

Contents

Preface

1. What is Linear Regression?	1
1.1. Introduction	1
1.2. The Equation of a Line	1
1.3. The Best Fitting Line	5
1.4. Regression and Causation	7
1.5. Regression: A Summary	8
2. Finding the Best Fitting Line	9
2.1. Introduction	9
2.2. Exhaustive Search	9
2.3. Onwards and Downwards	10
2.4. The Normal Equations	11
2.5. Numerical Example	15
2.6. Matlab Code	16
3. How Good is the Best Fitting Line?	19
3.1. Introduction	19
3.2. Variance and Standard Deviation	19
3.3. Covariance and Correlation	20
3.4. Partitioning the Variance	23
3.5. The Coefficient of Determination	27
3.6. Numerical Example	28
3.7. Matlab Code	29
4. Statistical Significance: Means	31
4.1. Introduction	31
4.2. The Distribution of Means	31
4.3. Degrees of Freedom	36
4.4. Estimating Variance	38
4.5. The p -Value	39
4.6. The Null Hypothesis	41
4.7. The z -Test	43
4.8. The t -Test	44
4.9. Numerical Example	47
4.10. Matlab Code	49
5. Statistical Significance: Regression	51
5.1. Introduction	51
5.2. Statistical Significance	51
5.3. Statistical Significance: Slope	52
5.4. Statistical Significance: Intercept	57
5.5. Significance Versus Importance	57
5.6. Assessing the Overall Fit	58
5.7. Numerical Example	60
5.8. Matlab Code	64

6. Maximum Likelihood Estimation	65
6.1. Introduction	65
6.2. The Likelihood Function	67
6.3. Likelihood and Least Squares Estimation	69
7. Multivariate Regression	71
7.1. Introduction	71
7.2. The Best Fitting Plane	71
7.3. Vector–Matrix Formulation	73
7.4. Finding the Best Fitting Plane	76
7.5. Statistical Significance	78
7.6. How Many Regressors?	80
7.7. Numerical Example	82
7.8. Matlab Code	85
8. Weighted Linear Regression	89
8.1. Introduction	89
8.2. Weighted Sum of Squared Errors	89
8.3. Vector–Matrix Formulation	91
8.4. Statistical Significance	92
8.5. Numerical Example	96
8.6. Matlab Code	98
9. Nonlinear Regression	101
9.1. Introduction	101
9.2. Polynomial Regression	102
9.3. Nonlinear Regression	104
9.4. Numerical Example	106
9.5. Matlab Code	108
10. Bayesian Regression: A Summary	111
10.1. Introduction	111
10.2. Bayes’ Theorem	112
Appendices	
A. Glossary	115
B. Mathematical Symbols	117
C. A Vector and Matrix Tutorial	119
D. Setting Means to Zero	121
E. Key Equations	125
F. Matlab Utilities	127
Index	129