
Contents

1	Introduction	1
1.1	About Causality and This Book	1
1.2	Overview of Topics	3
2	Causality and No Causality	11
2.1	Potential Outcomes, Causal Effects, and the Stable Unit Treatment Value Assumption	11
2.2	Treatment Selection Bias	14
3	Social Experiments and Linear Regression	19
3.1	Social Experiments	19
3.2	Effect Identification by Linear Regression	22
3.3	Estimation by Linear Regression and Its Properties	26
3.4	Variance Estimation, Inference, and Goodness of Fit	35
3.5	Extensions to Multiple or Continuous Treatments	49
3.6	Including Covariates	58
4	Selection on Observables	65
4.1	Identification under Selection on Observables	65
4.2	Linear, Series, and Kernel Regression	70
4.3	Covariate Matching	80
4.4	Propensity Score Matching	88
4.5	Inverse Probability Weighting, Empirical Likelihood, and Entropy Balancing	94
4.6	Doubly Robust Methods	99
4.7	Practical Issues: Common Support and Match Quality	102
4.8	Multivalued or Continuous Treatments and Distributional Effects	113
4.9	Dynamic Treatment Effects	120

4.10	Causal Mechanisms (Mediation Analysis)	126
4.11	Outcome Attrition and Posttreatment Sample Selection	133
5	Causal Machine Learning	137
5.1	Motivation for Machine Learning and Fields of Application	137
5.2	Double Machine Learning and Partialling out with Lasso Regression	138
5.3	A Survey of Further Machine Learning Algorithms	145
5.4	Effect Heterogeneity	151
5.5	Optimal Policy Learning	159
5.6	Reinforcement Learning	163
6	Instrumental Variables	169
6.1	Evaluation of the Local Average Treatment Effect	169
6.2	Instrumental Variable Methods with Covariates	177
6.3	Nonbinary Instruments and Treatments	184
6.4	Sample Selection, Dynamic and Multiple Treatments, and Causal Mechanisms	189
7	Difference-in-Differences	195
7.1	Difference-in-Differences without Covariates	195
7.2	Difference-in-Differences with Covariates	203
7.3	Multiple Periods of Treatment Introduction	207
7.4	Changes-in-Changes	213
8	Synthetic Controls	219
8.1	Estimation and Inference with a Single Treated Unit	219
8.2	Alternative Estimators and Multiple Treated Units	225
9	Regression Discontinuity, Kink, and Bunching Designs	231
9.1	Sharp and Fuzzy Regression Discontinuity Designs	231
9.2	Sharp and Fuzzy Regression Kink Designs	243
9.3	Bunching Designs	248
10	Partial Identification and Sensitivity Analysis	255
10.1	Partial Identification	255
10.2	Sensitivity Analysis	264

11	Treatment Evaluation under Interference Effects	271
11.1	Failure of the Stable Unit Treatment Value Assumption	271
11.2	Partial Interference	272
11.3	Interference Based on Exposure Mappings	281
12	Conclusion	285
	References	287
	Index	311