

Contents

Preface	1	1.5.2. Continuous Distributions: Histogram and Density	37
1. Introduction	3	1.5.3. Empirical Cumulative Distribution Function (ECDF)	38
1.1. Getting Started	3	1.5.4. Fundamental Statistics	40
1.1.1. Software	3	1.6. Probability Distributions	41
1.1.2. R Scripts	4	1.6.1. Discrete Distributions	41
1.1.3. Packages	7	1.6.2. Continuous Distributions	43
1.1.4. File names and the Working Directory	8	1.6.3. Cumulative Distribution Function (CDF)	44
1.1.5. Errors and Warnings	9	1.6.4. Random Draws from Probability Distributions	45
1.1.6. Other Resources	9	1.7. Confidence Intervals and Statistical Inference	47
1.2. Objects in R	10	1.7.1. Confidence Intervals	47
1.2.1. Basic Calculations and Objects	10	1.7.2. <i>t</i> Tests	50
1.2.2. Vectors	12	1.7.3. <i>p</i> Values	51
1.2.3. Special Types of Vectors . .	14	1.7.4. Automatic calculations	52
1.2.4. Naming and Indexing Vectors	15	1.8. Advanced R	56
1.2.5. Matrices	16	1.8.1. Conditional Execution	56
1.2.6. Lists	19	1.8.2. Loops	56
1.3. Data Frames and Data Files	20	1.8.3. Functions	57
1.3.1. Data Frames	20	1.8.4. Outlook	57
1.3.2. Subsets of Data	21	1.9. Monte Carlo Simulation	58
1.3.3. R Data Files	22	1.9.1. Finite Sample Properties of Estimators	58
1.3.4. Basic Information on a Data Set	22	1.9.2. Asymptotic Properties of Estimators	61
1.3.5. Import and Export of Text Files	23	1.9.3. Simulation of Confidence Intervals and <i>t</i> Tests	64
1.3.6. Import and Export of Other Data Formats	24	I. Regression Analysis with Cross-Sectional Data	67
1.3.7. Data Sets in the Examples .	25	2. The Simple Regression Model	69
1.4. Graphics	26	2.1. Simple OLS Regression	69
1.4.1. Basic Graphs	26	2.2. Coefficients, Fitted Values, and Residuals	74
1.4.2. Customizing Graphs with Options	28	2.3. Goodness of Fit	77
1.4.3. Overlaying Several Plots .	29	2.4. Nonlinearities	79
1.4.4. Legends	30	2.5. Regression through the Origin and Regression on a Constant	80
1.4.5. Exporting to a File	32	2.6. Expected Values, Variances, and Standard Errors	82
1.4.6. Advanced Graphs	33	2.7. Monte Carlo Simulations	84
1.5. Descriptive Statistics	34	2.7.1. One sample	84
1.5.1. Discrete Distributions: Frequencies and Contingency Tables	34	2.7.2. Many Samples	86

2.7.3. Violation of SLR.4	89	7. Multiple Regression Analysis with Qualitative Regressors	135
2.7.4. Violation of SLR.5	89	7.1. Linear Regression with Dummy Variables as Regressors	135
3. Multiple Regression Analysis: Estimation	91	7.2. Logical Variables	137
3.1. Multiple Regression in Practice . .	91	7.3. Factor variables	138
3.2. OLS in Matrix Form	95	7.4. Breaking a Numeric Variable Into Categories	139
3.3. Ceteris Paribus Interpretation and Omitted Variable Bias	97	7.5. Interactions and Differences in Regression Functions Across Groups	141
3.4. Standard Errors, Multicollinearity, and VIF	99		
4. Multiple Regression Analysis: Inference	103	8. Heteroscedasticity	143
4.1. The <i>t</i> Test	103	8.1. Heteroscedasticity-Robust Inference	143
4.1.1. General Setup	103	8.2. Heteroscedasticity Tests	147
4.1.2. Standard case	104	8.3. Weighted Least Squares	150
4.1.3. Other hypotheses	106		
4.2. Confidence Intervals	108	9. More on Specification and Data Issues	155
4.3. Linear Restrictions: <i>F</i> -Tests	109	9.1. Functional Form Misspecification .	155
4.4. Reporting Regression Results	113	9.2. Measurement Error	157
5. Multiple Regression Analysis: OLS Asymptotics	115	9.3. Missing Data and Nonrandom Samples	160
5.1. Simulation Exercises	115	9.4. Outlying Observations	163
5.1.1. Normally Distributed Error Terms	115	9.5. Least Absolute Deviations (LAD) Estimation	164
5.1.2. Non-Normal Error Terms	116		
5.1.3. (Not) Conditioning on the Regressors	119		
5.2. LM Test	121		
6. Multiple Regression Analysis: Further Issues	123	II. Regression Analysis with Time Series Data	165
6.1. Model Formulae	123		
6.1.1. Data Scaling: Arithmetic Operations Within a Formula	123	10. Basic Regression Analysis with Time Series Data	167
6.1.2. Standardization: Beta Coefficients	125	10.1. Static Time Series Models	167
6.1.3. Logarithms	126	10.2. Time Series Data Types in R	168
6.1.4. Quadratics and Polynomials	126	10.2.1. Equispaced Time Series in R	168
6.1.5. Interaction Terms	128	10.2.2. Irregular Time Series in R	170
6.2. Prediction	130	10.3. Other Time Series Models	173
6.2.1. Confidence Intervals for Predictions	130	10.3.1. The <i>dynlm</i> Package	173
6.2.2. Prediction Intervals	132	10.3.2. Finite Distributed Lag Models	173
6.2.3. Effect Plots for Nonlinear Specifications	133	10.3.3. Trends	176
		10.3.4. Seasonality	177
11. Further Issues In Using OLS with Time Series Data	179		
11.1. Asymptotics with Time Series	179		
11.2. The Nature of Highly Persistent Time Series	182		
11.3. Differences of Highly Persistent Time Series	185		

