Contents

List of Contributors xi

Foreword, by Joseph B. Kruskal xiii

Preface xv

I
Basic Concepts and Data Bank

1
Introduction 3

1.1 Why Multidimensional Scaling (MDS)? 3
1.2 What MDS Can Do 4
1.3 How MDS Works 6
1.4 How Many Dimensions and What Do They Mean? 10
1.5 How MDS Differs from Factor Analysis 13
1.6 Glossary of MDS Terminology 14
References 17

2
Gathering Data for Multidimensional Scaling Experiments 19

2.1 General Comments 19
2.2 Time Required to Do an Experiment 20
2.3 Presentation of Taste and Smell Stimuli 21

2.4 Recording Similarity Judgments 22
2.5 Order of Stimulus Presentation 24
2.6 Selection of a Stimulus Set 24
2.7 Selection of Subjects 25
2.8 How to Get Subjects to Understand What to Do 27
2.9 Summary 28
References 28

3
Data Bank Used Throughout This Book 29

3.1 Colas 29
3.2 Food Flavors 31
3.3 Strawberry-Flavored Beverages 33
3.4 Taste of Chemicals 40
3.5 Musk Odors 43
3.6 Cigarettes 45
3.7 Odor of Chemicals 49
3.8 Blended Foods 50
References 52
Additional References on Multidimensional Scaling in Chemoreception 52

4
Overview of the Multidimensional Scaling Programs Used in This Book 55

4.1 Basic Data Concepts 56
4.2 Unweighted MDS 59
4.3 Weighted MDS 65
4.4 Additional Data Concepts 73
4.5 Individual Differences 78
4.6 Program Characteristics 82
References 85

II
Methods and Applications

5
How to Use MINISSA 89

5.1 Setting Up a MINISSA MDS Job 89
5.2 Understanding MINISSA Output 91
5.3 Colas 92
5.4 Food Flavors 95
5.5 Strawberry-Flavored Beverages 96
5.6 Taste of Chemicals 97
5.7 Musk Odors 99
5.8 General Comments 100
References 101

6 How to Use POLYCON 103

6.1 Setting Up a POLYCON MDS Job 103
6.2 Understanding POLYCON Output 109
6.3 Colas 113
6.4 Food Flavors 121
6.5 Strawberry-Flavored Beverages 124
6.6 General Comments 125
References 126

7 How to Use KYST-2 127

7.1 Setting Up a KYST MDS Job 127
7.2 Understanding KYST Output 132
7.3 Colas 134
7.4 Food Flavors 138
7.5 Strawberry-Flavored Beverages 140
7.6 General Comments 142

8 How to Use INDSCAL and SINDSCAL 143

8.1 Setting Up an INDSCAL Job 143
8.2 Understanding INDSCAL Output 146
8.3 Colas 149
8.4 Food Flavors 151
8.5 Strawberry-Flavored Beverages 156
8.6 Musk Odors 158
8.7 Cigarettes 159
8.8 Setting Up a SINDSCAL Job 160
8.9 Understanding SINDSCAL Output 163
8.10 Colas by SINDSCAL 163
8.11 General Comments 167
Reference 168

9 How to Use ALSCAL 169

9.1 Setting Up an ALSCAL Job 169
9.2 Understanding ALSCAL Output 174
9.3 Colas 179
9.4 Food Flavors 192
9.5 Strawberry-Flavored Beverages 196
9.6 Odor of Chemicals—WMDS 199
9.7 Musk Odors 201
9.8 General Comments 209
References 209

10
How to Use MULTISCALE 211

10.1 Setting Up a MULTISCALE Job 211
10.2 Understanding MULTISCALE Output 217
10.3 Colas 224
10.4 Food Flavors 229
10.5 Strawberry-Flavored Beverages 233
10.6 General Comments 235

11
Comparison of Programs

11.1 Overview 237
11.2 CMDS by MINISSA, POLYCON, KYST, ALSCAL, and MULTISCALE 238
11.3 RMDS by POLYCON, KYST. ALSCAL, and MULTISCALE 239
11.4 WMDS by INDSCAL, ALSCAL, and MULTISCALE 241
11.5 Summary 251

12
Interpreting Stimulus Spaces 253

12.1 Overview 253
12.2 Preference and Property Models 254
12.3 PREFMAP 266
12.4 Canonical Regression 282
References 297

13
Interpreting Subject Spaces 299

13.1 Mean and Variation 301
13.2 Analysis of Angular Variation (ANAVA) 306
13.3 Scaling Subjects 309
Appendix A: Subject Statistics Program Listing 314
References 319

14
Treating Rectangular Matrices by Multidimensional Scaling 321

14.1 Overview 321
14.2 Blended Foods—Transformation of a Rectangular Matrix 322
14.3 Taste of Chemicals 325
14.4 Color Vision Data 328
14.5 Mathematical Description of the Schiffman–Falkenberg Procedure 330
References 333

15
Use of Multidimensional Scaling in Product Development 335

15.1 Overview 335
15.2 Case Study 1: Raspberry-Flavored Liqueurs 337
15.3 Case Study 2: Comparison of Taste Images and Taste Experiences 341
15.4 Summary 343

III
Theory

16
How Multidimensional Scaling Programs Work 347

16.1 Overview 347
16.2 ALSCAL 348
FORREST W. YOUNG
16.3 KYST and POLYCON 358
FORREST W. YOUNG
16.4 MINISSA 362
EDWARD E. ROSKAM
JAMES C. LINGOES
16.5 INDSCAL 371
J. DOUGLAS CARROLL
16.6 MULTISCALE 389
JAMES O. RAMSAY
References 402

Appendix 407

Index 409