

Understanding Regression Analysis

Michael Patrick Allen

*Washington State University
Pullman, Washington*

Plenum Press • New York and London

Contents

1	The Origins and Uses of Regression Analysis	1
2	Basic Matrix Algebra: Manipulating Vectors	6
3	The Mean and Variance of a Variable	11
4	Regression Models and Linear Functions	16
5	Errors of Prediction and Least-Squares Estimation	21
6	Least-Squares Regression and Covariance	26
7	Covariance and Linear Independence	31
8	Separating Explained and Error Variance	36
9	Transforming Variables to Standard Form	41
10	Regression Analysis with Standardized Variables	46
11	Populations, Samples, and Sampling Distributions	51
12	Sampling Distributions and Test Statistics	56
13	Testing Hypotheses Using the t Test	61
14	The t Test for the Simple Regression Coefficient	66

15	More Matrix Algebra: Manipulating Matrices	71
16	The Multiple Regression Model	76
17	Normal Equations and Partial Regression Coefficients	81
18	Partial Regression and Residualized Variables	86
19	The Coefficient of Determination in Multiple Regression	91
20	Standard Errors of Partial Regression Coefficients	96
21	The Incremental Contributions of Variables	101
22	Testing Simple Hypotheses Using the F Test	106
23	Testing Compound Hypotheses Using the F Test	109
24	Testing Hypotheses in Nested Regression Models	113
25	Testing for Interaction in Multiple Regression	118
26	Nonlinear Relationships and Variable Transformations	123
27	Regression Analysis with Dummy Variables	128
28	One-Way Analysis of Variance Using the Regression Model	133
29	Two-Way Analysis of Variance Using the Regression Model	138
30	Testing for Interaction in Analysis of Variance	143
31	Analysis of Covariance Using the Regression Model	147

32	Interpreting Interaction in Analysis of Covariance	152
33	Structural Equation Models and Path Analysis	156
34	Computing Direct and Total Effects of Variables	161
35	Model Specification in Regression Analysis	166
36	Influential Cases in Regression Analysis	171
37	The Problem of Multicollinearity	176
38	Assumptions of Ordinary Least-Squares Estimation	181
39	Beyond Ordinary Regression Analysis	186
	Appendix A: Derivation of the Mean and Variance of a Linear Function	191
	Appendix B: Derivation of the Least-Squares Regression Coefficient	195
	Appendix C: Derivation of the Standard Error of the Simple Regression Coefficient	198
	Appendix D: Derivation of the Normal Equations	202
	Appendix E: Statistical Tables	205
	Suggested Readings	210
	Index	213