

# Contents



<b>INTRODUCTION .....</b>	<b>1</b>
FEATURES .....	2
NEW FEATURES ADDED IN AMOS 4.0 .....	3
<i>Improvements to the interface</i> .....	3
<i>Additional analyses</i> .....	5
<i>Programmability</i> .....	5
OTHER SOURCES OF INFORMATION .....	5
ACKNOWLEDGMENTS .....	6
A NOTE FROM THE AUTHOR OF AMOS .....	7
<b>OVERVIEW OF AMOS 4.0 .....</b>	<b>9</b>
ABOUT THE AMOS DOCUMENTATION .....	9
STARTING AMOS 4.0 .....	10
<b>TUTORIAL: GET RUNNING WITH AMOS GRAPHICS.....</b>	<b>13</b>
<i>Purpose</i> .....	13
<i>Prerequisites</i> .....	14
<i>The data</i> .....	14
<i>Starting Amos Graphics</i> .....	15
<i>Attaching the data</i> .....	18
<i>Reading data from an SPSS system file</i> .....	19
<i>Specifying the model and drawing variables</i> .....	20
<i>Naming the variables</i> .....	22
<i>Drawing arrows</i> .....	23
<i>Constraining a parameter</i> .....	24
<i>Improving the appearance of the path diagram</i> .....	25
<i>Performing the analysis</i> .....	27
<i>Viewing the text output</i> .....	29

<i>Viewing the table (spreadsheet) output</i>	30
<i>Viewing the graphics output</i>	32
<i>Printing the path diagram</i>	33
<i>Copying the path diagram</i>	34
<b>TUTORIAL: LEARNING TO WRITE IN AMOS BASIC</b>	<b>35</b>
<i>Purpose</i>	35
<i>Prerequisites</i>	36
<i>Data and model</i>	36
<i>Specifying the model</i>	37
<i>Reading data from an SPSS system file</i>	39
<i>Optional output</i>	42
<i>Print functions</i>	42
<i>Copy functions</i>	43
<b>TUTORIAL: LEARNING TO PROGRAM AMOS WITH VISUAL BASIC</b>	<b>45</b>
<i>Purpose</i>	45
<i>Beyond the basics</i>	58
<b>WORKED EXAMPLES</b>	<b>59</b>
EXAMPLE 1: ESTIMATING VARIANCES AND COVARIANCE	61
<i>Purpose</i>	61
<i>The data</i>	61
<i>Analyzing the data</i>	65
<i>Optional output</i>	76
<i>Technical note: Distribution assumptions for Amos models</i>	78
EXAMPLE 2: TESTING HYPOTHESES	81
<i>Purpose</i>	81
<i>Data</i>	81
<i>Placing constraints on parameters</i>	82
EXAMPLE 3: MORE HYPOTHESIS TESTING	99
<i>Purpose</i>	99
<i>The data</i>	99
<i>Testing a hypothesis that two variables are uncorrelated</i>	100
<i>Results of the analysis</i>	103
EXAMPLE 4: CONVENTIONAL LINEAR REGRESSION	107
<i>Purpose</i>	107
<i>The data</i>	107
<i>Analysis of the data</i>	108
<i>Results of the analysis</i>	117
EXAMPLE 5: UNOBSERVED VARIABLES	123
<i>Purpose</i>	123
<i>The data</i>	123
<i>Model A</i>	125
<i>Identification</i>	127
<i>Results for Model A</i>	134

<i>Model B</i> .....	136
<i>Results for Model B</i> .....	138
<i>Testing Model B against Model A</i> .....	140
<b>EXAMPLE 6: EXPLORATORY ANALYSIS</b> .....	143
<i>Purpose</i> .....	143
<i>The data</i> .....	143
<i>Model A for the Wheaton data</i> .....	144
<i>Output from the analysis of Model A</i> .....	147
<i>Model B for the Wheaton data</i> .....	150
<i>Analysis of Model B</i> .....	150
<i>Misuse of modification indices</i> .....	153
<i>Improving a model by adding new constraints</i> .....	153
<i>Model C for the Wheaton data</i> .....	157
<i>Output from the analysis of Model C</i> .....	159
<i>Parameter estimates for Model C</i> .....	160
<i>Multiple models in a single file</i> .....	160
<i>Output from multiple models</i> .....	166
<i>Other optional output</i> .....	169
<b>EXAMPLE 7: A NONRECURSIVE MODEL</b> .....	173
<i>Purpose</i> .....	173
<i>The data</i> .....	173
<i>Felson and Bohrnstedt's model</i> .....	174
<i>Output from the analysis</i> .....	179
<i>Stability index</i> .....	182
<b>EXAMPLE 8: FACTOR ANALYSIS</b> .....	185
<i>Purpose</i> .....	185
<i>The data</i> .....	185
<i>A common factor model</i> .....	186
<i>Identification</i> .....	187
<i>Model input</i> .....	188
<i>Results of the analysis</i> .....	190
<b>EXAMPLE 9: AN ALTERNATIVE TO ANALYSIS OF COVARIANCE</b> .....	195
<i>Purpose</i> .....	195
<i>Introduction</i> .....	195
<i>The data</i> .....	196
<i>Analysis of covariance</i> .....	197
<i>Model A for the Olsson data</i> .....	198
<i>Testing Model A</i> .....	199
<i>Model B for the Olsson data</i> .....	201
<i>Results for Model B</i> .....	202
<i>Model C for the Olsson data</i> .....	203
<i>Results for Model C</i> .....	207
<b>EXAMPLE 10: SIMULTANEOUS ANALYSIS OF SEVERAL GROUPS</b> .....	209
<i>Purpose</i> .....	209
<i>Introduction</i> .....	209
<i>The data</i> .....	210

