

Contents

PART I

1	A Framework for Investigating Change over Time	3
1.1	<i>When Might You Study Change over Time?</i>	4
1.2	<i>Distinguishing Between Two Types of Questions about Change</i>	7
1.3	<i>Three Important Features of a Study of Change</i>	9
2	Exploring Longitudinal Data on Change	16
2.1	<i>Creating a Longitudinal Data Set</i>	17
2.2	<i>Descriptive Analysis of Individual Change over Time</i>	23
2.3	<i>Exploring Differences in Change across People</i>	33
2.4	<i>Improving the Precision and Reliability of OLS-Estimated Rates of Change: Lessons for Research Design</i>	41
3	Introducing the Multilevel Model for Change	45
3.1	<i>What Is the Purpose of the Multilevel Model for Change?</i>	46
3.2	<i>The Level-1 Submodel for Individual Change</i>	49
3.3	<i>The Level-2 Submodel for Systematic Interindividual Differences in Change</i>	57
3.4	<i>Fitting the Multilevel Model for Change to Data</i>	63
3.5	<i>Examining Estimated Fixed Effects</i>	68
3.6	<i>Examining Estimated Variance Components</i>	72
4	Doing Data Analysis with the Multilevel Model for Change	75
4.1	<i>Example: Changes in Adolescent Alcohol Use</i>	76
4.2	<i>The Composite Specification of the Multilevel Model for Change</i>	80
4.3	<i>Methods of Estimation, Revisited</i>	85
4.4	<i>First Steps: Fitting Two Unconditional Multilevel Models for Change</i>	92

4.5	<i>Practical Data Analytic Strategies for Model Building</i>	104
4.6	<i>Comparing Models Using Deviance Statistics</i>	116
4.7	<i>Using Wald Statistics to Test Composite Hypotheses About Fixed Effects</i>	122
4.8	<i>Evaluating the Tenability of a Model's Assumptions</i>	127
4.9	<i>Model-Based (Empirical Bayes) Estimates of the Individual Growth Parameters</i>	132
5	<i>Treating TIME More Flexibly</i>	138
5.1	<i>Variably Spaced Measurement Occasions</i>	139
5.2	<i>Varying Numbers of Measurement Occasions</i>	146
5.3	<i>Time-Varying Predictors</i>	159
5.4	<i>Recentering the Effect of TIME</i>	181
6	<i>Modeling Discontinuous and Nonlinear Change</i>	189
6.1	<i>Discontinuous Individual Change</i>	190
6.2	<i>Using Transformations to Model Nonlinear Individual Change</i>	208
6.3	<i>Representing Individual Change Using a Polynomial Function of TIME</i>	213
6.4	<i>Truly Nonlinear Trajectories</i>	223
7	<i>Examining the Multilevel Model's Error Covariance Structure</i>	243
7.1	<i>The "Standard" Specification of the Multilevel Model for Change</i>	243
7.2	<i>Using the Composite Model to Understand Assumptions about the Error Covariance Matrix</i>	246
7.3	<i>Postulating an Alternative Error Covariance Structure</i>	256
8	<i>Modeling Change Using Covariance Structure Analysis</i>	266
8.1	<i>The General Covariance Structure Model</i>	266
8.2	<i>The Basics of Latent Growth Modeling</i>	280
8.3	<i>Cross-Domain Analysis of Change</i>	295
8.4	<i>Extensions of Latent Growth Modeling</i>	299
PART II		
9	<i>A Framework for Investigating Event Occurrence</i>	305
9.1	<i>Should You Conduct a Survival Analysis? The "Whether" and "When" Test</i>	306
9.2	<i>Framing a Research Question About Event Occurrence</i>	309
9.3	<i>Censoring: How Complete Are the Data on Event Occurrence?</i>	315
10	<i>Describing Discrete-Time Event Occurrence Data</i>	325
10.1	<i>The Life Table</i>	326
10.2	<i>A Framework for Characterizing the Distribution of Discrete-Time Event Occurrence Data</i>	330
10.3	<i>Developing Intuition About Hazard Functions, Survivor Functions, and Median Lifetimes</i>	339

10.4	<i>Quantifying the Effects of Sampling Variation</i>	348
10.5	<i>A Simple and Useful Strategy for Constructing the Life Table</i>	351
11	Fitting Basic Discrete-Time Hazard Models	357
11.1	<i>Toward a Statistical Model for Discrete-Time Hazard</i>	358
11.2	<i>A Formal Representation of the Population Discrete-Time Hazard Model</i>	369
11.3	<i>Fitting a Discrete-Time Hazard Model to Data</i>	378
11.4	<i>Interpreting Parameter Estimates</i>	386
11.5	<i>Displaying Fitted Hazard and Survivor Functions</i>	391
11.6	<i>Comparing Models Using Deviance Statistics and Information Criteria</i>	397
11.7	<i>Statistical Inference Using Asymptotic Standard Errors</i>	402
12	Extending the Discrete-Time Hazard Model	407
12.1	<i>Alternative Specifications for the “Main Effect of TIME”</i>	408
12.2	<i>Using the Complementary Log-Log Link to Specify a Discrete-Time Hazard Model</i>	419
12.3	<i>Time-Varying Predictors</i>	426
12.4	<i>The Linear Additivity Assumption: Uncovering Violations and Simple Solutions</i>	443
12.5	<i>The Proportionality Assumption: Uncovering Violations and Simple Solutions</i>	451
12.6	<i>The No Unobserved Heterogeneity Assumption: No Simple Solution</i>	461
12.7	<i>Residual Analysis</i>	463
13	Describing Continuous-Time Event Occurrence Data	468
13.1	<i>A Framework for Characterizing the Distribution of Continuous-Time Event Data</i>	469
13.2	<i>Grouped Methods for Estimating Continuous-Time Survivor and Hazard Functions</i>	475
13.3	<i>The Kaplan-Meier Method of Estimating the Continuous-Time Survivor Function</i>	483
13.4	<i>The Cumulative Hazard Function</i>	488
13.5	<i>Kernel-Smoothed Estimates of the Hazard Function</i>	494
13.6	<i>Developing an Intuition about Continuous-Time Survivor, Cumulative Hazard, and Kernel-Smoothed Hazard Functions</i>	497
14	Fitting Cox Regression Models	503
14.1	<i>Toward a Statistical Model for Continuous-Time Hazard</i>	503
14.2	<i>Fitting the Cox Regression Model to Data</i>	516
14.3	<i>Interpreting the Results of Fitting the Cox Regression Model to Data</i>	523
14.4	<i>Nonparametric Strategies for Displaying the Results of Model Fitting</i>	535

15 Extending the Cox Regression Model	543
15.1 <i>Time-Varying Predictors</i>	544
15.2 <i>Nonproportional Hazards Models via Stratification</i>	556
15.3 <i>Nonproportional Hazards Models via Interactions with Time</i>	562
15.4 <i>Regression Diagnostics</i>	570
15.5 <i>Competing Risks</i>	586
× 15.6 <i>Late Entry into the Risk Set</i>	595
Notes	607
References	613
Index	627