

Contents

Review: Random Variables, Sampling, and Estimation

R.1	Introduction	1
R.2	Discrete random variables and expectations	3
R.3	Continuous random variables	10
R.4	Population covariance, covariance and variance rules, and correlation	14
R.5	Sampling and estimators	18
R.6	Unbiasedness and efficiency	22
R.7	Estimators of variance, covariance, and correlation	28
R.8	Asymptotic properties of estimators	29
	KEY TERMS	38
	Appendix R.1: Σ notation: a review	38
	Appendix R.2: Unbiased estimators of the population covariance and variance	40

1 Simple Regression Analysis

1.1	The simple linear model	43
1.2	Least squares regression	45
1.3	Least squares regression: two examples	48
1.4	Least squares regression with one explanatory variable	51
1.5	Two decompositions of the dependent variable	54
1.6	Interpretation of a regression equation	56
1.7	Goodness of fit: R^2	61
	KEY TERMS	65

2 Properties of the Regression Coefficients and Hypothesis Testing

2.1	Types of data and regression model	67
2.2	Assumptions for regression models with nonstochastic regressors	68
2.3	The random components of the regression coefficients	71
2.4	A Monte Carlo experiment	75
2.5	Unbiasedness of the regression coefficients	80
2.6	Precision of the regression coefficients	82
2.7	The Gauss–Markov theorem	90
2.8	Testing hypotheses relating to the regression coefficients	94
2.9	Confidence intervals	106
2.10	One-sided t tests	109
2.11	The F test of goodness of fit	114
2.12	Relationship between the F test of goodness of fit and the t test on the slope coefficient in simple regression analysis	116
	KEY TERMS	117

3 Multiple Regression Analysis

3.1	Illustration: a model with two explanatory variables	119
3.2	Derivation and interpretation of the multiple regression coefficients	121
3.3	Properties of the multiple regression coefficients	127
3.4	Multicollinearity	133
3.5	Goodness of fit: R^2	143
	KEY TERMS	151

4 Transformations of Variables

4.1	Basic procedure	153
4.2	Logarithmic transformations	156
4.3	The disturbance term	165
4.4	Nonlinear regression	167
4.5	Comparing linear and logarithmic specifications	170
	KEY TERMS	172

5 Dummy Variables

5.1	Illustration of the use of a dummy variable	173
-----	---	-----

5.2	Extension to more than two categories and to multiple sets of dummy variables	179
5.3	Slope dummy variables	189
5.4	The Chow test	194
	KEY TERMS	197
6	Specification of Regression Variables: A Preliminary Skirmish	
6.1	Model specification	199
6.2	The effect of omitting a variable that ought to be included	200
6.3	The effect of including a variable that ought not to be included	208
6.4	Proxy variables	212
6.5	Testing a linear restriction	216
6.6	Getting the most out of your residuals	222
	KEY TERMS	223
7	Heteroscedasticity	
7.1	Heteroscedasticity and its implications	224
7.2	Detection of heteroscedasticity	229
7.3	What can you do about heteroscedasticity?	233
	KEY TERMS	239
8	Stochastic Regressors and Measurement Errors	
8.1	Assumptions for models with stochastic regressors	241
8.2	Finite sample properties of the OLS regression estimators	243
8.3	Asymptotic properties of the OLS regression estimators	245
8.4	The consequences of measurement errors	247
8.5	Friedman's critique of the conventional consumption function	255
8.6	Instrumental variables	259
	KEY TERMS	268
9	Simultaneous Equations Estimation	
9.1	Simultaneous equations models: structural and reduced form equations	269
9.2	Simultaneous equations bias	271

9.3	Instrumental variables estimation	276
	KEY TERMS	288
10	Binary Choice and Limited Dependent Variable Models, and Maximum Likelihood Estimation	
10.1	The linear probability model	291
10.2	Logit analysis	294
10.3	Probit analysis	300
10.4	Censored regressions: tobit analysis	303
10.5	Sample selection bias	308
10.6	An introduction to maximum likelihood estimation	312
	KEY TERMS	321
11	Models Using Time Series Data	
11.1	Static models	323
11.2	Dynamic models	327
11.3	The adaptive expectations model	330
11.4	The partial adjustment model	338
11.5	Prediction	341
11.6	Stability tests	347
	KEY TERMS	349
12	Properties of Regression Models with Time Series Data	
12.1	Assumptions for regressions with time series data	350
12.2	The assumption of the independence of the disturbance term and the regressors	351
12.3	Definition and detection of autocorrelation	354
12.4	What can you do about autocorrelation?	359
12.5	Autocorrelation with a lagged dependent variable	363
12.6	The common factor test	366
12.7	Apparent autocorrelation	372
12.8	Model specification: specific-to-general versus general-to-specific	374
	KEY TERMS	379
	Appendix 12.1: Demonstration that the Durbin–Watson statistic approximates $2 - 2\rho$ in large samples	380

13 Introduction to Nonstationary Time Series

13.1	Stationarity and nonstationarity	381
13.2	Consequences of nonstationarity	387
13.3	Detection of nonstationarity	391
13.4	Cointegration	398
13.5	Fitting models with nonstationary time series	403
13.6	Conclusion	407
	KEY TERMS	407

14 Introduction to Panel Data Models

14.1	Introduction	408
14.2	Fixed effects regressions	412
14.3	Random effects regressions	416
	KEY TERMS	421

<i>Appendix A: Statistical Tables</i>	424
<i>Appendix B: Data Sets</i>	442
<i>Bibliography</i>	451
<i>Author Index</i>	455
<i>Subject Index</i>	456