

# CONTENTS

<b>Acknowledgments</b>	<b>ix</b>
<b>1. Introduction</b>	<b>1</b>
1.1 Can You Repeat That Please?	2
1.2 Simulation and Resampling Methods	4
1.2.1 Simulations as Experiments	4
1.2.2 Simulations Help Develop Intuition	5
1.2.3 An Overview of Simulation	6
1.2.4 Resampling Methods as Simulation	7
1.3 OLS as a Motivating Example	8
1.4 Two Brief Examples	12
1.4.1 Example 1: A Statistical Simulation	13
1.4.2 Example 2: A Substantive Theory Simulation	15
1.5 Looking Ahead	15
1.5.1 Assumed Knowledge	16
1.5.2 A Preview of the Book	16
1.6 R Packages	17
<b>2. Probability</b>	<b>19</b>
2.1 Introduction	19
2.2 Some Basic Rules of Probability	20
2.2.1 Introduction to Set Theory	20
2.2.2 Properties of Probability	22
2.2.3 Conditional Probability	22
2.2.4 Simple Math With Probabilities	23
2.3 Random Variables and Probability Distributions	24
2.4 Discrete Random Variables	29
2.4.1 Some Common Discrete Distributions	30
2.5 Continuous Random Variables	33
2.5.1 Two Common Continuous Distributions	36
2.5.2 Other Continuous Distributions	39
2.6 Conclusions	43
<b>3. Introduction to R</b>	<b>45</b>
3.1 Introduction	45
3.2 What Is R?	45
3.2.1 Resources	46
3.3 Using R With a Text Editor	46

3.4	First Steps	47
3.4.1	Creating Objects	47
3.5	Basic Manipulation of Objects	48
3.5.1	Vectors and Sequences	48
3.5.2	Matrices	49
3.6	Functions	50
3.6.1	Matrix Algebra Functions	51
3.6.2	Creating New Functions	51
3.7	Working With Data	52
3.7.1	Loading Data	52
3.7.2	Exploring the Data	53
3.7.3	Statistical Models	54
3.7.4	Generalized Linear Models	57
3.8	Basic Graphics	59
3.9	Conclusions	61
<b>4.</b>	<b>Random Number Generation</b>	<b>63</b>
4.1	Introduction	63
4.2	Probability Distributions	63
4.2.1	Drawing Random Numbers	65
4.2.2	Creating Your Own Distribution Functions	67
4.3	Systematic and Stochastic	68
4.3.1	The Systematic Component	69
4.3.2	The Stochastic Component	70
4.3.3	Repeating the Process	71
4.4	Programming in R	72
4.4.1	for Loops	73
4.4.2	Efficient Programming	74
4.4.3	If-Else	76
4.5	Completing the OLS Simulation	77
4.5.1	Anatomy of a Script File	80
<b>5.</b>	<b>Statistical Simulation of the Linear Model</b>	<b>83</b>
5.1	Introduction	83
5.2	Evaluating Statistical Estimators	84
5.2.1	Bias, Efficiency, and Consistency	84
5.2.2	Measuring Estimator Performance in R	87
5.3	Simulations as Experiments	96
5.3.1	Heteroskedasticity	96
5.3.2	Multicollinearity	103
5.3.3	Measurement Error	105
5.3.4	Omitted Variable	109
5.3.5	Serial Correlation	112
5.3.6	Clustered Data	114
5.3.7	Heavy-Tailed Errors	118
5.4	Conclusions	125



<b>6. Simulating Generalized Linear Models</b>	<b>127</b>
6.1 Introduction	127
6.2 Simulating OLS as a Probability Model	128
6.3 Simulating GLMs	130
6.3.1 Binary Models	130
6.3.2 Ordered Models	135
6.3.3 Multinomial Models	141
6.4 Extended Examples	145
6.4.1 Ordered or Multinomial?	145
6.4.2 Count Models	150
6.4.3 Duration Models	157
6.5 Computational Issues for Simulations	162
6.5.1 Research Computing	162
6.5.2 Parallel Processing	163
6.6 Conclusions	167
<b>7. Testing Theory Using Simulation</b>	<b>169</b>
7.1 Introduction	169
7.2 What Is a Theory?	169
7.3 Zipf's Law	171
7.3.1 Testing Zipf's Law With <i>Frankenstein</i>	171
7.3.2 From Patterns to Explanations	174
7.4 Punctuated Equilibrium and Policy Responsiveness	181
7.4.1 Testing Punctuated Equilibrium Theory	183
7.4.2 From Patterns to Explanations	185
7.5 Dynamic Learning	190
7.5.1 Reward and Punishment	193
7.5.2 Damned If You Do, Damned If You Don't	195
7.5.3 The Midas Touch	197
7.6 Conclusions	200
<b>8. Resampling Methods</b>	<b>201</b>
8.1 Introduction	201
8.2 Permutation and Randomization Tests	202
8.2.1 A Basic Permutation Test	203
8.2.2 Randomization Tests	205
8.2.3 Permutation/Randomization and Multiple Regression Models	208
8.3 Jackknifing	209
8.3.1 An Example	210
8.3.2 An Application: Simulating Heteroskedasticity	213
8.3.3 Pros and Cons of Jackknifing	214
8.4 Bootstrapping	215
8.4.1 Bootstrapping Basics	217
8.4.2 Bootstrapping With Multiple Regression Models	220
8.4.3 Adding Complexity: Clustered Bootstrapping	225
8.5 Conclusions	228

<b>9. Other Simulation-Based Methods</b>	<b>231</b>
9.1 Introduction	231
9.2 QI Simulation	232
9.2.1 Statistical Overview	232
9.2.2 Examples	235
9.2.3 Simulating QI With <code>zelig</code>	245
9.2.4 Average Case Versus Observed Values	249
9.2.5 The Benefits of QI Simulation	254
9.3 Cross-Validation	255
9.3.1 How CV Can Help	257
9.3.2 An Example	258
9.3.3 Using R Functions for CV	266
9.4 Conclusions	267
<b>10. Final Thoughts</b>	<b>269</b>
10.1 A Summary of the Book	270
10.2 Going Forward	271
10.3 Conclusions	272
<b>References</b>	<b>275</b>
<b>Index</b>	<b>283</b>