Contents

1. Introduction 1
   1. Motivation, 1
   2. Types of Data and How to Handle Them, 3
      2.1 Interval-Scaled Variables, 4
      2.2 Dissimilarities, 16
      2.3 Similarities, 20
      2.4 Binary Variables, 22
      2.5 Nominal, Ordinal, and Ratio Variables, 28
      2.6 Mixed Variables, 32
   3. Which Clustering Algorithm to Choose, 37
      3.1 Partitioning Methods, 38
      3.2 Hierarchical Methods, 44
   4. A Schematic Overview of Our Programs, 50
   5. Computing Dissimilarities with the Program DAISY, 52
      Exercises and Problems, 63

2. Partitioning Around Medoids (Program PAM) 68
   1. Short Description of the Method, 68
   2. How to Use the Program PAM, 72
      2.1 Interactive Use and Input, 72
      2.2 Output, 80
      2.3 Missing Values, 88
   3. Examples, 92
   *4. More on the Algorithm and the Program, 102
      4.1 Description of the Algorithm, 102
      4.2 Structure of the Program, 104
*5. Related Methods and References, 108
   5.1 The k-Medoid Method and Optimal Plant Location, 108
   5.2 Other Methods Based on the Selection of Representative
       Objects, 110
   5.3 Methods Based on the Construction of Central Points, 111
   5.4 Some Other Nonhierarchical Methods, 116
   5.5 Why Did We Choose the k-Medoid Method?, 117
   5.6 Graphical Displays, 119

Exercises and Problems, 123

3. Clustering Large Applications (Program CLARA) 126
   1. Short Description of the Method, 126
   2. How to Use the Program CLARA, 127
      2.1 Interactive Use and Input, 127
      2.2 Output, 130
      2.3 Missing Values, 134
   3. An Example, 139
*4. More on the Algorithm and the Program, 144
   4.1 Description of the Algorithm, 144
   4.2 Structure of the Program, 146
   4.3 Limitations and Special Messages, 151
   4.4 Modifications and Extensions of CLARA, 153
*5. Related Methods and References, 155
   5.1 Partitioning Methods for Large Data Sets, 155
   5.2 Hierarchical Methods for Large Data Sets, 157
   5.3 Implementing CLARA on a Parallel Computer, 160

Exercises and Problems, 162

4. Fuzzy Analysis (Program FANNY) 164
   1. The Purpose of Fuzzy Clustering, 164
   2. How to Use the Program FANNY, 166
      2.1 Interactive Use and Input, 167
      2.2 Output, 170
   3. Examples, 175
*4. More on the Algorithm and the Program, 182
   4.1 Description of the Algorithm, 182
   4.2 Structure of the Program, 188
5. Related Methods and References, 189
   5.1 Fuzzy k-Means and the MND2 Method, 189
   5.2 Why Did We Choose FANNY?, 191
   5.3 Measuring the Amount of Fuzziness, 191
   5.4 A Graphical Display of Fuzzy Memberships, 195

Exercises and Problems, 197

5. Agglomerative Nesting (Program AGNES)  199
   1. Short Description of the Method, 199
   2. How to Use the Program AGNES, 208
      2.1 Interactive Use and Input, 208
      2.2 Output, 209
   3. Examples, 214
   *4. More on the Algorithm and the Program, 221
      4.1 Description of the Algorithm, 221
      4.2 Structure of the Program, 223
   *5. Related Methods and References, 224
      5.1 Other Agglomerative Clustering Methods, 224
      5.2 Comparing Their Properties, 238
      5.3 Graphical Displays, 243

Exercises and Problems, 250

6. Divisive Analysis (Program DIANA)  253
   1. Short Description of the Method, 253
   2. How to Use the Program DIANA, 259
   3. Examples, 263
   *4. More on the Algorithm and the Program, 271
      4.1 Description of the Algorithm, 271
      4.2 Structure of the Program, 272
   *5. Related Methods and References, 273
      5.1 Variants of the Selected Method, 273
      5.2 Other Divisive Techniques, 275

Exercises and Problems, 277

7. Monothetic Analysis (Program MONA)  280
   1. Short Description of the Method, 280
   2. How to Use the Program MONA, 283
2.1 Interactive Use and Input, 284
2.2 Output, 287
3. Examples, 290
*4. More on the Algorithm and the Program, 298
   4.1 Description of the Algorithm, 298
   4.2 Structure of the Program, 301
*5. Related Methods and References, 304
   5.1 Association Analysis, 304
   5.2 Other Monothetic Divisive Algorithms for Binary Data, 307
   5.3 Some Other Divisive Clustering Methods, 308
Exercises and Problems, 310

APPENDIX

1. Implementation and Structure of the Programs, 312
2. Running the Programs, 313
3. Adapting the Programs to Your Needs, 316
4. The Program CLUSPLOT, 318

References

Author Index

Subject Index