

Paul R. Rosenbaum

Observational Studies

With 14 Illustrations



Springer-Verlag

New York Berlin Heidelberg London Paris
Tokyo Hong Kong Barcelona Budapest

Contents

Preface	vii
List of Examples	xv
CHAPTER 1	
Observational Studies	1
1.1. What Are Observational Studies?	1
1.2. Some Observational Studies	2
1.3. Purpose of This Book	9
1.4. Bibliographic Notes	10
Some Books and a Few Papers	11
References	12
CHAPTER 2	
Randomized Experiments	13
2.1. Introduction and Example: A Randomized Clinical Trial	13
2.2. The Lady Tasting Tea	15
2.3. Randomized Experiments	17
2.4. Testing the Hypothesis of No Treatment Effect	21
2.5. Models for Treatment Effects	32
2.6. Confidence Intervals	35
2.7. Point Estimates	37
*2.8. More Complex Outcomes	40
*2.9. Appendix: Order-Preserving Tests Under Alternatives	45
*2.10. Appendix: The Set of Treatment Assignments	46

* An asterisk indicates either an appendix of a section that has a footnote indicating that the section may be skipped without loss of continuity or deferred. The material in these sections is either a little more technical or a little more specialized or both. See the Preface, §2.

2.11. Bibliographic Notes	53
2.12. Problems	54
References	56
CHAPTER 3	
Overt Bias in Observational Studies	59
3.1. Introduction: An Example and Planning Adjustments	59
3.2. Adjustments by Exact Stratification and Matching	65
3.3. Case-Referent Studies	70
*3.4. Inexact Matching Followed by Stratification	73
*3.5. Small Sample Inference with an Unknown Propensity Score	79
3.6. Bibliographic Notes	82
3.7. Problems	83
References	84
CHAPTER 4	
Sensitivity to Hidden Bias	87
4.1. What Is a Sensitivity Analysis?	87
4.2. A Model for Sensitivity Analysis	88
4.3. Matched Pairs	92
4.4. Sensitivity Analysis for Sign-Score Statistics	101
4.5. Sensitivity Analysis for Comparing Two Unmatched Groups	115
*4.6. Appendix: Technical Results and Proofs	125
4.7. Bibliographic Notes	132
4.8. Problems	132
References	133
CHAPTER 5	
Known Effects	136
5.1. Detecting Hidden Bias Using Known Effects	136
5.2. An Outcome Known to Be Unaffected by the Treatment	142
5.3. An Outcome for Which the Direction of the Effect Is Known	149
5.4. Appendix: The Behavior of T^ with Nonnegative Effects	150
5.5. Bibliographic Notes	151
5.6. Problems	151
References	152
CHAPTER 6	
Multiple Reference Groups in Case-Referent Studies	154
6.1. Multiple Reference Groups	154
6.2. Matched Studies with Two Referent Groups	160
*6.3. Appendix: Selection and Hidden Bias	167
*6.4. Appendix: Derivation of Bounds for Sensitivity Analysis	169
6.5. Bibliographic Notes	171
6.6. Problems	171
References	172

CHAPTER 7

Multiple Control Groups	174
7.1. The Role of a Second Control Group	174
7.2. Comparing Outcomes in Two Control Groups	179
7.3. Bibliographic Notes	183
7.4. Problems	183
References	185

CHAPTER 8

Coherence and Focused Hypotheses	187
8.1. Coherent Associations	187
8.2. Sensitivity of a Test for a Coherent Association	192
*8.3. Appendix: Arrangement-Increasing Functions of Matrices	195
8.4. Bibliographic Notes	197
8.5. Problems	197
References	198

CHAPTER 9

Constructing Matched Sets and Strata	200
9.1. Introduction: Propensity Scores, the Form of Optimal Strata, the Construction of Optimal Matched Samples	200
9.2. The Propensity Score	201
9.3. Optimal Strata	205
9.4. Optimal Matching	211
9.5. Bibliographic Notes	221
9.6. Problems	222
References	223

CHAPTER 10

Some Strategic Issues	225
10.1. What Are Strategic Issues?	225
10.2. Strategic Issues in Observational Studies: Some Specific Suggestions	226
References	227

Index	229
-------	-----