

Regression Analysis: Concepts and Applications

Franklin A. Graybill

Colorado State University

Hariharan K. Iyer

Colorado State University

An Alexander Kugushev Book



Duxbury Press
An Imprint of Wadsworth Publishing Company
Belmont, California

Contents

Preface ix

CHAPTER 1 Review of Basic Statistical Concepts and Matrices 1

- 1.1 Overview 1
- 1.2 Basic Ingredients for Statistical Inference 3
- 1.3 Population 5
- 1.4 Model 10
- 1.5 Parameters (Summary Numbers) 14
- 1.6 Samples and Inferences 20
- 1.7 Functional Notation 47
- 1.8 Matrices and Vectors 50
- 1.9 Multivariate Gaussian Populations 62
- 1.10 Exercises 70

CHAPTER 2 Regression and Prediction 73

- 2.1 Overview 73
- 2.2 Prediction 73
- 2.3 Regression Analysis 82
- 2.4 Exercises 97

C H A P T E R	3	Straight Line Regression	99
	3.1	Overview	99
	3.2	An Example of Straight Line Regression	100
	3.3	Straight Line Regression Model—Assumptions (A) and (B)	109
	3.4	Point Estimation	112
	3.5	Checking Assumptions	132
	3.6	Confidence Intervals	161
	3.7	Tests	171
	3.8	Analysis of Variance	178
	3.9	Coefficient of Determination and Coefficient of Correlation	181
	3.10	Regression Analysis When There Are Measurement Errors	194
	3.11	Regression Through the Origin	210
	3.12	Exercises	214
C H A P T E R	4	Multiple Linear Regression	219
	4.1	Overview	219
	4.2	Notation and Definitions	220
	4.3	Assumptions for Multiple Linear Regression	232
	4.4	Point Estimation	235
	4.5	Residual Analysis	251
	4.6	Confidence Intervals	262
	4.7	Tests	278
	4.8	Analysis of Variance	283
	4.9	Comparison of Two Regression Functions (Nested Case) and Coefficients of Determination	291
	4.10	Comparing Two Multiple Regressions Models (Nonnested Case)	309
	4.11	Lack-of-Fit Analysis	318
	4.12	Exercises	335
C H A P T E R	5	Diagnostic Procedures	351
	5.1	Overview	351
	5.2	Outliers	352

- 5.3 Leverages or Hat Values 365
- 5.4 Influential Observations—Cook's Distance and DFFITS 371
- 5.5 Ill-Conditioning and Multicollinearity 392
- 5.6 Exercises 399

CHAPTER 6 Applications of Regression I 403

- 6.1 Overview 403
- 6.2 Prediction Intervals 403
- 6.3 Tolerance Intervals 416
- 6.4 Calibration and Regulation for Straight Line Regression 425
- 6.5 Comparison of Several Straight Line Regressions—Identical, Parallel, and Intersecting Lines 436
- 6.6 Intersection of Two Straight Line Regression Functions 450
- 6.7 Maximum or Minimum of a Quadratic Regression Model 456
- 6.8 Linear Splines 465
- 6.9 Exercises 476

CHAPTER 7 Applications of Regression II 501

- 7.1 Overview 501
- 7.2 Subset Analysis and Variable Selection 501
- 7.3 All-Subsets Regression 504
- 7.4 Alternative Methods for Subset Selection 520
- 7.5 Growth Curves 551
- 7.6 Exercises 567

CHAPTER 8 Alternate Assumptions for Regression 571

- 8.1 Overview 571
- 8.2 Straight Line Regression with Unequal Subpopulation Standard Deviations 571
- 8.3 Straight Line Regression—Theil's Method 584
- 8.4 Exercises 592

C H A P T E R 9	Nonlinear Regression	599
	9.1	Overview 599
	9.2	Some Commonly Used Families of Nonlinear Regression Functions 599
	9.3	Statistical Assumptions and Inferences for Nonlinear Regression 605
	9.4	Linearizable Models 615
	9.5	Exercises 622
	Appendix A:	Answers to Selected Problems and Exercises 627
	Appendix B:	Bibliography 645
	Appendix D:	Data Sets 647
		Table D-1: Car Data 649
		Table D-2: Car2 Data 657
		Table D-3: Grades Data 659
		Table D-4: Plastic Data 669
	Appendix T:	Tables 679
		Table T-1: Percentiles of a Standard Gaussian Population 681
		Table T-2: Percentiles of a Student's t Population 682
		Table T-3: Percentiles of a Chi-Square Population 683
		Table T-4: Student's t for m Simultaneous Confidence Intervals for $m = 2, 3, 4, 5, 6$ 684
		Table T-5: Percentiles of Snedecor's F Population 689
		Table T-6: Table for Obtaining Confidence Bounds for $a_0\beta_0 + a_1\beta_1$ Using Theil's Method 692
		Table T-7: Charts for Confidence Bounds for the Simple Correlation Coefficient 693
		Table T-8: Selected Percentiles of the Noncentral t 695
Index		697