology Suitable for the Purpose .....	185
2.3	Publications So Far .....	185
2.4	Objective of the Current Chapter .....	185

3	Case-Study .....	185
3.1	Example.....	185
3.2	Data Analysis .....	186
4	Discussion.....	189
4.1	Multifactorial Nature of Drug Efficacy .....	189
4.2	Theoretical Background of Novel Methodology .....	192
4.3	Flexibility of Hierarchical Cluster Analysis .....	192
4.4	Comparison with Other Machine Learning Methods.....	193
5	Conclusions.....	193
	References.....	195
<b>16</b>	<b>Partial Least Squares.....</b>	<b>197</b>
1	Summary.....	197
1.1	Background .....	197
1.2	Objective .....	197
1.3	Methods.....	197
1.4	Results.....	198
1.5	Conclusions .....	198
2	Introduction.....	198
3	Some Theory.....	199
3.1	Principal Components Analysis .....	200
3.2	Partial Least Squares Analysis .....	200
4	Example .....	201
4.1	Principal Components Analysis .....	201
4.2	Partial Least Squares Analysis .....	203
4.3	Comparison of the Two Models .....	204
5	Discussion.....	205
6	Conclusions.....	206
7	Appendix: Datafile of the Example Used in the Present Chapter .....	207
	References.....	212
<b>17</b>	<b>Discriminant Analysis for Supervised Data.....</b>	<b>215</b>
1	Summary.....	215
1.1	Background .....	215
1.2	Objective .....	215
1.3	Methods.....	215
1.4	Results.....	215
1.5	Conclusions .....	216
2	Introduction.....	216
3	Some Theory.....	217
4	Case-Study .....	218
5	Discussion.....	221
6	Conclusions.....	222
7	Appendix: Data File.....	223
	References.....	224



<b>18 Canonical Regression</b>	225
1 Summary	225
1.1 Background	225
1.2 Objective	225
1.3 Methods	225
1.4 Result	225
1.5 Conclusions	226
2 Introduction	226
3 Some Theory	227
4 Example	227
5 Discussion	232
6 Conclusions	233
7 Appendix: Datafile of the Example Used in the Present Chapter	234
References	239
<b>19 Fuzzy Modeling</b>	241
1 Summary	241
1.1 Background	241
1.2 Objective	241
1.3 Methods and Results	241
1.4 Conclusions	242
2 Introduction	242
3 Some Fuzzy Terminology	243
3.1 Fuzzy Memberships	243
3.2 Fuzzy Plots	243
3.3 Linguistic Membership Names	243
3.4 Linguistic Rules	243
3.5 Triangular Fuzzy Sets	243
3.6 Universal Space	243
4 First Example, Dose-Response Effects of Thiopental on Numbers of Responders	243
5 Second Example, Time-Response Effect of Propranolol on Peripheral Arterial Flow	247
6 Discussion	251
7 Conclusions	252
References	252
<b>20 Conclusions</b>	255
1 Introduction	255
2 Limitations of Machine Learning	255
3 Serendipities and Machine Learning	256
4 Machine Learning in Other Disciplines and in Medicine	256
5 Conclusions	256
References	257
<b>Index</b>	259





<http://www.springer.com/978-94-007-5823-0>

Machine Learning in Medicine

Cleophas, T.J.; Zwinderman, A.H.

2013, XV, 265 p. 44 illus., Hardcover

ISBN: 978-94-007-5823-0