11.4. Regression with First Differences	186	
12. Serial Correlation and Heteroscedasticity in Time Series Regressions	187	
12.1. Testing for Serial Correlation of the Error Term	187	
12.2. FGLS Estimation	191	
12.3. Serial Correlation-Robust Inference with OLS	192	
12.4. Autoregressive Conditional Heteroscedasticity	193	
III. Advanced Topics	195	
13. Pooling Cross-Sections Across Time: Simple Panel Data Methods	197	
13.1. Pooled Cross-Sections	197	
13.2. Difference-in-Differences	198	
13.3. Organizing Panel Data	201	
13.4. Panel-specific computations	202	
13.5. First Differenced Estimator	204	
14. Advanced Panel Data Methods	207	
14.1. Fixed Effects Estimation	207	
14.2. Random Effects Models	209	
14.3. Dummy Variable Regression and Correlated Random Effects	212	
14.4. Robust (Clustered) Standard Errors	216	
15. Instrumental Variables Estimation and Two Stage Least Squares	219	
15.1. Instrumental Variables in Simple Regression Models	219	
15.2. More Exogenous Regressors	221	
15.3. Two Stage Least Squares	222	
15.4. Testing for Exogeneity of the Regressors	224	
15.5. Testing Overidentifying Restrictions	225	
15.6. Instrumental Variables with Panel Data	225	
16. Simultaneous Equations Models	229	
16.1. Setup and Notation	229	
16.2. Estimation by 2SLS	230	
16.3. Joint Estimation of System	231	
16.4. Outlook: Estimation by 3SLS	233	
IV. Appendices	281	
R Scripts	283	
1. Scripts Used in Chapter 01	283	
2. Scripts Used in Chapter 02	293	
3. Scripts Used in Chapter 03	299	
4. Scripts Used in Chapter 04	301	
5. Scripts Used in Chapter 05	303	
6. Scripts Used in Chapter 06	305	
17. Limited Dependent Variable Models and Sample Selection Corrections	235	
17.1. Binary Responses	235	
17.1.1. Linear Probability Models	235	
17.1.2. Logit and Probit Models: Estimation	237	
17.1.3. Inference	240	
17.1.4. Predictions	241	
17.1.5. Partial Effects	242	
17.2. Count Data: The Poisson Regression Model	245	
17.3. Corner Solution Responses: The Tobit Model	248	
17.4. Censored and Truncated Regression Models	251	
17.5. Sample Selection Corrections	253	
18. Advanced Time Series Topics	255	
18.1. Infinite Distributed Lag Models	255	
18.2. Testing for Unit Roots	257	
18.3. Spurious Regression	260	
18.4. Cointegration and Error Correction Models	262	
18.5. Forecasting	263	
19. Carrying Out an Empirical Project	267	
19.1. Working with R Scripts	267	
19.2. Logging Output in Text Files	269	
19.3. Formatted Documents and Reports with R Markdown	269	
19.3.1. Basics	269	
19.3.2. Advanced Features	270	
19.3.3. Bottom Line	272	
19.4. Combining R with LaTeX	274	
19.4.1. Automatic Document Generation using Sweave and knitr	274	
19.4.2. Separating R and L ^A T _E X code	278	

7.	Scripts Used in Chapter 07	307
8.	Scripts Used in Chapter 08	309
9.	Scripts Used in Chapter 09	311
10.	Scripts Used in Chapter 10	314
11.	Scripts Used in Chapter 11	316
12.	Scripts Used in Chapter 12	318
13.	Scripts Used in Chapter 13	320
14.	Scripts Used in Chapter 14	322
15.	Scripts Used in Chapter 15	324
16.	Scripts Used in Chapter 16	326
17.	Scripts Used in Chapter 17	326
18.	Scripts Used in Chapter 18	330
19.	Scripts Used in Chapter 19	333
Bibliography		335
List of Wooldridge (2016) examples		337
Index		339