<i>Model A</i> .....	210
<i>Output from Model A</i> .....	215
<i>Model B</i> .....	216
<i>Output from Model B</i> .....	222
EXAMPLE 11: FELSON AND BOHRNSTEDT'S GIRLS AND BOYS .....	225
<i>Purpose</i> .....	225
<i>Introduction</i> .....	225
<i>The data</i> .....	226
<i>Model A for girls and boys</i> .....	226
<i>Output from Model A</i> .....	230
<i>Model B for girls and boys</i> .....	233
<i>Output from Model B</i> .....	241
<i>Model C for girls and boys</i> .....	244
<i>Results for Model C</i> .....	249
EXAMPLE 12: SIMULTANEOUS FACTOR ANALYSIS FOR SEVERAL GROUPS.....	251
<i>Purpose</i> .....	251
<i>The data</i> .....	251
<i>Model A for the Holzinger and Swineford boys and girls</i> .....	252
<i>Results for Model A</i> .....	255
<i>Model B for the Holzinger and Swineford boys and girls</i> .....	257
<i>Results for Model B</i> .....	260
EXAMPLE 13: ESTIMATING AND TESTING HYPOTHESES ABOUT MEANS .....	265
<i>Purpose</i> .....	265
<i>Introduction</i> .....	265
<i>The data</i> .....	266
<i>Model A for young and old subjects</i> .....	266
<i>Output for Model A</i> .....	270
<i>Model B for young and old subjects</i> .....	272
<i>Results for Model B</i> .....	276
<i>Comparison of Model B with Model A</i> .....	276
EXAMPLE 14: REGRESSION WITH AN EXPLICIT INTERCEPT .....	279
<i>Purpose</i> .....	279
<i>Introduction</i> .....	279
<i>The data</i> .....	280
<i>Input file for the regression analysis</i> .....	281
<i>Results of the regression analysis</i> .....	284
EXAMPLE 15: FACTOR ANALYSIS WITH STRUCTURED MEANS .....	289
<i>Purpose</i> .....	289
<i>Introduction</i> .....	289
<i>The data</i> .....	290
<i>Model A for boys and girls</i> .....	290
<i>Results for Model A</i> .....	294
<i>Model B for boys and girls</i> .....	297
<i>Results for Model B</i> .....	299
EXAMPLE 16: SÖRBOM'S ALTERNATIVE TO ANALYSIS OF COVARIANCE .....	301
<i>Purpose</i> .....	301

<i>Introduction</i> .....	301
<i>The data</i> .....	302
<i>Model A</i> .....	304
<i>Results for Model A</i> .....	306
<i>Model B</i> .....	308
<i>Results for Model B</i> .....	311
<i>Model C</i> .....	312
<i>Results for Model C</i> .....	314
<i>Model D</i> .....	316
<i>Results for Model D</i> .....	318
<i>Model E</i> .....	319
<i>Results for Model E</i> .....	321
<i>Comparison of Sörbom's method with the method of Example 9</i> .....	323
<i>Model X</i> .....	323
<i>Results for Model X</i> .....	325
<i>Model Y</i> .....	326
<i>Results for Model Y</i> .....	328
<i>Model Z</i> .....	330
<i>Results for Model Z</i> .....	330
<b>EXAMPLE 17: MISSING DATA</b> .....	331
<i>Purpose</i> .....	331
<i>Introduction</i> .....	331
<i>The data</i> .....	333
<i>Modeling in Amos Graphics</i> .....	335
<i>Modeling in Amos Basic</i> .....	338
<b>EXAMPLE 18: MORE ABOUT MISSING DATA</b> .....	349
<i>Purpose</i> .....	349
<i>Introduction</i> .....	349
<i>The data</i> .....	350
<i>Model A</i> .....	352
<i>Output from Model A</i> .....	354
<i>Model B</i> .....	357
<i>Output from Model B</i> .....	358
<b>EXAMPLE 19: BOOTSTRAPPING</b> .....	359
<i>Purpose</i> .....	359
<i>Introduction</i> .....	359
<i>The data</i> .....	360
<i>A factor analysis model</i> .....	361
<i>Speed of the analysis</i> .....	363
<i>Results of the analysis</i> .....	364
<b>EXAMPLE 20: BOOTSTRAPPING FOR MODEL COMPARISON</b> .....	369
<i>Purpose</i> .....	369
<i>Introduction</i> .....	369
<i>The data</i> .....	370
<i>Five models</i> .....	370
<i>Text output</i> .....	376

<i>Summary</i> .....	378
EXAMPLE 21: BOOTSTRAPPING TO COMPARE ESTIMATION METHODS.....	379
<i>Purpose</i> .....	379
<i>Introduction</i> .....	379
<i>The data</i> .....	380
<i>The model</i> .....	380
<i>Text output</i> .....	384
<b>APPENDICES.....</b>	<b>387</b>
APPENDIX A: NOTATION .....	389
APPENDIX B: DISCREPANCY FUNCTIONS .....	391
APPENDIX C: MEASURES OF FIT.....	395
<i>Measures of parsimony</i> .....	396
<i>The minimum sample discrepancy function</i> .....	398
<i>Measures based on the population discrepancy</i> .....	401
<i>Information-theoretic measures</i> .....	404
<i>Comparisons to a baseline model</i> .....	407
<i>Parsimony adjusted measures</i> .....	411
<i>GFI and related measures</i> .....	412
<i>Miscellaneous measures</i> .....	414
<i>Selected list of fit measures</i> .....	416
APPENDIX D: NUMERICAL DIAGNOSIS OF NONIDENTIFIABILITY .....	417
<b>BIBLIOGRAPHY .....</b>	<b>419</b>
<b>INDEX .....</b>	<b>429</b>